

# Traditional Management of the Desert Locust, *Schistocerca gregaria* (Forsk.) by farmers in Barmer, Rajasthan

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**Abstract:** The invasion of Desert Locust, *Schistocerca gregaria* (Forsk.) was occurred in India during second fortnight of March, 2019 to August 2020 and subsequently adequate pesticidal locust-control measures were taken by the Central and State Governments in the scheduled desert areas of India. The real time information on swarm's roosting on trees and bushes were provided by Farmers/ Grazers/ Gram Pradhan/ Patwari through Mobile / Whatsapp calls at the Locust Circle Office (LCO) Barmer to under taken locust control operations. Reporting on the emergence of hoppers and bands formations were observed from June to August of the year 2019 and 2020. Locust Control Operation teams were reached at the reported place early morning to control hoppers. However, farmers were also observed to manage hoppers with available popular-traditional cultural and mechanical methods nearby cropped land. The ground report was made on the bases of observations along with interviews of farmers. The traditional cultural techniques were used by farmers to manage desert locust at egg-pods stage by ploughing identified eggs laid spotted fellow land prior to hatch eggs into hoppers, emerged hoppers (I to II instars) were circled with tractor drawn single furrow ridge maker (20.0 centimetre deep) and trenched (50.0 centimetres deep) with tractor to fall hoppers (III to IV instars) in it. The fallen hoppers were killed by spraying of Chlorpyrifos 20% EC with Knapsack Sprayer. The mechanical traditional technique; scattered a mixture of dry hay and green fodder in the hoppers-prone area nearby crop-lands during dusk to hopper's roost in/on it and finally flamed aggregated hoppers with the scattered mixture. Farmers were commonly seen to run over their Tractors, Camper-jeep cars and Bikes on basking swarms nearby crop-land to make locust's swarm fly and simultaneously other members of family were also observed to scarify locusts either basking or feeding on the crops by making loud sound such as "TidHudda....Hudda...Heeeee" repeatedly, made sound with beating plastic/ tin containers and directly beaten locusts with local made broom to make them fly during morning hours of the Rabi and Kharif seasons. Collected adult desert locusts were also usage by farmers as food and cattle feed.

**Keywords:** Desert locust (*Schistocerca gregaria*), food and cattle feed, Traditional management, Cultural management, Mechanical or physical management.

## INTRODUCTION

The desert locust: *Schistocerca gregaria* (Forsk.) (Orthoptera: Acrididae) is the world's oldest primitive devastating and most destructive or dangerous gregarious migratory insect-pest (Cressman, *et al.*, 2016; Lazar *et al.*, 2016) and the *S. gregaria* has two separate habit appearance phases namely; solitary and gregarious. In the

solitary phase, locust's hoppers and adults are prefer to live an individual and avoid each other is called "asocial-locust-insect". However, in the gregarious phase of locust's hoppers and adults; like to live in together/ gregarious/ group is triggered, individuals become strongly "social-locust-insect". Hoppers and

adults form dense, long-lived migratory aggregations are called “hopper bands” in non-flying nymphs and “swarms” in flying adults (Kennedy, 1951; Uvarov, 1928). Flying swarms of locusts may travel long distances (hundreds or thousands of kilometres) over a period of many days fly towards the downwind direction. Swarms are distinct and recognizable, maintaining integrity for many days and cover long distances (Ellis, 1953 and Edelstein *et al.*, 1998) whereas, hopper bands are moving/marching and covers less distances.

There are three main breeding seasons found in the Desert locust *i.e.*, winter breeding season (November to December the area near Red Sea in Sudan), spring breeding season (January to June in North West Africa, Iran, Pakistan) and summer breeding season (July to October in Sahel, West Africa, Sudan, Eritrea, Ethiopia, and the India-Pakistan border desert). A new spring breeding has started in March 2020 and went until May. During March, breeding took place mainly in Balochistan and in the Indus valley, as well as in the plains of Punjab in Pakistan. Breeding continued into April and May, and a second generation of laying eggs began in mid-April in the north near Dalbandin in Balochistan. As a result of this breeding, an increasing number of adult groups and immature swarms formed and began to mature during May. During June, as conditions dried out, these swarms moved from the spring breeding areas eastward to the summer breeding areas. Summer breeding started in late June and continued into July and August. Numerous first-generation hopper groups and hopper bands formed, especially in the Thar Desert up to the Indian border in the extreme southeast of Sindh (Dowlatchahi *et al.*, 2020b, FAO 2020a and 2020d).

The hopper band is a unified aggregation of hoppers that persists and moves as a unit. As in bands formed, hoppers are cover short distances and reported to crossing over of the

Indo-Pak border of country. The observations on phenomenon of gregarization of hoppers occurs rapidly due to the aggregation just after a few hours of hatched from eggs forced and crowding due to non-availability or less-availability of vegetation to feed at breeding place of the Indian Thar-Desert during June to August, 2019 and July to August, 2020. During this crowding, there is increased attraction between the hoppers because of “serotonin” release at the thoracic ganglia, a part of the central nervous-system that gets triggered while ‘mechano-sensory stimulation’ of a hind femur of legs and forms hoppers band (Anstey *et al.*, 2009). Behavioural transformation of gregarization from solitary phase occurs due to a series of chemical change that occur in the brain of desert locust which results in synthesis of serotonin when they come in physical contact with each other (Simpson *et al.*, 2001 and Anstey *et al.*, 2009).

The *S. gregaria* is reported to defoliate and caused significant damage to crop plants, Horticulture orchard plants and forest trees. Farmers are using their available traditional knowledge or techniques to manage the locust and have developed a variety of cultural, mechanical and physical methods to protect their crops from the locusts. These methods are practiced by farmers especially when the hoppers and locusts infesting crops. Some of them are killing or trampling the hopper bands, ploughing or burning the egg infested field & trapping the hoppers in pits or trenches and killing them (Sharma, 2014). When a huge swarm of locusts are about to land in cultivated areas, the best way is to chase them away. Local people use fire, clouds of smoke and loud sounds to repel them from descending in the field. Gordon *et al.*, (2014) reported that tympanal movement and electrophysiological response of locust is between 4 and 8 kHz. They have the ability to distinguish between low frequencies (conspecific) and high frequencies (like predatory echo locating bats)

(Robert, 1989). Acoustic and electronic devices that pulses ultrasounds can be used to deter large swarms of desert locusts (Ibrahim *et al.*, 2013). Also, people use nets to protect small nurseries and kitchen gardens. Medicated nets, which are sprayed with garlic or neem oil are also effective to repel different insects including locusts and grasshoppers (Kaur, 2017). However, these traditional methods work well when the swarms and crop areas are small.

The present investigation based on the observation as well as interviews of farmers during ground surveys carried out on the traditional management measures are usually practicing in the Barmer, Rajasthan's farmers to protect their crops from desert locust hoppers and swarms during locust invasion 2019 to 2020.

## MATERIALS AND METHODS

On site observations on the popular/traditional/ localised techniques were practiced by farmers to manage locusts at various stages with cultural techniques, mechanical techniques and scare technique (Physical) in the Barmer District of Rajasthan since long back. A total of 200 numbers of elder farmers were selected from different villages of several Blocks of the District mostly aged between 45 to 70 years for personal interviews or focus group discussions for present study. The information received from the farmers has been categorized in different headings and sub-headings in the article.

## RESULTS AND DISCUSSION

The application of traditional techniques for the purposes of desert locust management at different stages of desert locust is well known to the villagers of desert regions of the Rajasthan. The traditional localised techniques such as cultural techniques, mechanical technique and scare technique are used by farmers to manage the desert locust at own

village level since long back. The interviews were mainly focused on the traditional knowledge of desert locust management so that researchers and administration can find the scientific exploration for further sustainable management measure's applications in the field of desert locust management strategies in scheduled desert areas in the India. The indigenous traditional technical knowledge for the management of desert locust in India is reported in following heading and sub-headings:

### **Role of Mobile/ Android-mobile in society communication to obtain real-time information on hoppers occurrence and swarms of desert locust**

In the Barmer, rural people are usually staying in Dhani in Jhaupa house at farms. The primary occupations of farmers are animal husbandry and cultivation of rainfed agriculture for their livelihood. For grazing their livestock (sheep/ goats/ indigenous (desi) cows and others), herdsman were observed to cover long distances to graze their cattle in the desert. Herdsman are the good monitor and communicator of locust activities. Present days, mobile (android/iOS) / mobile are very helpful in disseminating the activities of desert locusts, as any herdsman noticed the emergence of newly hatched hoppers as well as hopper bands formation and swarm settle, immediately grazer was observed to viral the message with the photographic evidence by WhatsApp or mobile calls amongst rural people. The mobile phones are able to reduce travel time needs and improving information accessibility and contacts with families and friends (Souter *et al.*, 2005).

The same reports/ information was verified by farmers and Gram Pradhan at said spots about the movement of hoppers mostly noticed near croplands. As information reported by villager / Gram Pradhan from different locations were also jointly re-

confirmed by the Patwari and Assistant Agriculture Officer prior to pass the message to the Locust Circle Office (LCO), Barmer for taken suitable control measures. However, farmers were also observed to carried out various traditional management measures at own level nearby crop-land areas. The mobile evolution made the revolution in human communication process and relationships. Along with mobile penetration, the social media has also had unprecedented growth in present times (Saravanan *et al.*, 2013)

### **Farmers apply localized Traditional cultural techniques to management the desert locust's at eggs and hoppers stages**

#### ***I. Cultural management at eggs stage:***

Farmers are well aware of how to manage the desert locust at the egg pods stage by using traditional cultural practices prior to eggs hatch into hoppers, when the eggs were already laid in or near crop able lands. Farmers were observed to practice to plough eggs infested barren land by tractor drawn cultivator for exposing and desiccating hidden egg pods of desert locusts. The exposed eggs pods were also feed by birds.

#### ***II. Cultural management at hoppers stage:***

Farmers were observed any hoppers movement or hoppers band formation (newly hatched to II instars) near the cropped area. Group of farmers immediately taken the decision to manage crop from hoppers attack by making deep furrow in a circle with the help of tractor drawn single furrow plough (about 20.00 centimetres) around the hoppers to prevent their entry into the crop-land. However, for the preventing the entry of III to V instars hoppers bands into cropland and residential housing area, farmers were also observed to use tractor mount trench machine to make a deep trench (about 50 centimetres) to stop hoppers entry into the

crop lands as well as residential housing area (figure 1 to 5) and finally spraying Chlorpyrifos 20% EC insecticides with the Knapsack prayers to kill the fallen hoppers. At the local level, farmers are dealt with issue like eggs laying infested land, emergence of hoppers and hoppers band formation of desert locus by traditional control methods such as ploughing and digging of fields are in practice for many years (Aryal, *et. al.*, 2020). Trampling hoppers, ploughing infested land with egg pods, driving them to trenches followed by burning or drowning and protection of crops and nursery seedling cover with the help of nets are some other traditional and cultural ways to keep the damage to minimum (Sah, *et al.*, 2020 and Sharma, 201).

### ***Mechanical or Physical traditional techniques for Desert Locust management nearby crop land***

***I. Management at hoppers stage:*** Farmers were observed to spread a mixture of dry hay and green fodder in scattered manner in hopper bands prone area nearby crop land to trap the gregarious marching hoppers during dusk. Hoppers usually rested in the night (hoppers roost). Starved hoppers near the crop able main lands were noticed to attract towards the spread mixtures to feed and night roost in/on it. The marching hoppers were reached and started feeding on the trap's mixture. On the meantime farmers intelligently flammable the trapped hoppers (figure 6 to 7). Desert locust control started in 1860, mainly by digging ditches, trapping, and burning to reduce the population (Van Huis 1995). In 1921, Uvarov (1921) put forward the "prevention and control" strategy for desert locusts to prevent pest population build up. Measures that serve to prevent desert locust populations from

reaching a damaging level are priorities in any IPM program, which are usually chemical control, ecological management, and biological control (Lomer et al. 2001; Magor et al. 2008).

II. **Traditional Management of locust at adult stage:** In the Barmer district crops were standing in fields during Rabi and Kharif seasons of years 2019 and 2020. Farmers were observed to scarifying locust swarm by running over their Tractors, Camper-jeep cars and Bikes on basking swarm during dawn hours to make locust fly from open field nearby cropland. Other members of farmers family were also observed to scarifying locust swarm either basking or feeding on the crops by making loud sound such as “TidHudda... Hudda...He” repeatedly and beating locusts with local made broom to make them fly from crop canopy to save the crop. Metallic wares, loud music and musical instruments can be used to produce high decibel sound and night firing can be done to produce smoke to keep locust away from the field (Sah, *et al.*, 2020). The swarm starts basking on the ground after sunrise while it rests after the sunset (Symmons, *et. al.*, 2001).

Before the use of pesticides locusts were controlled by mechanical and cultural control (trampling, beating, burning pastures, digging up egg beds) as mentioned for the brown locust by (Price and Brown 2000), and digging trenches, beating and burning for the desert locust (Dobson, 2001).

III. **Desert Locusts as Curry and cattle feeds:** The Tribals of Barmer, Rajasthan told a very popular slogan “CharTidpau Ghee” (consumption of Four Locust gives energy equal to 250 grams of Ghee). Swarm of *S. gregaria* was observed that night roosted swarm were not able to fly during morning due to wings get wet with dew moisture.

Group of 3 to 4 persons were spread sheets under the kair bushes; *Capparis decidua* (Forsk.) Edgew where desert locust swarm taken night roost and beaten aggressively, night roosted locust with sticks till drop on the spread sheets during early morning. The injured dropped locusts were collected in bags to carry them home (Dhani).

Collected locust bags opened and pour into the porringer water (Tasala). The wet locust was not able to fly or escape. Head, wings, legs and abdominal genital parts of locust body were taken aloof (detached) and clean with the water. Cleaned locusts were fried with cow ghee and used salt and spices according their taste. This locust traditional dish (Curry) was consumed with Bajra chapatti (Bajari Tikkad).

Worldwide, mature locusts have been collected during outbreaks and reported to consume in 65 countries especially in Africa and Asia for millennia (Mitsuhashi, 2016; Van Huis, 2020; Weingarten, 2005). The collected locusts are prepared for eating in diverse ways including boiling, toasting, roasting, frying, and sun-drying or even raw, usually with wings and legs plucked off in different countries/customs. People feel the taste of locusts relates to that of walnuts and almonds (Weingarten, 2005), with a neutral flavour (Paul *et al.*, 2016; Ramos-Elorduy, 1998). People consume and trade locusts in at least one of the five locusts, namely migratory, desert, red, brown and Sahelian locusts in 26 countries in Africa (Kelemu *et al.*, 2015; Mitsuhashi, 2016). The red locust is consumed in Mexico, Kuwait and Saudi Arabia (Mitsuhashi, 2016). The Migratory and the Bombay locusts are delicacies in many Asian countries (e.g., Thailand, China, Japan, Philippines, Vietnam, India, Laos, Malaysia and Myanmar); South America (Mexico); and Europe (Ukraine and Belgium) (Costa-Neto and Dunkel, 2016; Mitsuhashi, 2016; Poma *et al.*, 2017; Yhoun-Aree, 2010). Australian plague locust is consumed in Australia; Italian and Siberian



Description of figures: 1. Newly hatched hoppers and its bands formation, 2. Farmers making a circle around hoppers by Single furrow plough by tractor, 3. Hoppers fall in the furrow, 4. Tractor made trench, 5. Hoppers fall in the trench, 6. Hoppers band towards provided mixed of dry hay & green fodder and 7. Finally hoppers trapped and flamed.

locusts in China; and South American locust in Brazil and Colombia (Mitsuhashi, 2016).

In the Barmer; the tribal farmers collected locusts were sun dried on the floor during invasion. The dried locusts were used directly to feed as energy feed to their sheep while dried locusts powdered with domestic mortar and pestle (Okhali and Moosal/Kharna) were given to feed camels as energy feed. Globally the desert and migratory locusts can replace 25% of dietary protein in fish feed (Makkaret *et al.*, 2014). However, the substitution of the locust-meal beyond 25% reduces fish performance, probably due to high chitin levels, which interfere with protein solubility (Brogan, 2018). An unspecified amount of red locust has been added to pig diets with satisfactory growth (Makkar *et al.*, 2014). However, the bacon and pork produced from red locust-based diet had a fishy taste, which was avoidable by discontinuing the diet 3-weeks before slaughter. Locusts reportedly contain lower levels of arginine—an essential amino acid for laying chicken—than soybean (Makkar *et al.*, 2014). However, low-cost synthetic amino acids commonly used in animal feeds can be incorporate-rated into locust-based feeds (Makkar *et al.*, 2014).

## CONCLUSION

The Barmer, Rajasthan India is a rich source of traditional techniques/ knowledge in the management of desert locust and applies cultural techniques, mechanical techniques and scares technique are used in the management of desert locust at different stages such as eggs, hoppers and adults locally by farmers to save their crops. Some of tribal farmers collected adult locusts and taken as food as well as cattle feeds. Hence, there is the need to provide awareness to other State's farmers for the traditional management of desert locust through available various traditional management techniques of desert locust in the county for the sustainable crop protection.

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## CONFLICT OF INTEREST

The authors have no conflict of interest to disclose.

## AUTHORS' CONTRIBUTIONS

The authors have contributed equally in collecting information and preparing the manuscript.

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