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Article Information

Received: October 28, 2022

Accepted: December 15, 2022

Published: December 31, 2022

Keywords

Locust invasions,
Polymorphism,
Migratory behavior,
Desert.

Authors' Contribution

Imran Arshad conceived and designed the study; Muhammed Umer Rabbani analysed data; Zaheer Ahmed Khan wrote the manuscript; Wajiha Ali revised the paper.

How to cite

Arshad, I., Rabbani, M.U., Khan, Z.A., Ali, W., 2022. Desert Locust Invasions its Aftermath and Myth of its Existence: A Review. PSM Vet. Res., 7(2): 101-109.

*Correspondence

Imran Arshad

Email:

enqr_imran1985@yahoo.com

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Desert Locust Invasions its Aftermath and Myth of its Existence: A Review

Imran Arshad^{1*}, Muhammed Umer Rabbani², Zaheer Ahmed Khan³, Wajiha Ali⁴

¹Agriculture Engineer, SAA Technical & Specialized Services Establishment, Abu Dhabi, United Arab Emirates.

²Agriculture Engineer, Saif Al Ghurair Group, Dubai, United Arab Emirates.

³Lecturer, Faculty of Agricultural Engineering, Department of Farm Structures, Sindh Agriculture University, Tandojam, Sindh, Pakistan.

⁴Deputy Manager, Health and Nutrition Nutritional Resources, Agriculture Department, SGS Pakistan, Private Limited, Karachi, Sindh, Pakistan.

Abstract:

The insects are the primitive inhabitants of our universe earlier than the start of mankind they are very adaptable in nature due to which they can exist right from the low to the earth to hill tops desert and arid areas as well. Insects may be classified into many categories among them some are beneficial for mankind while other inflict heavy losses to nature and mankind due to their harmful nature. Desert locust is one which is very dangerous for mankind and natural environment. Desert locusts highly have migratory nature, polymorphism and its feeding protocol is very voracious. They form swarms (adults' congregations) very risky and hopper land (nymphal congregation) due to which when attack they erode natural and cultivated vegetation and play to havoc to nature and mankind which tantamount in food shortage, fodder facility for animals. They are the sleeping giant and can wake up and any time subject to favorable conditions. The invasion area of desert locust consists of 30 million square kilometers which includes Iran, Gulf Region, Afghanistan, Africa, Middle East, and Indian sub-continent. During recession period locust occurs in low densities and they live in a broad belt of arid and semi-arid land stretched from Atlantic to Gulf regions (United Arab Emirates, Oman, Yemen, Saudi Arabia), and northwest India covering over 16 million square kilometers covering around 30 countries. Desert locusts migrate to survive in arid environment it is neither due to hunger nor fleeing their cannibalistic peers force these insects to migrate. This migratory behavior of these insects is due to long evolution, which enables them to revive in desert environment, where food plant production occurs due to favorable rains which entail in excellent atmosphere for these locusts.

INTRODUCTION

The desert locust being polyphagous feeder makes massive damage to crops and natural vegetation. It inflicts havoc beyond imagination that is why it is adjusted as the curse to mankind; the same has been cited in the Holy Quran and Bible as well. On the average small locust eat as much as food in one day only as about 10 elephants over 25 or people eat (Akhtar *et al.*, 2009). They devour plants leaves, flowers, fruits, seed, and growing points respectively. Moreover, trees may breakdown due to their massive weight when they accumulate on that tree in a massive number. As the desert locust rapid growth makes it more hazardous pest and moreover it is capable to cover long distances in search of good food and suitable breeding place (Cheseto *et al.*, 2015). The desert locust can transform its behavior and physiology and can transmit itself from harmless solitary individual to be the collective mess of insects to form cohesive swarms, which can cross continents very briskly to do devour the natural vegetation, farmer field and anything (crops) which comes across their way (FAO, 2020). Thus, the desert locust is very terrible, harmful, migratory insect, which not only deprive farmers livelihood, but also disturbs and erode in natural vegetation as well as inflicting financial losses and environment havoc by transforming lush green fields in to and strip of land i.e., it can be highly said that among all the migratory pests of the world the desert locust is the unthinkable threat to mankind and environment (Hanboonson, 2010).

Since the beginning of August 2019, hopper bands and swarms of desert locust originating from Yemen have been infesting farmland and rangeland in the Horn of Africa region comprising mainly Somalia, Ethiopia, Kenya, Uganda, Djibouti, and United Arab Emirates. The infestation represents a substantial risk to food security and livelihoods of about 13 million people who are mainly smallholder farmers and pastoralists in the region of which 2.1m are in Kenya (Haskell, 2021). From January 2020, Kenya has been experiencing the heaviest Desert Locust crisis in over 70 years. Numerous immature and mature swarms continued to

move throughout northern and central counties. Aerial and ground control operations are continuing in the affected counties which as of September 2020 are confined to Samburu, Turkana, West Pokot, Laikipia and Baringo out of the initial 27 affected counties (Khan, 2021). The Food and Agriculture Organization (FAO) Locust Watch Group (FAO/DLIS) reports that there is still a threat of a bigger invasion and hence surveillance continues across the country and the region.

The prime adobe of solitarious locusts are the deserts of North Africa, Middle East and Southwest Asia living on separate annual vegetation in the wake of rain, laying eggs in the moist sandy soil after intermittent rains. This arid area is stretched over 16 million square kilometer in size, approximately twice the area of United States of America and encircles 30 countries (Kinyuru, 2020). This area is known as recession area and calm period without widespread and heavy infestation and this scenario is known as recession. When unexpected heavy rainfall in any of the recession area, locust avail the golden opportunity to increase their population rapidly. Under this ideal atmospheric boon, they multiply their numbers by 16-20 times, after the span of 3 months, new generation is introduced to add the miseries of mankind (Lanfranchi, 2015). The desert locust occurs naturally as isolated individuals (solitarious) in the desert areas (recession areas), however when rains fall causing the density of green vegetation to increase, they aggregate and feed more. As the locust population density increases, they deplete food resources in their immediate environment, this forces them to group into bands and swarms and move invading other regions normally not their natural habitats (invasion areas) in search of more food (Le-Gall *et al.*, 2019).

Desert Locust Life cycle

Desert locust undergoes three stages namely Egg, Hopper/Nymph and Adult (Figure 1). Weather conditions and availability of food influences the length of each developmental stage. Desert locust can transition between solitary and gregarious phases depending on

weather conditions and availability of food. Desert locust can complete 2-5 generations a year. Desert locust generally moves during the day at warm temperatures but can exceptionally move during the night during warm temperatures and at full moon (Lockwood, 2014). Desert locusts tend to have a shorter life cycle in warmer temperatures as opposed to cooler temperatures. In each of the stages of the life cycle, the hopper (3rd to 5th instars) and the immature adult are the most active stages in the life cycle. However, the immature stage is the most destructive since they are very mobile and heavy feeders.

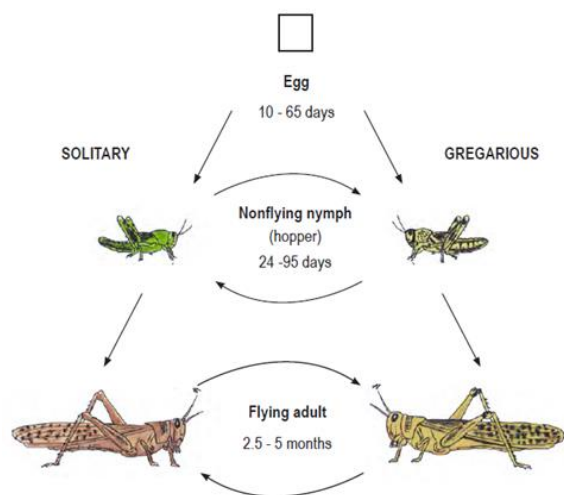


Fig. 1. Life cycle of a Desert Locust (Source: Cheseto, *et al.*, 2015).

Egg stage

Eggs are laid in moist coarse sand to silty clay soils 10-15 cm below the surface. Females deposit a batch of eggs, called egg pods, at intervals of 7-10 days (Figure 2). Solitary females lay 3-4 egg pods each containing 100-160 eggs (Figure 3). Gregarious females lay 2-3 egg pods each enclosing 60-80 eggs. Egg's incubation period can range between 10 and up to 70 days. The length of incubation period for the eggs depends on temperature and soil moisture (Figure 4). 10 - 14 days in the summer breeding regions, 25 - 30 days in the cooler regions and up to 70 days in the cooler regions of North Africa (Lysakov *et al.*, 2019).



Fig. 2. A female laying (Left), Eggs laid in the soil (Right) (Source: Lanfranchi., 2015).



Fig. 3. Adult female locust laying eggs in the sand (Source: Le Gall, *et al.*, 2019).



Fig. 4. Desert locusts mating (Source: Ratner., 2021).

Hopper Stage

The hopper stage gradually moults to increase in size across the instar stages. Solitary phase undergoes six instars in its life cycle, all with uniform green colour. The Gregarious phase undergoes five instars; the 1st instars are black, while the 2nd, 3rd, 4th, and 5th instars have distinct black and yellow patterns (Figure 5). Hopper development takes about 22 days under warm conditions (37°C) and up to 70 days under cool

conditions (22°C). To adjust their body temperatures, hoppers bask in the early morning and roost at mid-day. Green vegetation is important as a source of food and shelter (Price *et al.*, 2020). Large mortality (perinatal mortality) commonly occurs in the first instar stage aggravated by cannibalism and predation and not all emerged hoppers survive to fledge. At the final moult or the fledged young adult is known as a fledgling. The following key characteristics are useful in identifying hopper stages:

- Solitary phase undergoes 6 hopper stages while the gregarious undergoes 5 hopper stages.
- Solitary hoppers are all green all through the 6 hopper stages but sometimes the last two instars (5th and 6th) become brown while in gregarious phase, the first instar is black while the remaining instars maintain a black and yellow pattern.

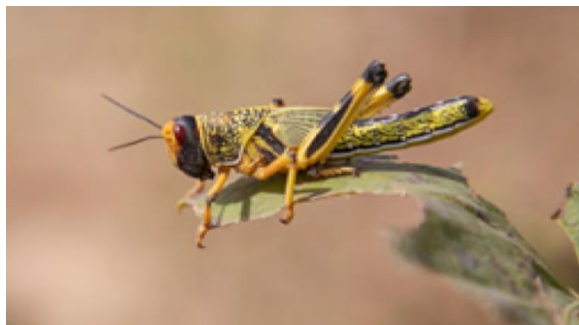


Fig. 5. Desert locust Nymph (Source: Hanboonsong, Y., 2010).

Adult stage

Adults do not grow (in size) but gradually increase in weight (an adult weighs 2g). Female adults are generally larger than males in size. Maturity is usually associated with the onset of the rainy season. Under dry condition locust can remain immature up to 6 months (Figure 6). Under favorable ecological conditions maturation takes place rapidly (2 to 4 weeks). Male adults mature earlier and release hormones that induce

female maturity. Mature adults do not feed or move much as they search for favorable breeding areas and settle to copulate and lay. Adult life span varies from 3-6 months depending on weather and ecological conditions (Ratner, 2021).

Solitarious Adult

Immature adults are usually pale grey to brownish in colour. Mature males change to pale yellow, while females show no change in colour (Figure 7). They are usually less mobile and migrate at night. 100% take off takes place at >27°C environmental temperature and can fly up to 10 hours (Samejo *et al.*, 2021).

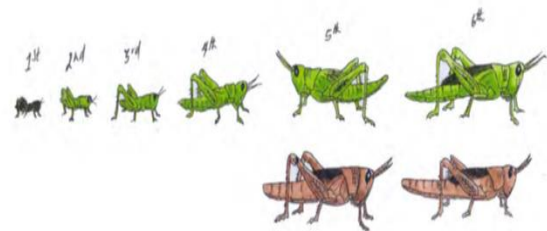


Fig. 6. Key features for identifying hopper stages Solitary (Source: Cheseto, X., *et al.*, 2015).

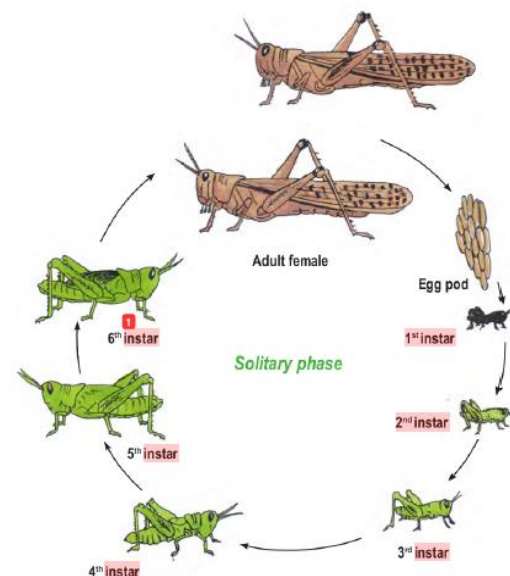


Fig. 7. Solitary phases of desert locust (Source: Haskell, P.T., 2021).

Gregarious Adult

Fledglings take about 10 days to harden the wings to be able to fly. After wing hardening, the locust is referred to as an immature adult, pink in color. Immature adults are very mobile and heavy feeders hence very destructive (Figure 8). Mature adults are bright yellow in colour which is prominent in the males (Figure 9). They usually migrate during the day (Van-Huis, 2020). Take off usually occurs 2-3 hours after sunrise in warm weather and 4-6 hours in cool weather. The adults can fly up to 150 to 200 km in a day. Swarms settle just before sunset and spend the night on vegetation (roosting). In the morning they descend to the ground and bask in the sun.

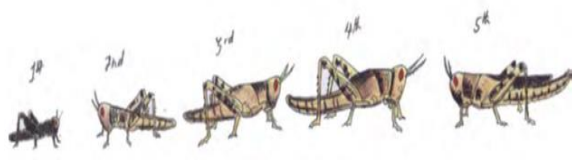


Fig. 8. Key features for identifying hopper stages Gregarious (Source: Cheseto, X., *et al.*, 2015).

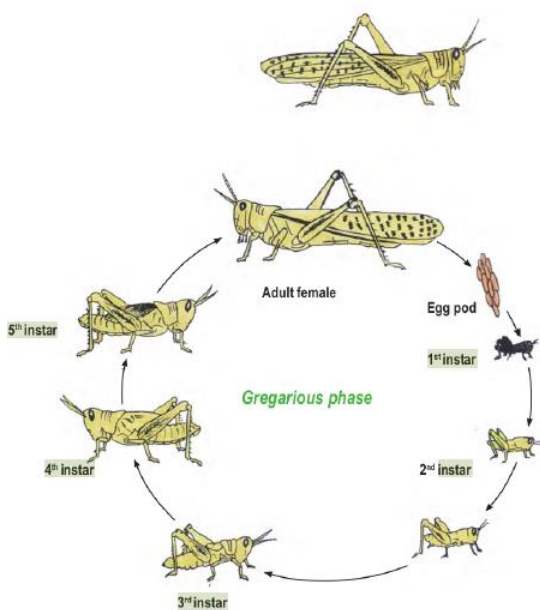


Fig. 9. Gregarious phases of desert locust (Source: Haskell, P.T., 2021).

How much havoc desert locust may inflict to nature and mankind?

Desert locust poses manifold threats to the survival of mankind and this beautiful whole universe. It inflicts serious challenges to the countries under its invasion. It is serious threat since time immemorable and will always be capable of inflicting horrible aftershocks of its invasion of evasive measure to its soil be devised. Being a polyphagous the desert locust can damage crops and vegetation to which it encounters i.e., barley, wheat, millet, maize, sorghum, and rice are its favorite diet (Van-Huis *et al.*, 2007). So much so, vines citrus fruits, palm trees, date palms or vegetable crops are also consumed. These insects also play havoc in pastoral area, which directly affect the grass production of biomass which makes the paucity of fodder for livestock in the aftermath of its invasion severe poverty is the ultimate outcome of its outbreak. Ensuingly people must sell their household, belonging, animals etc. for their survival. Due to paucity of funds, its impact on every effected person's life i.e., education specially, due to the desert locust devastation get halfhearted and at may a random to plaguy the fields and growing crops. It may also lead evolution further computing the diversely populate of cities spraying the chemical pesticides may be dangerous for the diverse and may be more to that to under insect like grasshoppers and may oral or arthropods (Van-Itterbeeck *et al.*, 2019).

What is their goal?

The desert locust has migratory behavior, they migrate from one place to another into subside their hunger in search of food to ensure their survival. They migrate in the form of hopper bands, swarms of adults flying during daytime. They can also solitarious fly during night as well. It has been established that their cannibalistic peers push them to migrate to various detestations (Xinhua, 2020). To ensure the positive check on these insects the local locust warning organizations established in each country ensures survey, surveillance and control

operations as where and when required bases. Due to migratory behaviors these species are very adaptable to its desert environment, especially weather favorable rainfalls occur, which acts as the catalyst for breeding and abundant food plant production grown after rains. Migration is very necessary for desert locust for their survival. These migrations are very systematic, winds are very helpful factor in the migration, and winds push the adults to the area of convergence where rains are expected to be generated.

There are two types of migrations, solitarious (night) and gregarious phase (by day). These insects' posses' high resistance and lays eggs only when conditions are conducive for breeding. Hopper consumes the local resources by enrolling vegetation regularly, migration mandatory for these insects even if local resources still exist (Yao *et al.*, 2009). They do not stay for a long time at the same place due to secure point of view to ensure their survival. Moreover, excessive rains are very helpful from breeding and constituting in upsurges of them. These insects lay their eggs in sandy or sandy

clay soils and suitable vegetation to develop its new generations. Two factors play vital role in the development of these insects, rains and availability of vegetation, locust concentrate on suitable area and get multiplied by leaps and bond. Ensuingly, phenomena of Gregarious start firstly are the form of hopper bands, followed by swarms which can entail firstly in outbreak and ultimately, upsurges an invasion provided no evasive measure are devised to encounter them at the early stage.

What Has the Government Created to Measure the Epidemic of Locust?

In the war-footing, first, a concerted assault on what farmer called "infiltrationists," was evaluated, investigated, prepared, and carried out by the government. But the locusts in United Arab Emirates, mostly of the Al Dhafra and Al Ain Region, affected more than 85,948 donums of land. In Al Dhafra and Al Ain regions of Abu Dhabi, government officials observed grasshopper groups on 11-12 Feb 2019 (Figure 10a).

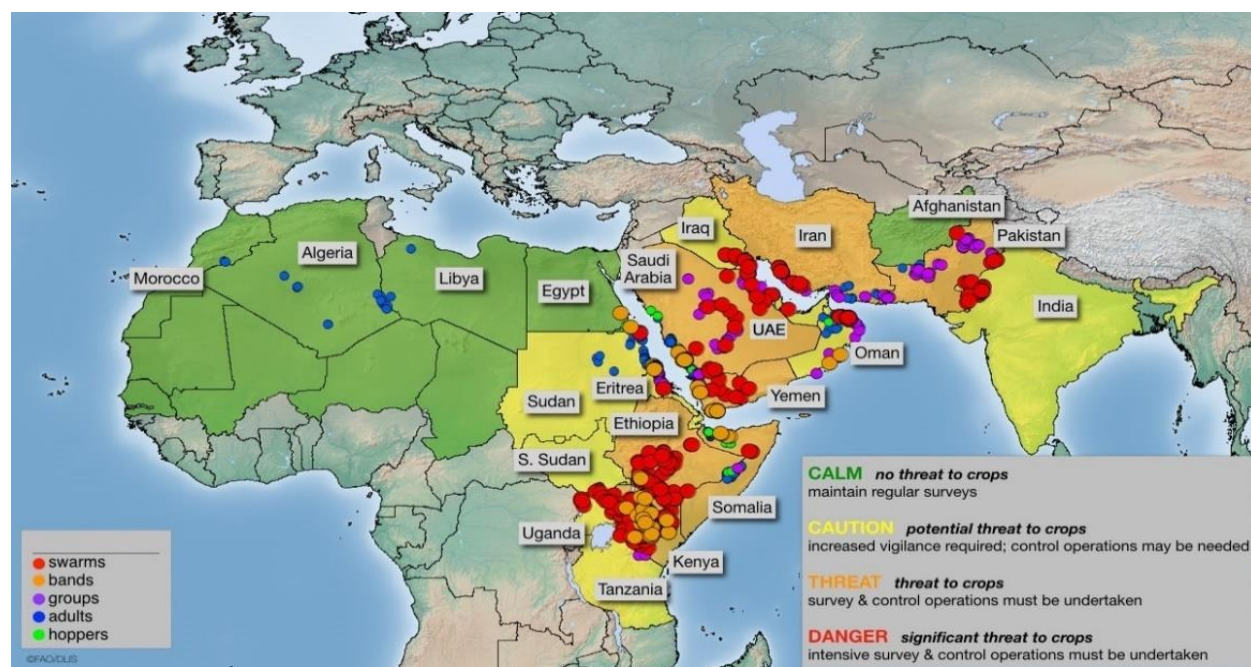


Fig. 10 (a). Distribution, invasion, and global forecast of desert locust February 2019 (Source: www.fao.org).

But far from ordinary hoppers, these were desert locusts. The same devastating migratory pests in East Africa that currently devour acres of maize, alfalfa, and date palms. While locusts are also found in UAE in July-October, this is usually seen in small, isolated groups or as lonely insects. Before mid-April 2020, (Figure 10b) and after the damage caused to the crops in Al Dhafra (Al-Sila - Ras Mushaireb - Ras Ghamis), Ghayathi (Al Nazrah), and Ghweifat (the border strip with KSA). Meanwhile, control teams also monitored locusts' first existence in Al Ain region (border strip with the Sultanate of Oman - Umm

Zmul - Al-Dhahirah - Al-Arad - Al-Wagan - Al-Awya - Al-Qou' - Boukariya - Al-Ain Al-Faida). In addition to controlling locusts in the western regions (As-Salamat - Siraa - Al-Anka - Al-Dumtha- Sweihan), locust control teams also surveyed the northern areas (Umm Ghafa - Al-Hayer - Masaken - Al-Shuwaib) during December-January, they were spotted along the Indian-Pakistan border, raising the alarms, and arriving at the time when the country is grappling with the most critical new corona viral pandemic (FAO, 2020).

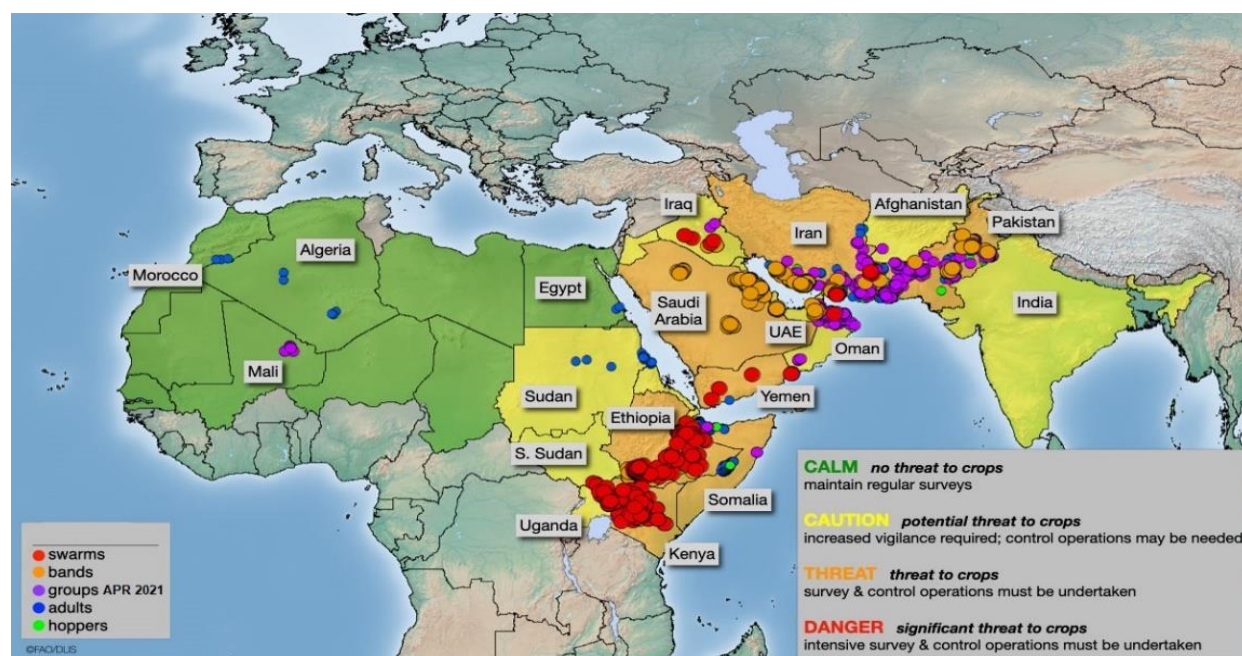


Fig. 10 (b). Distribution, invasion, and global forecast of desert locust April 2020 (Source: www.fao.org).

Over 73,930 donums of infested areas were handled with tractor-mounted sprayers and other vehicles by local authorities in Abu Dhabi, insecticides, such as Deltamethrin and Lambda-Cyhalothrin, are effective against locust. About a liter of the chemical is required, including the trees where they rest for the night, to treat a hectare of their breeding areas. Pesticides are abundantly available to control swarms (Zimmermann, 2007). Control operations also require equipment procurement, field engineers, spraying workers, field team training, supply pre-positioning in key breeding areas, and

contingency plans updating. The activities under the new lock-down system are not legally limited. However, there is also not a lot of time to waste. While insecticides regulated the outbreak of the locust, some areas agriculturists lost all their crops.

CONCLUSION

The invasions of desert locust do not occur overnight, but are depended on the rains, which is main factor for their survival and

multiplications, which are associated with rain and vegetation. The locust population was recorded very low in 2019 due to paucity of rains and population was calm and it was nonexistent from Atlantic to Middle East. During the second half of April and again in October 2019, strong tropical cyclone, in Arabian sea, which caused heavy rains in Yemen, Oman, Northern Somalia, Eastern Ethiopia and in Southern Rub-al-Khali in kingdom of Saudi Arabia and these favorable conditions which remained for 9 months from June 2019 March 2020. This long period of favorable conditions was a boon for the desert locust to develop its three new generations due to excessive population and due to favorable conditions for breeding resulted in outbreak, and invasion occurred regularly in the recent past. Moreover, if the excessive rains will occur in these breeding areas resulting in optimal precipitation will further augment the probability of such invasions of the locust if positive control is not kept checking the movement of the locust.

ACKNOWLEDGMENT

The authors highly acknowledge and appreciate the efforts of all the participants who engage in this research directly or indirectly.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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