

Life of Locust

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Introduction

Locusts have been one of the most dreadful pests causing serious economic damage to humans. They are referred in many ancient books such as in our epic poem Mahabharata, the Koran, and the Bible. Their magnitude of damage is beyond imagination as they have posed threat to food security (Latchininsky, 2019).

Locusts are short-horned grasshoppers belong to suborder Caelifera under family Acrididae of the insect order Orthoptera (Symmons and Cressman, 2001). They exhibit density dependent phenotypic polymorphism. Locusts under low population densities they prefer to live in the solitarious phase which they never form swarm and prefer to lead a sedentary life. They have camouflage coloration to escape from predators. At high population densities, triggered by suitable environmental conditions locusts develop into the gregarious phase. Gregarious adults' forms swarms and migrate in the direction of wind. They can cover up to 150 km/day. The direction and velocity of the wind determines the displacement of the insect (Simpson and Sword, 2008).

Major Species of Locusts

About 9 species of locusts are prevalent in the entire world. They can form swarms and can migrate to several countries. Those are Desert Locust, *Schistocerca gregaria*; Bombay Locust, *Nomadacris succincta*; Migratory Locust, *Locusta migratoria*; Italian Locust, *Calliptamus italicus*; Moroccan Locust, *Dociostaurus morocannus*; Red Locust, *Nomadacris septemfasciata*; Brown Locust, *Locustana pardalina*; South American Locust, *Schistocerca paranensis*; Australian Locust, *Chortoicetes terminifera*.

Among, nine species only four species of locusts are reported in India namely, desert locust, bombay locust, migratory locust and the tree locust are not considered as true locusts because they neither form swarms nor exhibit density dependent phase polyphenism.

Life Cycle

The life cycle of any locust species includes a sequence of embryonic (egg), nymphal, and adult stages.

Egg

Females lay eggs, using short hook-like valves of the ovipositor at the tip of their abdomen to bore into the top layer of the soil. During oviposition, a female extends her abdomen three to four times its normal length by means of elastic intersegmentary membranes. The duration of oviposition depends on soil properties, particularly compactness, and lasts from 30 min to 2 h. Eggs are laid in packets called egg-pods. The number of eggs in an egg-pod depends on the species and is often correlated with the body size of the females.

The smaller, Moroccan and Italian locusts have respectively, 18–42 and 20–60 eggs in their egg-pods, while the larger Migratory and Desert locusts have 40–120 and 30–146 eggs in their egg-pods, respectively. Egg-pods of the big red locusts may contain up to 190 eggs. Each female lays one to four egg-pods with about a 10-day interval between successive oviposition. The initial egg-pod contains more eggs than the subsequent ones of the same female. In the temperate zones, locust embryos develop with obligatory diapause, meaning that eggs laid in the summer delay hatch the next spring. To enhance survival through long periods of freezing temperatures and to protect from predator attacks. Whereas, Eggs of tropical and subtropical locust species incubate without diapause and hatch 2–3 weeks after ovipositor.

Hopper

During hatching, the newly born nymphs tunnel through the softened foam plug to reach the surface of the soil. Once out of the egg-pod, they immediately undergo an intermediate moult, shedding their embryonic cuticle and becoming first-instar nymphs. With a mortality rate of up to 90%, the first instar constitutes the critical developmental stage for the survival of the locust population. Nymphal development includes 5 (rarely 4, 6, 7, or even up to 9) successive instars each instar lasts 5–7 days with a total of 25–35 days to reach adulthood.

Adult

Adult locusts are characterized by two pairs of fully grown wings. The front pair, or tegmina are narrow and leathery, concealing the broad membranous hind wings, which are



folded along the main veins fanwise while at rest. Newly fledged locusts have a soft cuticle that hardens in several days. Adult locusts make short wandering flights in the first days after fledging but only after their cuticle hardens can they accomplish long-distance migratory flights. Sexual maturation takes from just a few days to several weeks, after which the locusts start mating. In some cases, such as Desert and Red locusts and tropical tree locusts of the genus *Anacridium*, mating can be delayed by unfavourable weather conditions, they remain sexually immature for up to 9 months and eventually die without producing offspring.

Maturation and Reproduction

Maturation is manifest by noticeable changes in pigmentation. Immature Desert locusts are pink and turn bright yellow when sexually mature. Immature Migratory locusts gradually change their coloration from green or brownish to mostly yellowish as they mature. Some other species as the Italian or Australian Plague locust do not exhibit noticeable pigmentation changes associated with sexual maturation. Physiological changes during maturation include the growth of testes and accessory glands in males and ovarian development and egg growth in female locust and males mature from one to several days earlier than females. The presence of the mature males accelerates the maturation of females.

Locusts reproduce sexually; cases of parthenogenetic reproduction are rare. Olfactory and acoustic signals are used to ensure the meeting of prospective mates. Locusts (often both sexes) produce stridulating call signals by rubbing the inner surface of the hind femora over the thickened veins on the tegmina. Copulation lasts from 1 to 20 h. During copulation, the male mounts the female, grasps the tip of her abdomen with his and transfers the sperm packet, called spermatophore, into the female's genital opening. The female stores the sperm in a special organ called the spermatheca. Locusts can mate multiple times during their adult lives. However, a single copulation is usually sufficient to fertilize all the eggs produced by the female.

Phase Transformation

The key event in the biology of locusts is the change from a single-living and mostly sedentary solitary phase to a gregarious phase in which they live in dense bands or swarms, actively migrate and may devastate crops and rangeland. This phenomenon, which is non-existent among non-swarmling grasshoppers, is called locust phase transformation. Besides the conspicuous behavioural, morphological and colour changes, the extreme

solitarious and gregarious locust phases differ in food selection, nutritional physiology, metabolism, reproductive physiology, neurophysiology, endocrinology, pheromone production, longevity and molecular biology.

Phase change is a reversible transition process between solitarious and gregarious phases in locusts in response to changes in population density. Polyphenism is density-dependent phenomenon in which two or more distinct phenotypes are produced by the same genotype. Locusts are polymorphic, and the extreme phases are connected by a continuum of intermediate, transitional forms (phase transiens). It takes at least four consecutive generations to complete the phase transformation from a typical solitarious phase to a fully gregarious phase. Phase transformation is a cumulative, but also a reversible, process that requires suitable environmental conditions. The process is density dependent and starts when locust density exceeds a certain threshold.

In the Desert locust, behavioural changes first become manifest when the density of the young nymphs exceeds approximately 50,000 individuals per hectare or 5 per square meter. For older nymphal instars, the threshold is 5000 per hectare, and for adults it is 250–500 per hectare. Most other locust species have higher phase transformation thresholds than the Desert locust.

Locusts have two different states called phases: solitarious and gregarious. When locusts are present at low densities, the individuals are solitarious. As locust numbers increase, they cluster into dense groups and they become gregarious. The transition from the solitarious phase to the gregarious and vice versa is called the transient phase, and the locusts are referred to as transiens. If locusts are on the increase they are referred to as congregans and if they are on the decrease, they are called dissocians.

Conclusion

Crop loss by insect pest is major limitation in production of food and its produce where, crop yield loss by all pests in every year ranges between 30 and 40% out of which 0.2% by locusts. Hence, the research has to be done in depth to under its life cycle, behavior, morphology and management in order to reduce the large quantum of loss caused by the locust across the world.

References

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