Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 04, Issue: 04 (JULY-AUG, 2024)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

Locust: An International Threat to Agriculture

(*M. Anil Kumar[1], Saleemali Kannihalli[2] and K. Sahithi[3])
[1]Plant Biosecurity Division, National Institute of Plant Health Management, Rajendranagar, Hyderabad - 500 030, India
[2]Department of Entomology, College of Agriculture, University of Agricultural Sciences, Dharwad-580 005, Karnataka, India
[3]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, 492006, India
*Corresponding Author's email: anilmethuku70320@gmail.com

Abstract
Locust, a group of short-horned grasshoppers belongs to family Acrididae, pose significant threats to agriculture worldwide due to their ability to aggregate in swarms and devastate crops. This behavior, characterized by a shift from solitary to gregarious habits, is influenced by various environmental and other factors. Guaiacol, a primary component of locust pheromones, plays a crucial role in facilitating swarm formation. Additionally, serotonin is implicated in the transition from gregarious to solitary phases in locusts. Desert locust swarms exhibit remarkable flying capabilities, often traveling long distances downwind at speeds matching those of the wind, covering distances of 100-200 kilometers in a single day. Historical data reveals that the most significant locust upsurges occurred in 1993, followed by 1968.

Keywords: Gregarious, locust, phase theory, swarm, solitary, upsurge etc.

Introduction
Locusts are the short-horned grasshoppers, belong to class Insecta, order Orthoptera, family Acrididae. They are voracious feeders with highly migratory habit and marked polymorphism. They are capable of forming swarms (adult's congregation) and hopper bands (nymphal congregation). They cause great devastation to natural and cultivated vegetation. They are indeed the sleeping giants that can flare up any time to inflict heavy damage to the crops leading international emergency of food and fodder. Exhibit a notable and potentially devastating form of phenotypic plasticity known as density-dependent phase polyphenism. Under low population densities, they adopt the solitarious phase, while crowded conditions trigger the aggregating, migratory gregarious phase. The desert locust, *Schistocerca gregaria* (Forskal), has been described as a curse in ancient texts such as the Old Testament and the Holy Quran due to the immense damage and starvation it causes as a polyphagous feeder (Kamil Usmani and Usmani, 2018).

There are 10 important species of locusts in the world which includes Desert locust (*Schistocerca gregaria*), Bombay locust (*Nomadacris succincta*), Migratory locust (*Locusts migratoria manilensis*; *Locusta migratoria migratoria-oides*), Italian locust (*Calliptamus italicus*), Moroccan locust (*Dociostaurus morocannus*), Red locust (*Nomadacris septemfaciata*), Brown locust (*Locustana pardalina*), South American locust (*Schistocerca paranensis*), Australian locust (*Chortoicetes termenifera*) and Tree locust (*Anacridium* Spp.). Desert locust (*Schistocerca gregaria*), Migratory locust (*Locusta migratoria*), Bombay

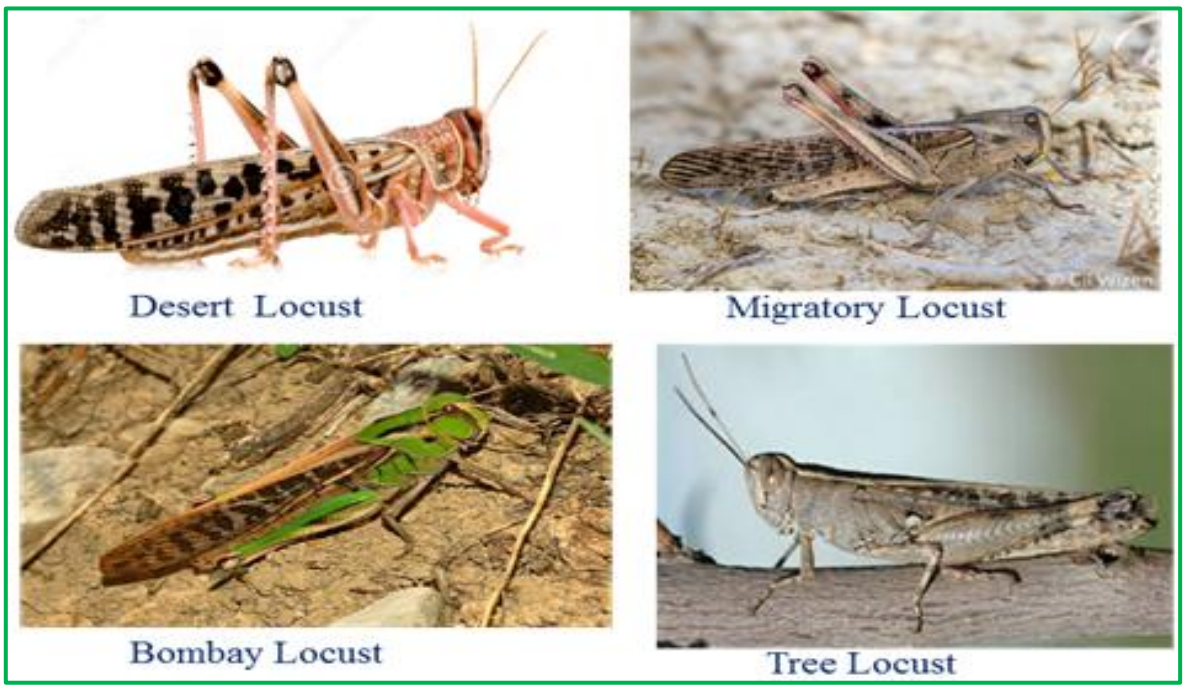
Locust (*Nomadacris succincta*) and Tree locust (*Anacridium* sp.) are found in India (Upadhyay, 2023). The desert locust is most important pest species in India as well as in intercontinental context. In India, the scheme Locust Control and Research (LC&R) is responsible for control of desert locust and is being implemented through organisation known as "Locust Warning Organisation (LWO)" established in 1939 and later amalgamated with the Directorate of Plant Protection Quarantine and Storage in 1946 at Faridabad. Locust Warning organization (LWO) is responsible to monitor and control the locust situation in Scheduled Desert Area (SDA) mainly in the States of Rajasthan and Gujarat while partly in the States of Punjab and Haryana (DPPQS, 2023).

Distribution

The invasion area of desert locust covers about 30 million sq km which includes whole or parts of nearly 64 countries. This includes countries like North West and East African countries, Arabian Peninsula, the Southern Republic of USSR, Iran, Afghanistan, the Indian sub-continent. During recession periods when locust occurs in low densities, it inhabits a broad belt of arid and semi-arid land which stretches from the Atlantic Ocean to North West India. Thus, it covers over 16 million sq kms in 30 countries (Pandey et al., 2021).

Locust biology

The life cycle consists of three stages: egg, nymph, and adult, spanning 2 to 6 months with 2 to 5 generations year^{-1}. Eggs are laid in pods in moist sandy soils at a depth of 10 cm, spaced 7 to 10 days apart, with an incubation period ranging from 10 to 65 days. There are 5 to 6 nymphal instars, also known as hoppers, with a nymphal period lasting 24 to 95 days depending on weather and food availability. When the last instar nymph moults, the adult emerges, initially soft and with underdeveloped wings, which is referred as fledging. After a few days, the wings harden, becoming well-developed after blood circulation through the wing veins. Adults reach sexual maturity 30 days after emerging as adults and live for 2.5 to 5 months (Zhang et al., 2019).



Different phases in desert locust

Uvarov proposed the Locust Phase Theory in 1921. There are three phases in desert locust, solitarious phase (individuals live separately from each other), gregarious phase (large

numbers of individuals gather together) and transiens phase (intermediate phase between soltarious and gregarious phases) which is further classified into congregans (locust are congregating and are in the transition from solitarious to gregarious phase) and dissocians phase (locust are dissociating and are in the transition from gregarious to solitarious phase) (Ayali, 2019).

Difference between solitarious and gregarious phases

Table 1. Difference between solitary phase and gregarious phase

Characteristics	Solitary phase	Gregarious phase
Behaviour	Do not form groups or swarms	Form persistent and cohesive groups, bands and swarm
	Roost, bask, feed and move as individuals	Roost, bask, feed and move together
	Hoppers move short distance; adults fly individuals at night	Very mobile, fly as swarms by day. Hoppers move in band.
Colour	Hoppers uniformly green in early instars but may be brown in last two instars. Adult pale greyish brown, buffer peach coloured. Males change to pale yellow on sexual maturation. Female show no colour change on maturation at low density.	Hoppers have black pattern on yellow or orange background. Adults rosy pink on fledging, darkens with age to greyish or brownish red then to yellow on sexual maturation. Males are brighter.
Morphometrics	Large hind femur	Relatively smaller hind femur
	Pronotum bears convex crests	Pronotum is concave or straight
	Have relatively smaller brains	Brain 30 % larger overall

What triggers them to swarm?

Guaiacol is a primary element of the pheromone responsible for locust swarming. It is generated in the gut of desert locusts through the breakdown of plant material by the gut bacterium, *Pantoea agglomerans*. Serotonin facilitates the transition to the solitary phase in migratory locusts (Simpson et al., 1999).

Facts about desert locust swarms

Desert locust swarms typically fly downwind, moving at nearly the same speed as the wind, enabling them to travel distances of 100-200 kms in a day. A single swarm can contain up to 50-100 billion locusts in it and can consume about 100-200 tonnes of vegetation day^{-1} and each swarm can cover up to 1200 sq. kms of area. The period of one or more years of widespread and cause heavy infestation *i.e.*, in the form of bands or swarms is referred as plague (Joshi et al., 2020).

Table 2. Locust plagues observed in India

Locust plagues observed during following years	
1812-1821	1900-1907
1843-1844	1912-1920
1863-1867	1926-1930
1869-1873	1940-1946
1876-1881	1949-1955
1889-1891	1959-1962

Locust upsurges in India

The highest number of upsurges occurred in 1993 followed by 1968. Upsurge is a period following recessions marked initially increase in locust numbers and outbreak of gregarious

population. In contrast, recessions are characterized by a lack of widespread and severe infestations by swarms (Van Huis et al., 2007).

Table 3. Locust upsurges observed in India

Year	No. of swarm's incursion
1964	004
1968	167
1970	002
1973	006
1974	006
1975	019
1976	002
1978	020
1983	026
1986	003
1989	015
1993	172
1997	004

Economic Importance

Locust swarms from Iran to Pakistan and aided by dusty summer winds (Arabian flow) facilitate to enter Rajasthan. The north westerly winds and the scarcity of vegetation in Pakistan likely propelled them towards Rajasthan, with subsequent winds carrying them eastward into Madhya Pradesh and Uttar Pradesh. During the 2019-20 cropping season, locust attacks ravaged about 3.75 lakh ha of crops in India, resulting in losses exceeding Rs 100 crore. Since the start of May, locusts have destroyed over 2 lakh ha of crops in India and pose a threat to an additional 6 lakh ha. In May-June 2020, the Government of Rajasthan reported crop damage of over 33 % in various areas, including 2235 ha in Bikaner, 140 ha in Hanumangarh and 1027 ha in Sri Ganganagar. Other state governments, including Haryana (6520 ha), Madhya Pradesh (4400 ha), Maharashtra (806 ha), Uttar Pradesh (488 ha) and Uttarakhand (267 ha), have reported crop damage of less than 33 % due to locust attacks this year. In western Rajasthan alone, crops spanning at least 3,50,000 ha of land have been annihilated.

In 1998, 2002, 2005, 2007 and 2010, there were localized small-scale reproductive events, totalling 12 locust plagues until 1962 (Shrestha et al., 2020). However, no plagues have occurred from 2010 to early 2019, with no reports of large-scale breeding or swarms. Multiple desert locust attacks were reported on 09/07/2019, 22/07/2019 and 14/12/2019 in Gujarat and Rajasthan during 2019. An advisory issued by the UN's Food and Agriculture Organization (FAO) on 10th May 2023 warned of a major outbreak following the sighting of Moroccan locusts, a species found from North Africa to Western Asia, in 10 provinces of Afghanistan. The last two significant outbreaks, 20 and 40 years ago, resulted in estimated losses of 8-25 % of Afghanistan's total annual wheat production. A full-scale outbreak this year could lead to crop losses ranging from 700,000 to 1.2 million metric tonnes of wheat, up to a quarter of the total annual harvest. During August 2023, increased moisture due to the monsoon following heavy rains from Cyclone Biparjoy has heightened the threat of locusts in the desert areas of western Rajasthan (DPPQS, 2023).

Conclusion

Desert locusts pose a significant threat to agriculture in numerous countries worldwide. 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. Despite experiencing numerous plagues in the past, scientists have extensively researched them to comprehend their phase transitions and underlying causes, and have proposed potential solutions to manage their populations. However, this is not the end, in order to keep the locusts silent, there is need for constant and honest monitoring and forewarning throughout the world.

References

1. Ayali, A. (2019). The puzzle of locust density-dependent phase polyphenism. *Current opinion in insect science*, **35**: 41-47.
2. DPPQS. (2023). http://www.ppqs.gov.in/divisions/locust-control-research/important information.
3. Joshi, M.J., Raj, V.P., Solanki, C.B. and Vaishali, V.B. (2020). Desert locust (*Schistocera gregaria* F.) outbreak in Gujarat (India). *Agriculture and Food: E-Newsletter*, **2**(6): 691-693.
4. Kamil Usmani, M. and Usmani, S. (2018). Locusts. *Pests and Their Management*, **5**: 825-869.
5. Pandey, B.W., Ganesh, P., Maurya, R., Pathak, U.K., Kumar, R., Ghosh, M. and Singh, Y. (2021). Spatial distribution of outbreak of locust swarms: a geographical analysis of vulnerability and preventions in India. *Sustainability, Agri, Food and Environmental Research*, **9**(1): 91-106.
6. Shrestha, S., Thakur, G., Jayanti, G., Acharya, N., Pandey, M. and Jiban, S. (2020). Desert locust and its management in Nepal: A review. *Journal of Agriculture and Natural Resources*, **4**(1): 1-28.
7. Simpson, S.J., Mccafferey, A.R. and Hagele, B. F. (1999). A behavioural analysis of phase change in the desert locust. *Biological Reviews*, **74** (4): 461-480.
8. Upadhyay, A., Rai, A.K., Verma, S.K., Upadhyay, L., Khan, A., Singh, O. and Rout, S. (2023). Integrated Management Practices against Desert Locust, *Schistocerca gregaria* (Forskal) in India: A review. *International Journal of Environment and Climate*, **13**(7): 617-629.
9. Van Huis, A., Cressman, K. and Magor, J.I. (2007). Preventing desert locust plagues: Optimizing management interventions. *Entomologia Experimentalis et Applicata*, **122**(3): 191-214.
10. Zhang, L., Lecoq, M., Latchininsky, A. and Hunter, D. (2019). Locust and grasshopper management. *Annual review of entomology*, **64**, 15-34.