DESERT LOCUST

(*Schistocerca gregaria*)

Early and subsequent monitoring in uncultivated sandy soil is very important for designing an IPM program for locust control.

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Locust Swarm

Locust is an international trans-boundary pest that has plagued the Earth for centuries. It affects agricultural production along with livelihoods in countries of Africa, the Middle East, and South-western Asia. Two major locust species invading Pakistan include Desert locust (*Schistocerca gregaria*) and Migratory locust (*Locusta migratoria*). These migratory pest species can cause a havoc in swarms and destroy the entire livelihood of the farmers in a single morning. This special grasshopper's capacity for rapid population growth exposes major challenges for control, especially in remote semiarid areas which happen to characterize much of the invaded area. Devastating desert locust invasions pose a major threat to agriculture and these infestations ravage a variety of vegetation affecting cultivated plants, forests, pastures eventually resulting in heavy crop losses. If not controlled, these upsurges spark a motion in a chain reaction that has adverse and far-reaching effects such as disruption of trade, diversion of labor, famine, abandonment of cultivation along with heavy expenditures on locust management and control measures. Locust is a phytophagus and feeds on large quantities of any kind of green vegetation including crops, pasture and fodder. Locusts have the ability to change their behavior and physiology, in particular their color and shape (morphology) in response to changes in density. In Pakistan, locust breeds in two breeding seasons i.e., Spring (in Balochistan) and Summer (in Sindh and Bahawalpur). Locust had ten morpho-characteristics similar to those of ten animals including face of horse, eyes of elephant, neck of bull, horn of stag, chest of lion, belly of scorpion, wings of vulture, leg of camel (hind), legs of ostrich (fore-legs) and tail of snake.

HISTORICAL PERSPECTIVE OF LOCUST SWARM IN PAKISTAN

Pakistan lies on the route of migratory locust swarms, both from west and east. From the western side, Pakistan faces the locust swarm attack coming from Iran, in Balochistan, while from the east coming from Indian Rajasthan, locust swarms enter Cholistan and Tharparkar deserts. Pakistan faced locust attacks in the past (1926), the worst being in 1952, where a single swarm size was over five km long and more than three km wide. Third locust swarm invaded in 1962 followed fourth outbreak in 1992 and then fifth invasion in 2019. Being a periodical phenomenon, locust attack happens in decades and Pakistan has recently witnessed it after 27 years since the last attack in 1992.

LOCUST OUTBREAK REGIONS AND 2019-2020 OUTBREAK IN PAKISTAN

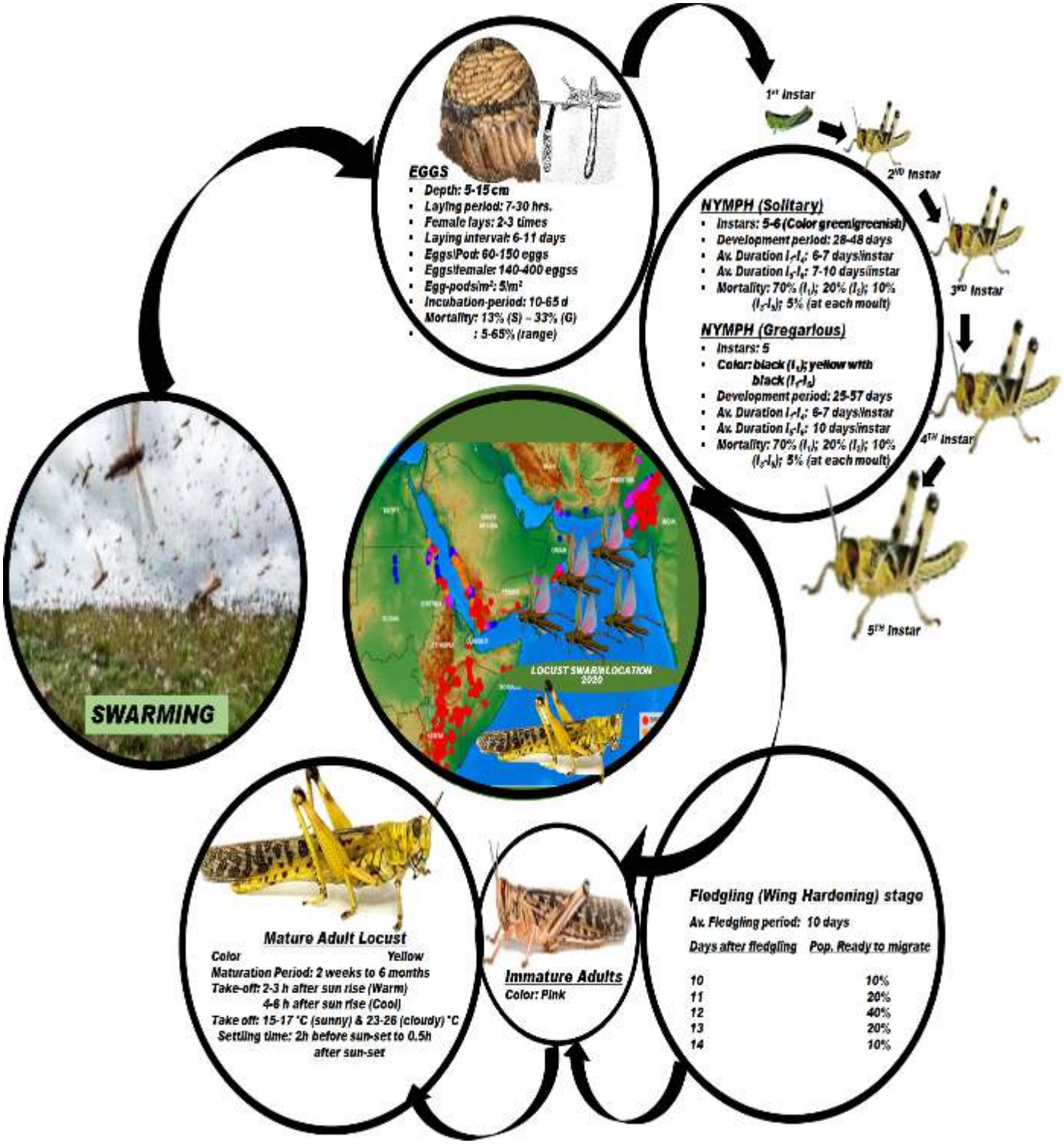
About thiry (30) countries of the World are invaded by the locust and these countries are categorized into three regions which include western regions (African countries like Mauritania, Sudan, Ethiopia and Somalia etc.), Middle regions (Egypt, Yemen, Saudi Arabia etc.) and Eastern regions (Pakistan, India, Iran and Afghanistan).

The locust outbreak travels from one region to others. This time (2019-2020), the desert locust swarm started from African countries like Mauritania, Sudan, Ethiopia and Somalia and invaded Yemen, Saudi Arabia and Oman in January 2019, from where, despite of adequate control measures, the undetected and uncontrolled gregarious locust adults' swarm migrated towards and invaded Iran in February 2019. Ecological conditions were also conducive in Iran for locust breeding due to heavy rainfall allowing them to lay eggs and increase their number. In March 2019, locust swarms migrated from Iran to Balochistan. Despite of control efforts in Balochistan by the Department of Plant Protection (DPP), the locust swarms started moving towards the summer-monsoon breeding zones of Sindh and Punjab in June 2019. After summer breeding in Thar, Nara and Cholistan deserts of Sindh and Punjab, the locusts migrated to the Indian Rajasthan desert in July 2019 and re-entered Tharparkar in Sindh between October and November 2019.

BIOLOGY

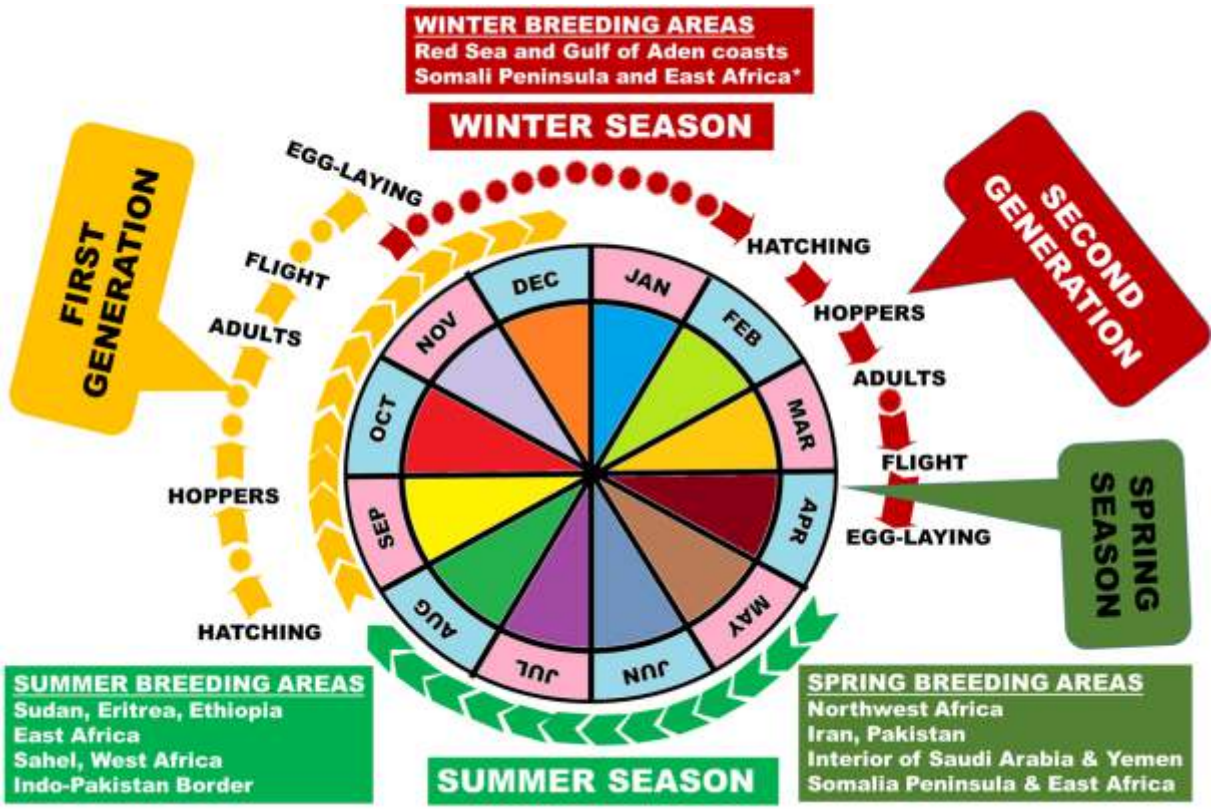
Locusts have three life stages i.e. Eggs, Nymphs (Hoppers) and Adults. Locust lives about a total of 3-5 months depending upon weather and ecological conditions. Female lays about 80-158 eggs in egg-pods in sandy soils at a depth of 5-15 cm. Females can lay eggs at least 3-times in their lifetime. Eggs hatch in about 2-weeks. Hoppers develop in 5-6 stages over a period of 30-40 days and adults mature in 3-4 weeks.

Adult locusts can form swarms which may contain millions of individuals and which behave as a unit which is called a swarm. Locusts usually fly with the speed of wings of about 16-19 km/h. Swarm can travel at about 5-130 km or more in a day. There can be at least 40-80 million locusts in each square km of swarm.



BREEDING SEASONS

Locust has two breeding seasons including summer and spring breeding seasons. Summer breeding areas is completed in Sudan, Eritrea, Ethiopia, East Africa, Sahel, West Africa and Indo-Pakistan Border; while spring breeding season occurs in North West Africa, Iran, Pakistan, Interior of Saudi Arabia & Yamen, Somalia Peninsula and East Africa. Sometime an additional winter breeding season is accomplished by locust in Red Seas and Gulf of Aden Coasts, Somali Peninsula and East Africa.



BEHAVIOUR OF INDIVIDUAL HOPPERS IN BANDS

Basking:
Lying exposed to warmth and light, typically from the sun, for relaxation and pleasure.

Roosting:
At night and in the early morning hoppers will be found roosting {Fig. 26). This means that the hoppers are off the ground, resting on plants, bushes or stones. Roosting also occurs during the middle of the day when the temperature exceeds about 36°C.

Ground grouping:
When hoppers are concentrated in dense groups on the ground and are mainly stationary they are said to be in ground groups. These are seen in the morning when the hoppers come down from the bushes and again in the evening before they roost for the night. Ground grouping may occasionally occur at other times of day.

Marching:
Hoppers usually spend the greater part of the day marching. This means that they are moving together by either jumping or walking in a definite direction. They stimulate each other and the whole band moves from one place to another. The net distance covered is called the displacement.

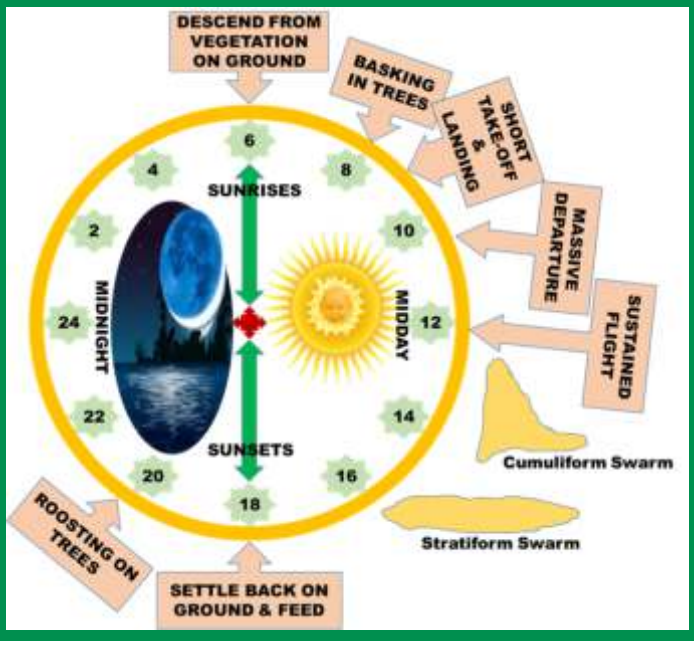
Feeding:
The main feeding period occurs when the hoppers go up into the bushes for their evening roost, but they also feed when marching, stopping briefly to eat low vegetation in their line of march. These two types of feeding are important to note because the success of certain control operations depends upon them.
Feeding mainly occurs in the evening but sometimes it is seen on a considerable scale in the middle part of the morning. Very little occurs during the hotter, middle part of the day. Hoppers

eat more during the middle part of each instar than at the beginning or the end. Just before moulting they feed either very little or not at all. For the first three moults this non-feeding period lasts about one day, but for the two later moults it may be 2-4 days. This is important when bait or vegetation poisoned by insecticides is being relied on to kill them when they eat it, since it means that at certain times the hoppers will not eat enough to pick up a lethal dose of insecticide. It is therefore necessary to learn to recognise these periods by observation and postpone control work until the appetite of the hoppers returns, or to use persistent insecticides which will remain effective for several days at least.

BEHAVIOUR OF INDIVIDUAL ADULTS

Fledging: The final moult into the adult stage is known as **fledging**, when the **locust** develops fully formed flying wings. The adult locusts exhibit the following changes in their behavior:

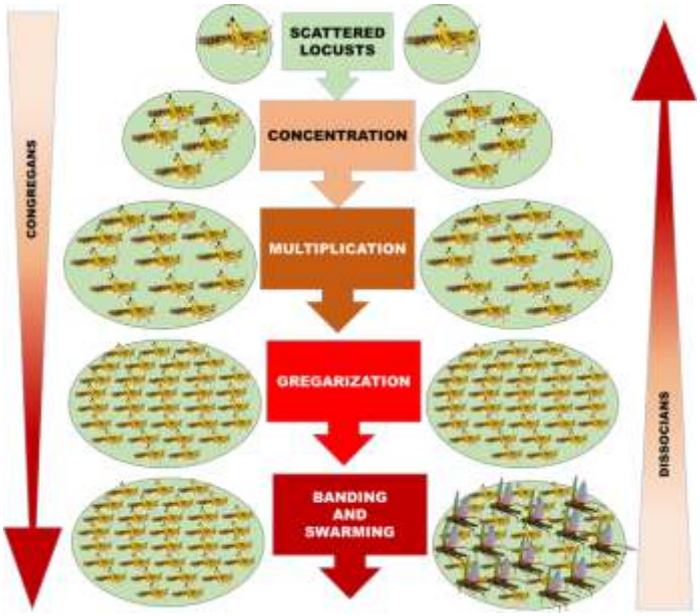
1. Fledging and Immature Adult
2. Maturation
3. Solitary Adults
4. Grouping Adults
    a. Basking
    b. Feeding
    c. Roosting
    d. Flying
5. Swarming



LOCUST'S BIOLOGICAL PHASES

Recessions are periods without widespread and heavy swarm infestations during which the species reverts to transiens and solitarious phases and these periods of recession may be regional. Outbreaks occurs when areas become favourable for breeding due to good rains and lush green vegetation and the number and density of the desert locust population increase sufficiently to form bands and swarms.

Upsurges are periods in which a widespread and very large increase in locust numbers initiates contemporaneous outbreaks followed by two or more successive seasons of transiens-to-gregarious breeding that occupies an expanding area in complementary breeding areas in the same or neighbouring desert locust regions.



Plagues occur when wide spread infestations of swarms and hopper bands affect extensive areas and generate large numbers of reports during the same year and in each of several successive years or in one or more years. Outbreaks and upsurges form successive stages in the continuum of plague development.

Why Locusts are so difficult to Control?

1. Extremely large area (16-30 million sq.km) which locusts cover.
2. Remoteness and difficult access of locust breeding areas.
3. Limited resources for locust monitoring and control.
4. Undeveloped basic infrastructure (roads, communication etc.)
5. Difficulty in organizing and implementing control operations.
6. Difficulty in maintaining enough trained staff.
7. Political relations among the affected countries.

Favorable Conditions for Locusts

1. Moist sandy or sand/clay soil to a depth of 10-15 cm.
2. Some bare areas for egg-laying.
3. Green vegetations for hopper development.

Global Scenario of Locust Infestation

1. Desert Locust spring breeding, amplified by heavy rains, can pose a serious threat to agricultural production areas of Yemen, Sudan, Eritrea and parts of Ethiopia and northern Somalia during the next three months, FAO warned.
2. Locust swarms are causing an "unprecedented threat to food security and livelihoods" across East Africa, the UN has warned.
3. Locust swarms are forming and moving to the traditional summer breeding areas in Yemen, Sudan, the Horn of Africa and along both sides of the Indo-Pakistan border.
4. Swarms have also been forming in Yemen, Saudi Arabia, Iran, Pakistan and India since 2019.
5. Intensive ground and aerial control operations were mounted in Iran (712 000 ha), Saudi Arabia (219 000 ha) and Sudan (105 000 ha) last year to reduce locust swarms (FAO).

Swarm Devastation

After becoming airborne, swarms of tens of millions of locusts can fly up to 150 km a day with the wind. A very small swarm eats the same amount of food in one day as about 35 000 people. Now is the most "critical period" for control of the desert locusts, because any eggs laid in the past month coincide with the cropping season.

Current Situation in Pakistan

1. Around 300,000 square kilometers of farmland is vulnerable to the locust outburst.
2. 4,500 acres of mustard and 2,500 acres of wheat crop have been destroyed already in Rabi season.
3. Frequent rains in current spring season created the favorable conditions for egg-hatching and subsequent hoppers development.
4. Timely surveys and surveillance of the locusts are necessary for devising a proper locust management program across the country.
5. More funds are required for research and development programs.

LOSS POTENTIALS OF LOCUST: HISTORICAL PERSPECTIVE

Locusts have probably been an enemy of man ever since he began to grow crops. The Desert Locust is mentioned in ancient writings such as the Old Testament of the Quran and Bible. Carved images of locusts have been found on Sixth Dynasty (2420-2270 BC) tombs at Saqqara in Egypt. Locusts are still a great enemy of the farmer and in some countries, they are the determining factor between enough food for the people and starvation. Damage is sometimes diffuse and not obvious, but it can be very severe in many more restricted areas. This depends on whether the swarms are moving about quickly or whether they stay for several days in one area. When environmental conditions produce many green plants and promote breeding, locusts can congregate into thick, mobile, ravenous swarms. Locust swarms devastate crops and cause major agricultural damage and attendant human misery, famine and starvation.

One ton of locusts (a very small part of an average swarm) eats as much food in one day as about 10 elephants or 25 camels, or 2500 people. Locusts do damage by eating the leaves, flowers, fruits, seeds, bark and growing points, and also by breaking down trees because of their weight when they settle in masses, and sometimes even by spoiling plants with their excrete. They do not, as far as we know, carry any disease but some laboratory workers have developed an allergy to them.

An analysis records of Desert Locust damage shows that: 8% of the damage is done by hoppers, 69% by immature and maturing swarms and 23% by mature swarms. The figure for hoppers is low because the breeding areas are mostly outside the main crop areas. In Africa and southwest Asia from 1986 to 1989, locust affected 16.8 million hectares (ha) and involved a cost of control of US$274 million; while from 2003 to 2005 it affected 13 million ha and resulted in an economic loss of US$500 million. Two invasions of the migratory locust, *Locusta migratoria*, in Madagascar from 1997 to 2000 affected 4.2 million ha and resulted in economic losses of US$50 million; while 2013 to 2016 I affected 2.3 million ha, and resulted in US$37 million economic loss. Large-scale infestations in Eurasia of the Italian locust *Calliptamus italicus* in 2000 (Kazakhstan) affected 8.1 million ha and causes US$23 million loss. Italian locust with some Moroccan locusts, *Dociostaurus maroccanus*, in 2014 (the Caucasus and central Asia) affected 6.7 million ha); while large outbreaks of *Chortoicetes terminifera* in eastern Australia in 2010 affected 1.1 million ha and caused US$50 million loss. Large outbreaks of various grasshoppers in the United States between 1986 and 1988 affected 8.2 million ha and resulted in US$75 million loss; while in 2010 (Wyoming) affected 2.4 million ha and cuased US$7.4 million economic loss.

RESEACH AND DEVELOPMENT ACTIVITIES NEEDED

- No research has been carried out for decaded on the biology, ecology, and behavior of locust. So, R&D projects should be encouraged emphasing on biology, ecology, and behavior of locust.
- Study on the morpho-molecular identification of invading locust
- Development of Monitoring and forecasting systems and models in changing environmental conditions
- Assessment of food preference of each biological stage of locust
- Study the migration behavior of locust
- Innovation in spraying technology for effective and ecofriendly eradication of locust
- Innovation in chemical control of locust
- Practical implementation of Geographical Positioning System (GPS) and GIS in Pakistan
- Satellite data imagery for planning the desert locust surveys according to the green vegetation availability in the field on a regular basis

STRATEGIES AND POLICIES FOR BETTER MANAGEMENT OF LOCUST

1. Increase number of outposts for better monitoring and surveillance of locust. There are only 2 outposts in Punjab (Bahawalpur, Rahimyar Khan) and Sindh (Sukkur and Mirpur Khas).
2. SWAC (FAO commission for controlling the desert locust in South-West Asia) needs to provide more funds to Pakistan and these funds should be in responsible hands.
3. Management is mostly done with the help of chemicals in Pakistan. To spray these chemicals, there is need for ULV mounted vehicles to cover more area in less time. Department had 14 vehicles. All were in critical condition except 4 that were barely working. AT LEAST 20 vehicles are needed.
4. Planes cover most area and at faster speed, taking less time for monitoring and survey. Planes are efficient because they can reach and spray those areas where access to vehicles is not possible or very risky. Department needs 10 properly working aircrafts at minimum but sadly, there is only 1 in flying condition. An aircraft got in an accident few months ago and pilot died.
5. There is no devised strategies or plans for emergency situations. There should be vehicles and planes always ready along with sufficient supply of petrol, diesel and chemicals to counter the emergency outbreaks.
6. Conventional Pesticides are very harmful for crops and humans. There is a need to devise strategies that involve minimum chemical usage. Use of biorational insecticides like Insect Growth Regulators (TGRs) should be assessed and recommended for area-wide eradication.
7. Bio-pesticides are much more echo-friendly. Next to non harm to animals and plants other than the target Organism. ***Metarhizium*** (a fungus) can be used as a bio pesticide and experiments on international scale have proven its efficiency. ***Paranosema*** has also shown good result against desert locust.
8. Trap cropping strategies and techniques have to be taught to farmers to keep losses at minimum.

VICE CHANCELLOR VISION AND UAF SCIENTISTS ENDEAVORS

Prof. Dr. Muhammad Ashraf (HI, SI) Vice Chancellor, University of Agriculture, Faisalabad directed the scientists to develop low cost biopesticides, test plant extracts to curb the locust problems across the Pakistan to save farmers crops. The Vice Chancellor announced the establishment of first R&D Cell of Locust at UAF. In a recent meeting held on 14-04-2020 in his office, the vice chancellor has directed the locust research and development cell to accelerate the pace of work and develop new pesticides and biopesticides to curb the locust that is playing havoc with agriculture sector. The Vice Chancellor further directed for the conduct of tangible research to investigate the locust rearing, life cycle, chemical-ecology, morpho-molecular identification, electrophysiology and other aspects on the scientific basis. In this regard, competent authority directed to initiate tangible research on the development of ecofriendly locust management strategies like local plant species (neem, eucalyptus, dhatura etc.) based botanicals and biopesticides, laser-control strategy etc. in collaboration with Dr. Yasir Jamil from Physics Department, UAF and Dr. Shoukat Ali from Chemistry Department, UAF. The Vice Chancellor, also emphasizes to develop a prototype of spray machine which has been identified that spell the spray-solution up to 50-60 feet height. The task has been assigned to the Department of Farm Machinery, UAF to develop the prototype of this machine which would be most appropriate and efficient for the proper coverage of pesticides application against locust. Finally, the worthy Vice Chancellor emphasized to invite the international locust experts at UAF for organizing meeting on sustainable management of locust in Pakistan and directed to develop a road map for the sustainable management of locust at national level. The task has been assigned to the Department of Entomology, CABB, Plant Pathology, Physics, Chemistry and Biochemistry. Locusts research and development cell has initiated the endeavors on molecular identification of locust species, bio-pesticides efficacy trials, new-chemistry insecticides trials, Eco-biology, host plant feeding, systematic and morphological characteristics and biotechnological approaches. UAF scientists are devising roadmap for sustainable management of locusts at national level.

RESEARCH AND DEVELOPMENT AT DEPARTMENT OF ENTOMOLOGY, UAF

On the directive of Vice chancellor, the Department of Entomology has established Locust Research and Development Cell at UAF and engaged ninety (90) undergraduate research students (Internees) in liaison with Agriculture Department, PW&QCP Department, and Agriculture Extension, Punjab as per directive of the honorable Vice Chancellor, University of Agriculture, Faisalabad. The internees did a remarkable work on the task of locust surveillance, monitoring, management and local awareness about this menace under the supervision of the DGs, PW&CQP and Agriculture Extension. The departmental locust research team, including Prof. Dr. Mansoor-ul-Hasan, Prof. Dr. Muhammad Jalal Arif, Prof. Dr. Sohail Ahmed, Dr. Amir Rasul, Dr. M. Dildar Gogi, Dr. Ahmad Nawaz, Dr. Shahid Majeed, Dr. M. Sufian,, Dr. M. Sagheer and Dr. M. Arshad has been visiting the highly locust infested areas of Punjab. All team members visited Pipli Pahar state forest, Depalpur, Okara, Sahiwal, Pakpatan, 18-Hazari, Bhakar, Khushab, Jhang, Toba Tek Singh for surveillance and monitoring of locust scenario and its management in these areas. The members also participated in NDMA meeting at Islamabad for devising locust management strategies at national level and extended the input on locust surveillance, monitoring system and management. Different faculty members of the department have submitted research proposals on locust rearing, life cycle, chemical-ecology, morpho-molecular identification, biotechnology and other aspects of desert locust in various national and international funding agencies.

CONTROL OF LOCUST

Cultural control

- Cultivating the soil where eggs were laid. By exposing, they dry out or eaten by birds

Mechanical Control

- Collecting hoppers with catching machines (Insect sucker)
- Killing them with flame-throwers
- Crushing them with rollers

Biological Control

Natural enemies

- Predators: Rose-coloured and common stralings (Pastor roseus and Sturnus vulgaris) Blister beetle, Ground beetle and Crickets are eggs predators.
- China sent 100,000 ducks for locust control in Pakistan.

Parasitoids:

Flesh flies, Tachinid flies and tangled veined flies are nymphal and adult parasitoids

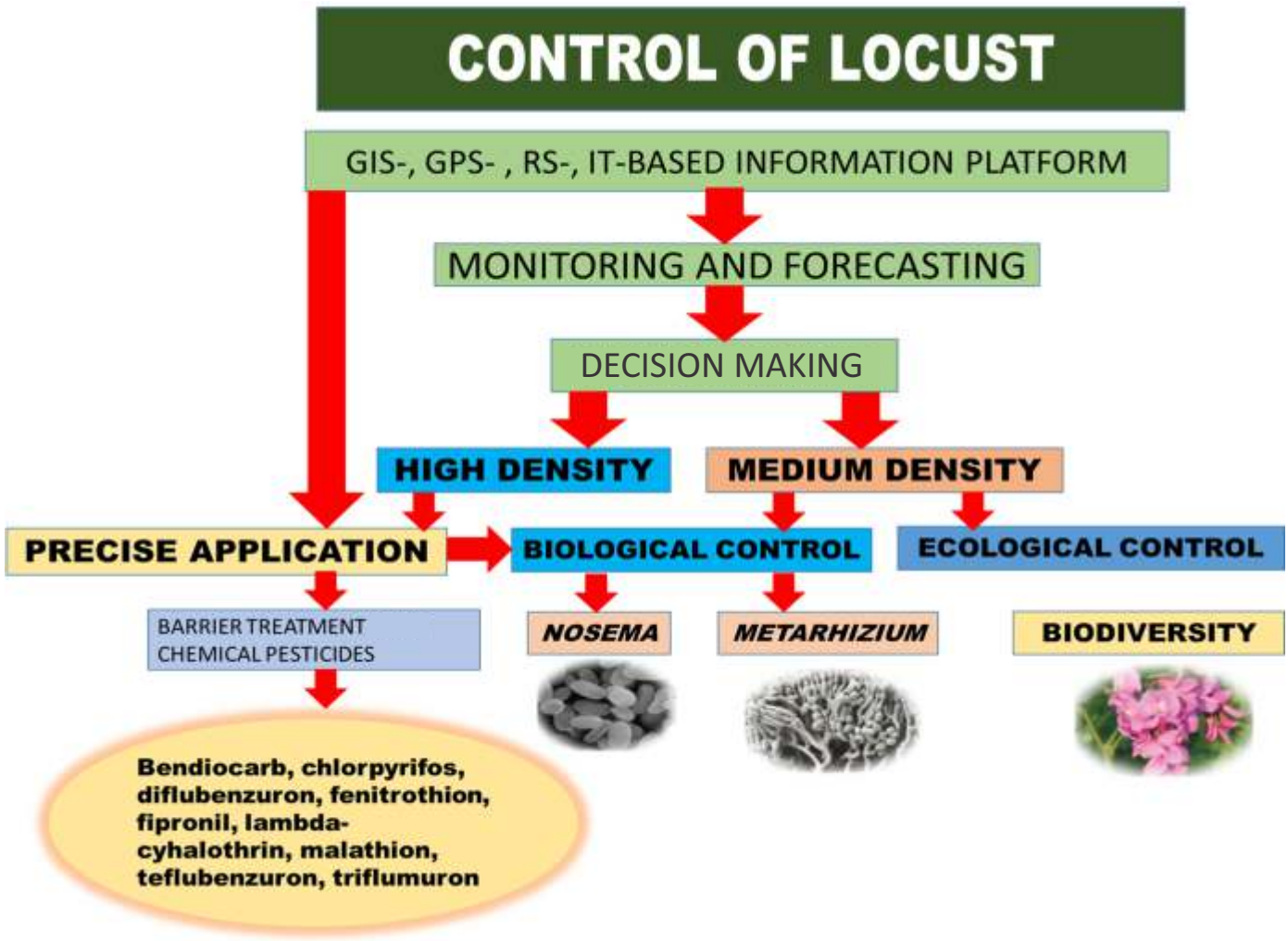
MICROBIAL CONTROL

1. Naturally occurring fungus *Metarhizium anisopliae*.
2. *Metarhizium acridum* for killing both hoppers and adult locusts.

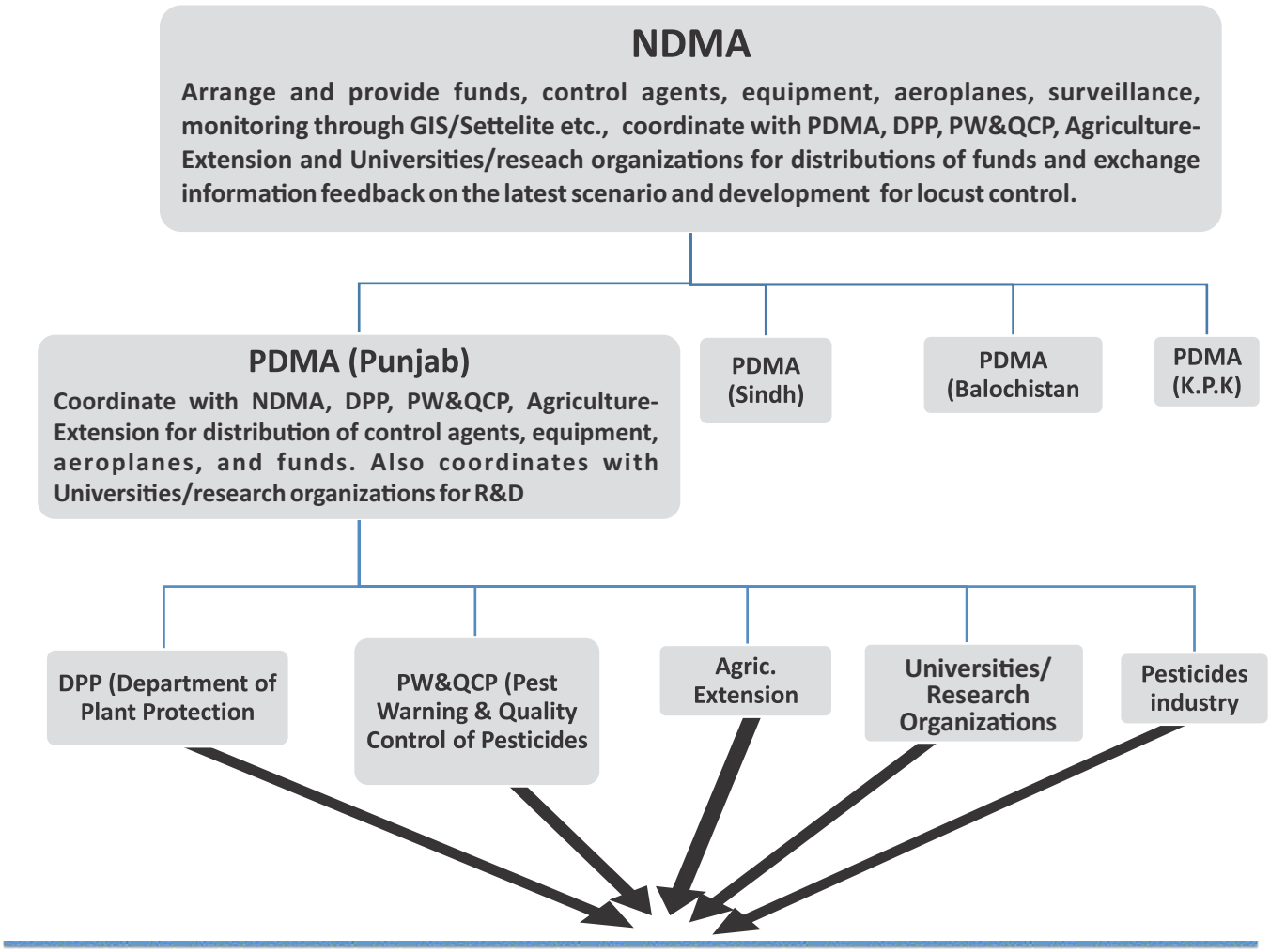
CHEMICAL CONTROLL OF LOCUST

Primary method of controlling locust swarms and hopper bands is mainly with broad-spectrum organophosphate agro-chemicals (stomach and contact) applied in small concentrated doses referred to as ultra-low volume (ULV) formulations by vehicle mounted and aerial sprayers and to lesser extent by knapsack and hand-held sprayers. Application methods includes sprays, baiting and dusting. Other chemicals include:

Chlorpyrifos 40EC (20 mL/1 L water), Deltamethrin 2.5EC (3 mL/1 L water), Cypermethrin (5% solution), Fenpropethrin (5% solution), Lamdacyhalothrin 2.5EC (3 mL/1 L water), Bifenthrin (5% solution), Carbaryl 85WP (dusting of mixture of 25 kg sand and 1 kg carbaryl). Other effective insecticides include Malathion 57EC (6 mL/1 L water), Diazinon, Benbiocarb, Fenitrothion, Fipronil and IGRs (Teflubenzuron, Triflumuron, Diflubenzuron etc.). For aerial spraying of afore-mentioned insecticides, only their ULV formulation should be sprayed without mixing water. Chemical control may be implemented when locust density is high and may involve barrier treatments—in other words, spraying of pesticide in barriers 300–500 m apart by aircraft flying in rangeland. When locust density is medium or in environmentally sensitive areas, a recommendation is made to implement biological control, such as *Metarhizium* (fungal microbial control agent) or *Nosema* (protist microbial control agent), or with ecological methods, such as an increase of biodiversity in the locust habitat. Phenylacetonitrile, or PAN is used for changing locust mating behavior.



SCHEMATIC DIAGRAM FOR THE ROADMAP TO LOCUST CONTROL IN PAKISTAN



ALL AFORE-MENTIONED ORGANIZATIONS SHOULD WORK IN COORDINATION WITH EACH OTHER FOR THE DISTRIBUTION OF FUNDS, CONTROL AGENTS, AND EQUIPMENT ETC. FOR R&D. THEY SHOULD ALSO COORDINATE WITH PDMA AND NDMA FOR SHARING LATEST SCENARIO OF LOCUST OUTBREAK AND ACTIVITY AND EXCHANGING FEEDBACK REGARDING R&D, DISTRIBUTION OF RESOURCES AND SCENARIO OF LOCUST CONTROL IN HOTSPOT AREAS. ALSO COORDINATE WITH LMT AND LLST.

LMT (Locust Management Team) at District level

1-2 members from each of above-mentioned organizations for each infected district. Make surveillance and monitoring the activity of locust and implement locust control practices provided and guided. Coordinate with LLST for distribution of control agents, equipments etc.

LLST (Local Land Services Team) at Tehsil Level

1-2 members from each above-mentioned organization/department at tehsil level. Coordinate with LMT and landlords of the effected areas and provide them with control agents, equipments etc.. Also develop their capacity building through training, printed materials and e-media for self help.

Control Agents (Chemicals)

Lamdacyhalothrin, Chlorpyrifos, Malathion, Diflubenzuron, Fenitrothion, Fipronil, Teflubenzuron, Triflumuron

Control Agents (Biopesticides)

Metarhizium, Nosema

Food baits

Baits (wheat or maize bran) with chemical insecticides (e.g. carbaryl)

Mechanical control like sucking by vehical mounted insect-sucker, Foliar application by Drone, Roller crushing, Flame-burning, netting etc.

Cultural Control like soil cultivation of eggs-bed

Equipment

Boom-sprayers, Aeroplane, Drone for insecticide application, mechanical suckers, equipment mounting vehicle, tractor mounted electric insect-suckers

LOCUST RESEARCH AND DEVELOPMENT CELL (LRDC)

DEPARTMENT OF ENTOMOLOGY, UAF

MISSION AND VISION STATEMENT

Strengthening the research, development and outreach activities and coordinating with national and regional locust control organizations for devising preventive and curative control operations/strategies against desert locust to reduce its potential damage to agricultural system and ensure food security in the country.

GOAL

Development short-term and long-term roadmap for large-scale sustainable and ecofriendly control of locust and safeguarding agricultural-productivity and national food-security in Pakistan

OBJECTIVES

- To monitor and make surveillance for control locust, risk assessment and loss estimation in infested areas
- To conduct research on various parameters of locust biology, behavior, ecology and management.
- Liaison and coordination with regional and National locust organizations (public and private sector) and other locust-stakeholders.
- Human resource development through training and demonstration for staff of National and Regional locust organizations, State officials and Farmers.
- To develop long-term and short-term control program/roadmaps to combat locust emergency.
- To protect standing crops and other green vegetation from the ravages of Desert locust

RESEARCH AND DEVELOPMENT MANDATES

Roadmap of activities of this cell will include:

- To determine the morpho-molecular identification of locust species in Pakistan
- Rearing of locust under controlled conditions to study the biology for the determination of most susceptible stage for its control
- To study the ecology and behavior of locust
- To study the reasons for its sudden outbreak
- To conduct monitoring and surveillance
- To asssess natural diet preference
- To evaluate the efficacy of pesticides and spraying techniques
- Import of biocontrol agents (*Nosema locustae*) and development of application methods for biological control against dessert locust in different geographical areas.
- To explore natural enemies (predators and parasitoids) of dessert locust in Pakistan.
- Risk assessment on faunal and floral diversity in the pesticides treated areas
- To enhance capacity building of locust stakeholders (Farmers, State functionaries and locust staff) on latest locust control technologies through public awareness campaign and transfer of technology
- To evaluate phyto-chemical based biopesticides of indigenous medicinal plants for their toxic, antifeedant and repellent properties against different life stages of locust
- To prepare and evaluate nanoparticle encapsulated formulations of synthetic and botanical insecticides for efficient control of locust with lower dose rate
- To explore local strains of entomopathogenic microbes (EPF, EPB, EPN etc.), conduct field station Bioefficacy trials for locust control and develop EPM formulations.
- To optimize spraying equipments/nozzles etc.

RESEARCH LABORATORIES IN LOCUST RESEARCH AND DEVELOPMENT CELL

1. Locust Biology, Ecology and Behavior Lab

- To study the life cycle of locust under different temperatures and relative humidity levels.
- To study the effect of changing climate on reproductive, feeding and migratory behavior of locust.

2. Locust Insecticide Resistance Management and Toxicology Lab

- Insecticide Bioassay studies of new chemistry insecticides with novel mode of action against locust under laboratory and locust breeding areas.
- Screening of insecticides against different insect pest for best chemical control strategies against locust.
- Monitoring of insecticide resistance against major insecticide in different geographical populations of locust.
- To study biochemical and genetic basis of insecticide resistance in locust.
- To develop the insecticide resistant strains of bio-control agents.

3. Locust Biosystematics and Molecular Biology Lab

- To identify different locust species, biotypes of different geographical areas feeding on different host plants.

4. Locust IPM Lab

4a. Locust Biological Control Lab

- Collection and mass rearing of predators and parasitoids of locust.
- To study Insect pest-plant and beneficial insect interaction.

4b. Locust Pathology Lab

- Development of microbial biopesticides using entomopathogenic fungi, bacteria, viruses and nematodes for environment friendly management of locust.

5. Locust Risk Assessment Lab

- Quantify, prioritize and develop database of chemicals-associated risks on faunal and floral diversity in the pesticides treated locust hotspot areas

PICTORIAL GLIMPSES OF LOCUST ACTIVITIES

WEBSITE SOURCES

1) https://www.google.com/search?sxsrf=ALeKk02pw6uER5HYEIJaoF18cZY8nLC1eg%3A1589780175189&source=hp&ei=zx7CXpKsCbSGjLsP_f6kiA0&q=Contingency+Plan+for+Desert+Locust+Invasions%2C+Outbreaks+and+Upsurges&oq=Contingency+Plan+for+Desert+Locust+Invasions%2C+Outbreaks+and+Upsurges&gs_lcp=CgZwc3ktYWIQA1DOGFjOGGCnIWgAcAB4AIABqQKIAakCkgEDMi0xmAEAoAECoAEBqgEHZ3dzLXdpeg&sclient=psy-ab&ved=0ahUKEwjSz_HU2LzpAhU0A2MBHX0_CdEQ4dUDCAc&uact=5
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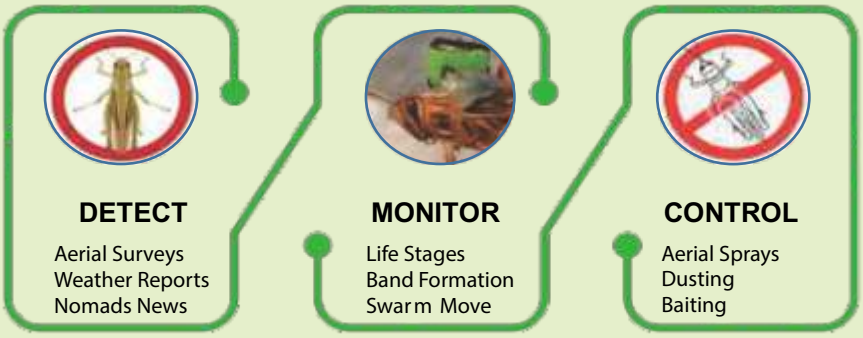

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