Two days National Training Workshop
On Desert Locust

05th & 06th October, 2017

Government of India

Ministry of Agriculture & Farmer's Welfare
Department of Agriculture Cooperation & Farmer's Welfare
Directorate of Plant Protection Quarantine& Storage
Locust Warning Organization, Jodhpur-342001 Rajasthan (India)

Two days National Training Workshop
On Desert Locust

05th& 06th October, 2017

at

Locust Warning Organization, Jodhpur-342001 Rajasthan (India)

Report prepared by: LWO Jodhpur (e-mail : lwo-jod-rj@nic.in)

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Introduction:

During the 30th Session of South West Asia Commission(SWAC) (A FAO Commission for Controlling the Desert Locust in South West Asia), it was decided that the trust fund will supplement national training workshops upon request by the member country that includes workshop date, participant, trainers, subjects and detailed budget. In order to implement the same and strengthening technical skill of officials involved in desert locust related activities, India has planned two days National Training Workshop on Desert Locust. The first National Training Workshop was conducted during 29th & 30th June, 2017 where 30 locust officers of Locust Warning Organization (LWO) were trained. Considering the importance of the training workshop remaining officers of LWO as well as concerned provincial State Government officials of Rajasthan and Jammu & Kashmir have been included in the second National Training Workshop held at LWO Jodhpur. For effective implementation of the training, a detailed program including training schedule, identification of participants, estimated budget etc. prepared and sent to the competent authority for approval/sanction. In consultation of LWO/ Directorate of Plant Protection Quarantine & Storage and FAO, a national training workshop was finalized to conduct on 05th & 06th October, 2017. The SWAC FAO has released Rs. 1,02,000/- for organizing the second national training workshop.

Resource Persons:

In consultation with SWAC and the Directorate, five numbers of resource persons have been involved as master trainers for successfully conducting the training workshop

Resource persons were advised in advance for preparation of their respective lectures and other responsibilities assigned to them for smooth conducting the national training workshop. They have been requested to report at the training venue one day advance of the commencement of the training workshop to discuss preparations for the workshop. They were also advised to use latest teaching methods viz best use of Power Point Presentations, white board, chart papers, live specimens, models, field exercises besides the participatory

approach during the course of training workshop. A list of resource persons is annexed in **Annexure-I.**

Participants:

Locust Warning Organization, Jodhpur has its 11 Circle offices situated in the entire Scheduled Desert Area of India. 24 participants from different LCOs were trained in the first national training workshop. During second national training workshop 24 participants from different LCOs, LWO, FSIL and six participants from state department of agriculture of Rajasthan and Jammu & Kashmir have been identified for participation in the workshop. These trainees participants are involved in field survey & related activities at their respective field offices. A list of trainees participants is annexed at **Annexure-II**.

Training Program:

Keeping in view the requirement of capacity building on desert locust during the locust active season in India which fall between June to November, It was decided to organize the National Training workshop during 05th& 06th October, 2017 on locust biology & behavior, survey, eLocust3 & RAMSES, field exercise etc. Accordingly a detail schedule of training programme including date, time for each classroom and field activities was identified with respect to the training was prepared and got approved by the appropriate authorities. A copy of the programme is annexed (**Annexure-III**).

Day wise programme:

Day 1 : 05.10.2017

Registration of the participants:

The National Training Workshop began with the registration of participants / resource persons. At the time of registration, participants were provided with T-Shirt, Cap, Training folder, Training literature, Note pad & pen.

Inaugural Session:

Inaugural session began with welcome address by Dr. J. P. Singh, Joint Director (Ento.) Locust Warning Organization, Jodhpur. In his address Dr. Singh briefed about history of locust in India, also enumerated the background of the national training programme and its usefulness to the participants. He encouraged all the participants to adopt participatory approach during the training workshop. He has further stated that considering the fact that many new comers have joined the locust scheme either their first entry into the Government system or transfer from other schemes and also officers from State Department of Agriculture require awareness about behavior and biology of desert locust which may help during control operations if any. Such national training programme needs to be organized frequently to brush up knowledge and skill of the field officers. He has expressed his gratitude to the Secretary SWAC FAO, Joint Secretary (PP) and PPA for providing financial support and administrative approval for conducting the workshop.

In his presidential address Dr. Balraj Singh, Vice Chancellor, Agriculture University, Jodhpur touched upon many interesting issues about local farming community. In his address, Dr. Singh emphasized on climatic condition and water availability in desert area and suggested famers to grow crop, which will give high production in short duration with minimum resources. As majority of rural population is solely, depend on agriculture. He has further emphasized that there is need of research and innovations in climate dependent agriculture especially in arid zones by improving cropping system, mechanization in agriculture. In concluding remarks chief guest expressed his satisfaction on the functioning of LWO dealing with a devastating transboundary pest i.e. desert locust.

Pre-evaluation Test:

In order to evaluate the skill of the participants, a pre-evaluation test was conducted. The test paper comprised of objective questions related to biology, behavior, survey & eLocust3. All trainees participants have attempted the pre evaluation test. The comparative result of pre evaluation / post evaluation test is placed at **Annexure-IV.**

Technical Session:

Classroom lectures / exercises:

Technical session began with the power point presentation of Dr. R. P. Sharma, Assistant Director (Ento) on "Desert Locust Introduction" "What are Locusts" followed by Shri Baldev Singh, APPO FSIL, Bikaner who has elaborated on "Life Cycle of Desert Locust" "Locust Phases" by using Power Point Presentation, White board along with live specimens of desert locust.

During post lunch, technical session resumed with the topic of Shri D. S. Poonia, PPO (PP), LCO Bikaner who explained "Desert Locust Survey Introduction & Survey Process" "Why make survey", "How to plan a survey" & "How to organize a survey" "What information to collect" "How to report survey results" using all the means of training techniques, white board, Color maps etc.

After tea break Shri P. K. Gour, Scientific Assistant, Locust Circle Office, Bhuj elaborated on "An overview on eLocust3" & "RAMSES" using PPT, eLocust3 tablet, white board & Colored imageries.

Day one technical session was ended with group discussion on locust situation as well as question answer session where all the trainees participants enthusiastically participated in the session which made the atmosphere charged and interesting.

At the end of the first day Shri D. S. Poonia, PPO wrapped up the day's activities and thanked the participants and resource persons for their active involvement.

Further, participants have been informed about mock drill exercise to be conducted next day morning i.e. on 06.10.2017.

Day 2: 06.10.2017

Field exercise:

During second day of the training workshop i.e. 06.10.2017 at 08.00 AM, all the trainees participants along with Master trainers were taken to the field venue identified for mock drill. The trainees participants were divided in to six groups and each group was explained about the field exercises to be conducted. Each group was provided eLocust3. Shri Baldev Singh Assistant Plant Protection Officer, FSIL Bikaner taken lead in conducting the mock drill and field demonstration on desert locust survey. Shri P. K. Gour, Scientific Assistant, LCO Bhuj and C. S. Sharma, Scientific Assistant, LWO Jodhpur demonstrated the use of eLocust3 in the field. These exercises lasted for three hours. After conducting field, exercises all the participants as well as Master Trainers taken back to the classroom training venue for the remaining technical session.

Classroom lectures / exercises:

During pre-lunch session Dr. R. P. Sharma, Assistant Director (Ento) Headquarter, Faridabad explained in detail the "Migration and seasonal distribution of Desert Locust" using PPT, white board through participatory approach.

After lunch break Shri Baldev Singh, APPO FSIL, Bikaner who elaborated on "Desert Locust Recessions, Upsurges, Plagues, Declines" which was followed by a group discussion organized amongst the all six groups where each team leader of a group has presented a brief on the two days training workshop.

Post training evaluation Test:

After completion of the technical session, a post training evaluation test was conducted to evaluate the difference in skill of the participants. Result of pre & post evaluation test is given at **Annexure-IV**.

Conclusion:

The following observations / conclusion have been made on the two days National training workshop on desert locust:-

1. Classroom discussions & field exercises viz. demonstration on eLocust3 and locust survey provided excellent practice training session which not only improved the skill of the participants but also sensitized them to think beyond the box on all relevant issues.
2. Pre and Post evaluation test results indicate that participants have acquired the fresh knowledge on the relevant topics covered during the training workshop.
3. At the end of the programme all group leaders expressed sense of satisfaction with upgradation in knowledge, which reflects positivity of participatory approach of the training workshop.
4. The workshop offered an opportunity to improve technical skill by learning & doing method. All participants were exchanged their knowledge and experience during the field exercise & group discussion session.
5. The participants expressed their keen interest, more in practical session followed by classroom training and suggested to continue such training program frequently in future.
6. Entire workshop conducted in Hindi and English languages.
7. Keeping in view of feedback of the participants during two national training workshop and requirement of training for field functionaries, it has been decided to submit a proposal for next training on “Locust Control Techniques” and other important subject for the participants who have undergone the training on biology and behavior of desert locust.

Acknowledgement:

First of all, LWO would like to give special thanks to Mr. Keith Cressman, Secretary SWAC, FAO for providing financial support and valuable suggestions for successfully conducting the national training workshop.

We would like to thank Shri Ashwani Kumar, Joint Secretary(PP), Department of Agriculture Cooperation & Farmers welfare, Ministry of Agriculture & Farmers Welfare, Government of India and Plant Protection Adviser for granting approval for conducting a national training workshop at LWO Jodhpur.

In last but not least, our thanks to all the resource persons and participants of different state governments as it would not be possible for successfully conduct the programme without their presence.

Annexure – I

List of Resource Person

S. No.	Name of Resource Person	Designation	Headquarter
1	Dr. R. P. Sharma,	AD (E)	Hqrs, Faridabad
2	Shri D. S. Poonia	PPO (E)	LCO Bikaner
3	Shri Baldev Singh	APPO	FSIL Bikaner
4	Shri P. K. Gour	SA	LCO Bhuj
5	Shri C. S. Sharma	SA	LWO Jodhpur

Annexure – II

List of trainees participants

S.No.	Name of participants	Designation	Headquarter
1	Shri Debasis Roy	AD (WS)	FSIL Bikaner
2	Shri S. C. Sharma	PPO (WS)	FSIL Bikaner
3	Shri Padam Singh	PPO (E)	FSIL Bikaner
4	Shri Mahesh Chandra	PPO (PP)	LCO Barmer
5	Shri G. L. Meena	PPO (PP)	LCO Palanpur
6	Shri Sunil Chandra	PPO (E)	LCO Suratgarh
7	Shri J. P. Godara	APPO	FSIL Bikaner
8	Shri Ram Gopal Meena	APPO	LCO Churu
9	Shri T. D. Ramawat	SA	LCO Phalodi
10	Shri Shrawan Singh	SA	LCO Phalodi
11	Shri Adarsh Sharma	SA	LCO Bhuj
12	Shri Rajendra Prasad	SA	LCO Palanpur
13	Shri Chain Singh	SA	LCO Palanpur
14	Shri Vijay Singh Bhati	SA	LCO Jaisalmer
15	Shri Awadhesh Kumar	SA	LCO Jaisalmer
16	Shri Bhagirath Singh	SA	LCO Jaisalmer
17	Shri Mala Ram	SA	LCO Barmer
18	Shri Prema Ram Dhaka	SA	LCO Jalore
19	Shri Raj Kumar	SA	LCO Bikaner
20	Shri Arun Panwar	TA	LWO Jodhpur
21	Shri Rajeev Pal	TA	LCO Jaisalmer
22	Shri Bhanwar Singh	TA	LWO Jodhpur
23	Shri S.P.Gupta	TA	LCO Bikaner
24	Shri Dulichand	TA	LCO Suratgarh
25	Mohd. Hussain	AEO	J & K
26	Mohd Iqbal	AEO	J & K
27	Mohd. Ali Yabgo	JAEO	J & K
28	Dr. Lal Chand	AAO	Bikaner
29	Shri Chhug Singh	AO	Jaisalmer
30	Shri Sukhdev	AAO	Balotra (Barmer)

Annexure - III

Schedule of Two Days Training Programme

Date	Time	event
05.10.2017	09.30-10.00	Registration of participants
	10.00-10.10	Lighting of lamp
	10.10-10.20	Address by Dr. K. L. Gurjar, Deputy Director (PP) Hqr, Faridabad.
	10.15-10.30	Address by Dr. J .P. Singh, Joint Director(E), LWO Jodhpur
	10.30-10.45	Address by Dr. Balraj Singh, Vice Chancellor , Agriculture University, Jodhpur
	10.45-10.55	Vote of thanks by Shri Om Prakash, APPO, LWO Jodhpur
	10.55-11.10	**Tea Break**
	Technical Session	
	11.10-11.30	Pre evaluation Test
	11.30-12.00	Lecture "Desert Locust Introduction" "What are Locusts" by Dr. R. P. Sharma, AD (E) Hqr Faridabad.
	12.00-12.30	Lecture "Life Cycle of Desert Locust" by Shri Baldev Singh, APPO, FSIL Bikaner
	12.30-13.00	Lecture "Locust Phase" by Shri Baldev Singh, APPO, FSIL Bikaner
	13.00-14.00	**Lunch**
	14.00-14.50	Lecture "Desert Locust Survey Introduction" & Survey process by Shri D.S.Poonia, PPO (E), LCO Bikaner.
	14.50-15.40	Lecture, "Why make survey", "How to plan a survey" & "How to organize a survey" "What information to collect" "How to report survey results" by Shri D. S. Poonia, PPO (E), LCO Bikaner.
	15.40-16.00	**Tea Break**
	16.00-17.00	Lecture "An overview on eLocust3" & "RAMSES" by Shri Pramod Gour, SA, LCO Bhuj.
	17.00-17.30	Group discussion & Wrap up
06.10.2017	8.00	Arrival to the mock drill site
	8.00-12.00	Mock drill & field demonstration of "desert Locust survey" by Shri Baldev Singh APPO, FSIL Bikaner and demonstration of eLocust3 by Shri P. K. Gour, SA, LCO Bhuj & C. S. Sharma, SA, LWO Jodhpur.
	12.00-12.30	Arrival to the lecture venue & Tea break
	12.30-13.30	Lecture "Migration and seasonal distribution of Desert Locust" by Dr. R. P. Sharma, AD (E) Hqr Faridabad.
	13.30-14.30	**Lunch**
	14.30-15.30	Lecture "Desert Locust Recessions, Upsurges, Plagues, Declines" by Shri Baldev Singh APPO, FSIL Bikaner.
	15.30-16.00	Group Presentations
	16.00-16.30	Post training evaluation
	16.30-17.00	Certificate distribution and Closing

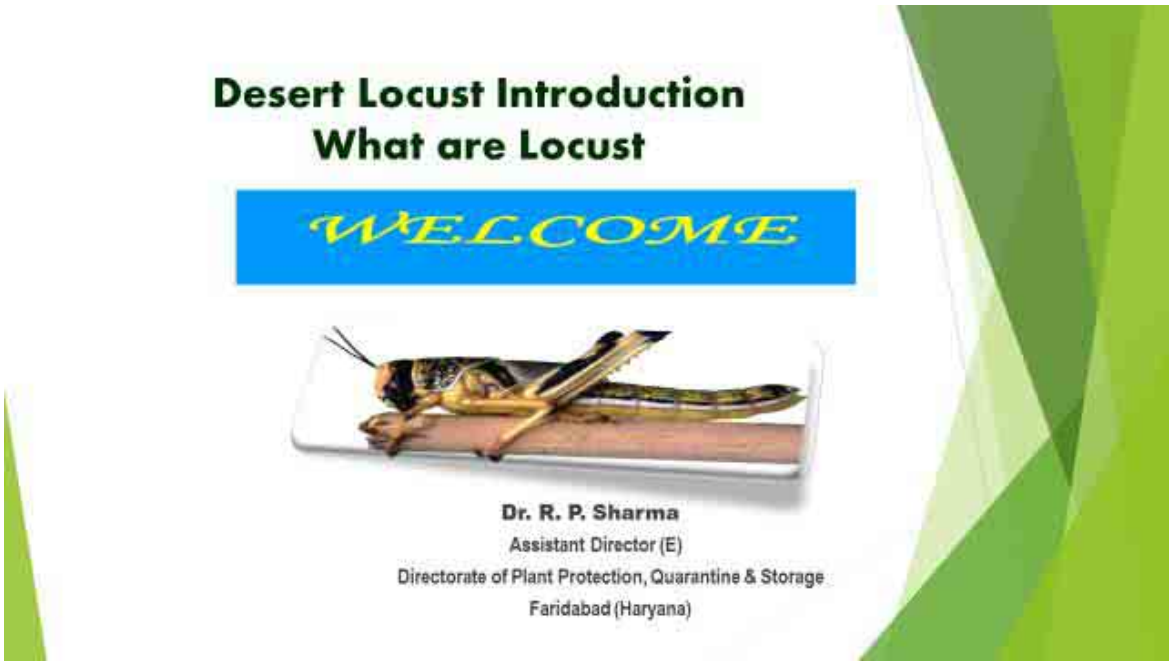
Annexure - IV

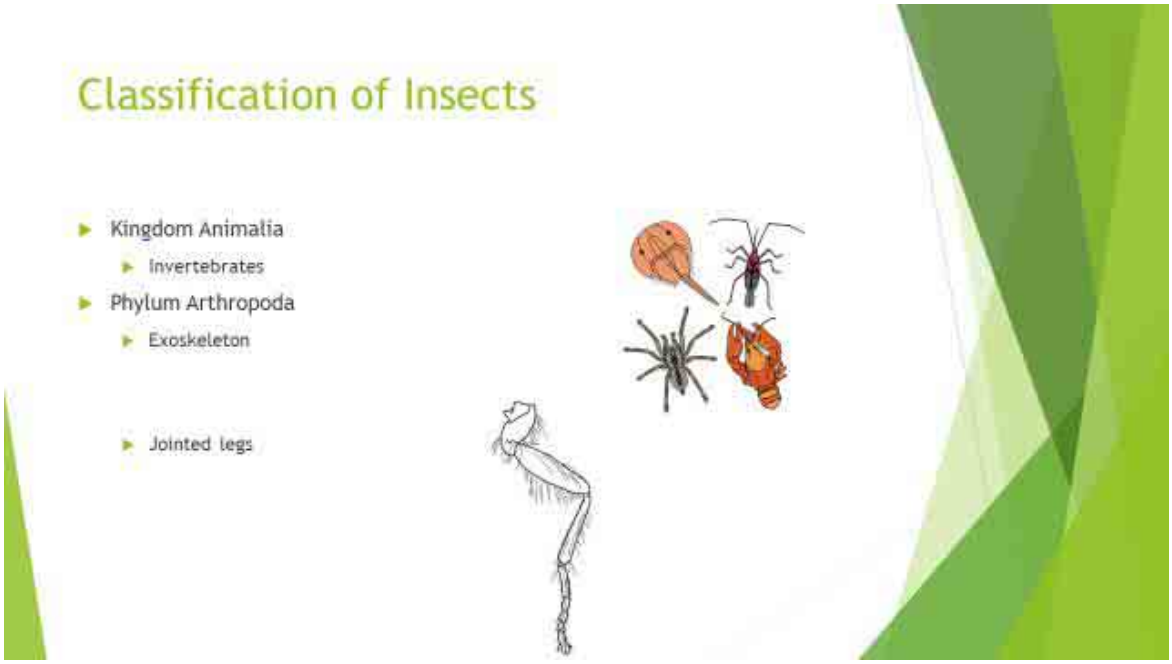
Test result : Pre & Post training evaluation

S.No.	Name of participants	Pre evaluation	Post evaluation	Difference (+)
1	Shri Debasis Roy	50	85	35
2	Shri S. C. Sharma	50	88	38
3	Shri Padam Singh	65	95	30
4	Shri Mahesh Chandra	40	68	28
5	Shri G. L. Meena	35	73	38
6	Shri Sunil Chandra	28	90	62
7	Shri J. P. Godara	63	90	27
8	Shri Ram Gopal Meena	58	95	37
9	Shri T. D. Ramawat	25	75	50
10	Shri Shrawan Singh	33	45	12
11	Shri Adarsh Sharma	40	93	53
12	Shri Rajendra Prasad	58	63	05
13	Shri Chain Singh	43	65	22
14	Shri Vijay Singh Bhati	30	90	60
15	Shri Awadhesh Kumar	30	95	65
16	Shri Bhagirath Singh	45	83	38
17	Shri Mala Ram	33	35	02
18	Shri Prema Ram Dhaka	50	55	05
19	Shri Raj Kumar	58	75	17
20	Shri Arun Panwar	35	83	48
21	Shri Rajeev Pal	38	88	50
22	Shri Bhanwar Singh	40	75	35
23	Shri S.P.Gupta	33	73	40
24	Shri Dulichand	38	63	25
25	Mohd. Hussain	35	88	53
26	Mohd. Iqbal	43	80	37
27	Mohd. Ali Yabgo	28	80	52
28	Dr. Lal Chand	00	85	85
29	Shri Chug Singh	60	88	28
30	Shri Sukhdev	28	80	52

Annexure-V

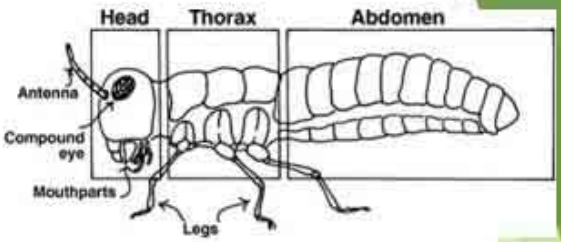
Power Point Presentation



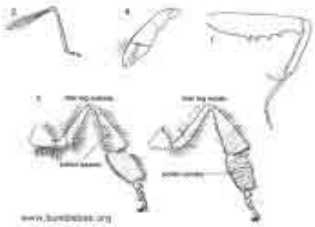


Class Insecta Characterisitics

- 3 body parts



- Six legs



Class Insecta Characteristics

- Two pairs of wings

- Two kinds of eyes
  - compound

Class Insecta Characteristics

- Two Antennae

Class Insecta Characteristics

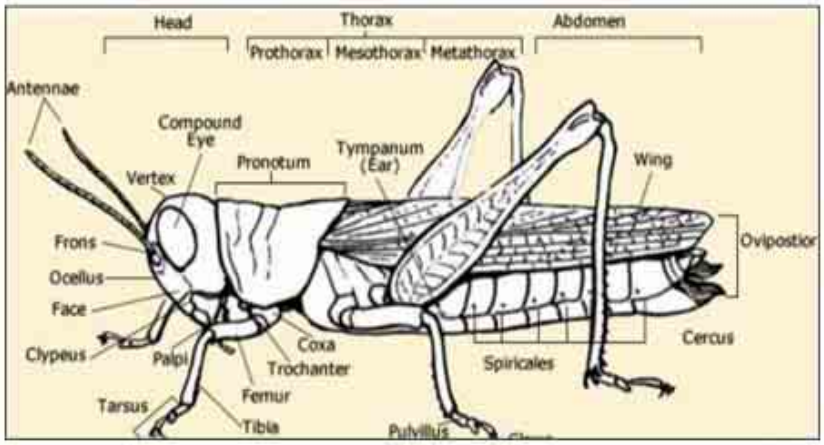
- All insects begin their life cycle as an egg.

Insect Orders

Classification of Desert Locust

CLASS	INSECTA	
ORDER	ORTHOPTERA	Grasshoppers (about 20 000 species worldwide)
SUBORDER	CAELIFERA	Short-horned grasshoppers (about 10 000 species worldwide)
SUPERFAMILY	ACRIDOIDEA	
FAMILY	ACRIDIDAE	Grasshoppers and locusts
SUBFAMILY	CYRTACANTHACRIDINAE	
GENUS	*Schistocerca*	
SPECIES	*gregaria*	


ORTHOPTERA


Head
Thorax
Abdomen
Prothorax
Mesothorax
Metathorax
Antennae
Compound Eye
Vertex
Pronotum
Tympanum (Ear)
Wing
Frons
Ocellus
Face
Ovipostior
Clypeus
Palpi
Coxa
Trochanter
Femur
Tibia
Tarsus
Pulvillus
Spiricales
Cercus

Orthoptera (Grasshopper, Cricket and katydids)

- Antenna shorter or longer than body
- Prothorax large, hind legs modified for jumping
- FW tegmina, HW membranous
- Cerci one to many segmented
- Ovipositor short or as long as body
- Gradual metamorphosis

Sub order : Ensifera	Sub order : Ceilifera
1. Antenna as long as or longer than body (> 30 segments)	1. Antenna shorter than body (< 30 segments)
2. Tympanum on *fore tibia*	2. Tympanum on *1st abdominal segment.*
3. Ovipositor long and sickle or tubular shaped	3. Ovipositor *short and blunt*
4. Sound production by *alary mechanism*	4. Sound production by *femoro - alary mechanism*
Eg. Long horned grasshopper, cricket	Eg. Short hornedgrasshopper

Desert locust, *Schistocerca gregarea*

What is Desert locust ?

The Desert Locust is one of about a dozen species of short-horned grasshoppers (Acridoidea) that are known to change their behavior and form swarms of adults or bands of hoppers (wingless nymphs). The swarms that form can be dense and highly mobile. The Latin name for Desert Locust *is Schistocerca gregaria* (Forskal).

Different Types of Locusts

Although the Desert Locust is considered to be the most important species of locust due to its ability to migrate over large distances and rapidly increase its numbers, there are several other important species of locusts throughout the world:

S. No.	English Name	Scientific Name
1.	The Desert Locust	*Schistocerca gregaria*
2.	The Bombay Locust	*Nomadacris succincta*
3.	The Migratory Locust	*Locusta migratoria manilensis*; *Locusta migratoria migratoria-oides*
4.	The Italian Locust	*Calliptamus italicus*
5.	The Moroccan Locust	*Dociostaurus moroccanus*
6.	The Red Locust	*Nomadacris septemfasciata*
7.	The Brown Locust	*Locustana pardalina*
8.	The South American Locust	*Schistocerca paranensis*
9.	The Australian Locust	*Chortoicetes terminifera*
10.	The Tree Locust	*Anacridium* Spp.

LOCUSTS REPORTED IN INDIA

Desert locust (*Schistocerca gregaria*)		
Migratory locust (*Locusta migratoria*)		
Bombay Locust (*Nomadacris succincta*)		
Tree locust (*Anacridium* spp.)		

Difference between Grasshopper and Locusts

1. The locust is a type of a grasshopper which is short horned. The grasshopper is not a type of a locust.

2. Both belong to the order Orthoptera.

3. The grasshopper belongs to the suborder known as Caelifera while the locust belongs to the suborder Acrididae.

4. The grasshopper has 28 distinct families while the locust has only 1 family.

5. Both are short horned and have short ovipositors, two, short antennae, long back legs used for leaping, and mandibles which are strong.

6. Both adults of the locusts and grasshoppers have two wings in the front and two membranous wings in the back which are all fully developed.

Difference between Grasshopper and Locusts

7. Both are regarded as delicacies in certain parts of the world.

8. Locusts can exist in two different behavioral states which are migratory and gregarious while grasshoppers do not.

9. Locusts may change their body shape and color, fertility, and survival behavior while grasshoppers generally do not.

10. Locusts can form dense swarms and bands while grasshoppers generally do not.

11.Locusts can migrate over large distances while grasshoppers cannot.

Terminologies

Solitarious: Phase when individuals live mostly separate from each other.

Gregarious: Phase when large numbers of individuals gather together.

Transiens: Intermediate phase when locusts are grouping and starting to act as a single mass and are either changing from solitarious to gregarious (gregarization) or from gregarious to solitarious (dissociation).

Congregans: Part of the transiens phase during which locusts are congregating and are in transition from the solitarious to the gregarious phase. Often used for nymphs.

Dissocians: Part of the transiens phase during which locusts are in transition from the gregarious to the solitarious phase. Often used for nymphs.

Solitaricolour: Showing types of colour associated with solitarious behaviour.

Gregaricolour: Showing types of colour associated with gregarious behaviour

What is the difference between hopper groups and bands?

One should carefully observe their behaviour and appearance. Groups will contain some hoppers that are starting to behave in the same manner but not all individuals will be doing this. Their colours are a mixture of those commonly associated with solitarious and gregarious individuals, that is, green with some black markings. On the other hand, bands consist of all or close to all of the locusts behaving in the same manner. Their appearance is distinctive hoppers in bands are either black (when young) or yellow with black markings

Do Desert Locust plagues occur with any regularity?

The attack of the desert locust used to occur earlier in a phases of plague cycles. India witnessed several locust plagues, upsurges and incursions in the past. About 12 locust plagues were observed in India till 1962.Since than no locust plagues occurred. Similarly, 13 locust upsurges were recorded since 1964 till 1997. Small scale localized locust breeding have also been reported and controlled during the period 1998, 2002, 2005 , 2007 and 2010. Since 2010 till now, situation remained calm and no large scale breeding and swarms have been reported. However, solitary phase of Desert locust has been reported from time to time at some locations in the State of Rajasthan and Gujarat

Migration and Seasonal Distribution of Desert Locust

WELCOME

Dr. R. P. Sharma
Assistant Director (E)
Directorate of Plant Protection, Quarantine & Storage
Faridabad (Haryana)

Dispersal

A. Dispersal through walking

- Immature stages of insects disperse through locomotion
  - Armyworm

B. Dispersal through flying

1.Trivial flight

- Displacement of insects with in breeding or feeding sites
- Usually movement over short distances
- Typically does not involve displacement of entire populations
  - Butterfly feeding, lightning, bug mating

2

2. Migration

- ✓ It involves displacement of **entire populations** - from breeding, feeding and over-wintering sites - flight
- ✓ **Hundreds of kilometers**
- ✓ Individuals predisposed to flight or transport

  Eg: Non-appetetial behaviours- un distracted by mates, food or oviposition sites
- ✓ Regular feature of seasonal cycle for some insects
- ✓ Can result in substantial mortality, only a minute fraction may locate suitable habitat

3

Migration

Mass movement of entire population where some insects return again to the area from which they had moved.

(Dhaliwal, 2003)

4

What is migration?

1. Persistent prolonged movement
2. Straightened course of movement
3. Undistracted by usual stimuli (e.g. food, mates)
4. Distinct departure and arrival behavior
5. Reallocation of energy in advance of migration

5

Migration within boundary layer

- ✓ That altitude at which wind speed equal to insect flight speed below the boundary layer insects can have direct flight
- ✓ Usually only a few meters high, flight of insect directly observable
- ✓ Insects control their own flight path, seem to maintain the study course

Eg: migrating butterflies (monarch butterfly), dragonflies

6

Migration above the boundary layer

A. Usually combines flight with wind aided transport
- ❖ Insect may not be in control of flight
- ❖ Transported by wind

  Eg: Aphids

B. Aspects of migration above the boundary layer (Muscular system)

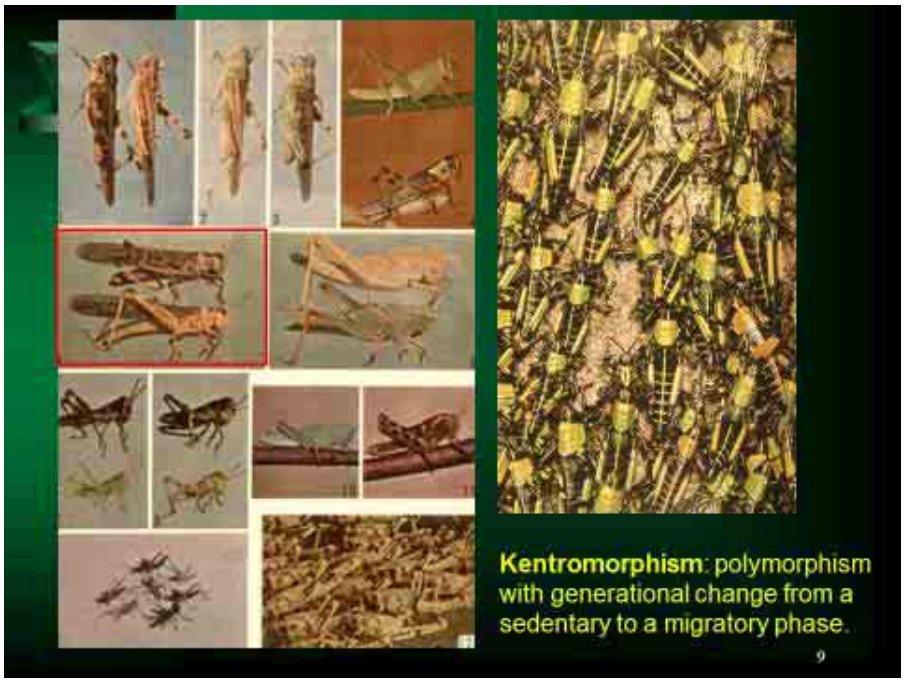
  Eg: Desert locust: *Schistocerca gregaria*

7

Migratory Locust, *Schistocerca gregaria* (ORTHOPTERA)

- Gigantic ***swarms***
- Long-distance migration
- Environmentally modulated
- Food- & interaction-stimulated
- Generational ***phase change***
- ***Reproductive diapause***

8


Kentromorphism: polymorphism with generational change from a sedentary to a migratory phase.
9


Some migratory locust swarms may contain hundreds of billions of insects, weighing thousands of tons.
10

How far and how fast can Desert locust Migrate ?

Desert Locusts usually fly with the wind at a speed of about 16-19 km/h depending on the wind. Swarms can travel about 5-130 km or more in a day. Locusts can stay in the air for long periods of time. For example, locusts regularly cross the Red Sea, a distance of 300 km. In the past there have been some spectacular and very long distance swarm migrations, for example from North-West Africa to the British Isles in 1954 and from West Africa to the Caribbean, a distance of 5,000 km in about ten days in 1988. Solitary Desert Locust adults usually fly at night whereas gregarious adults (swarms) fly during the day.

Basic biology of locust migration

Breeding grounds are associated with "convergence zones" that generate predictable cyclical air movement

1) Sedentary phase for several generations.
2) Last generation crowded, female responds to abdominal contact by stress reaction on **CA**, reducing **JH** production.
3) Eggs develop into strong-flying migratory generation.
4) Mature migrants, mutually stimulated, lift off *en masse* with wind.
5) Fly for several hours, maintain swarm by visual contact edge control.
6) Drop to feed, keep flying.
7) Finally drop for final feed, production of sedentary generation.
8) Cycle continues with return migration.

12

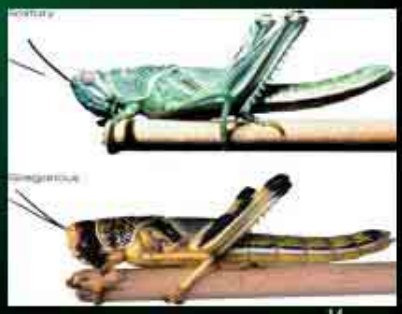
Locust

Dociostaurus marocconus	Mediterranean countries
Locusta migratoria	Europe, Africa
Schistocerca gregaria	Northern Africa and western India
Locustana paradalina and *Nomadacris septemfasciata*	southern half of Africa
Melanoplus mexicanus	mid Western United States

13

- **Uvarov's phase theory, 1921 Species of migratory locust there is associated a more solitory, more sedentary grasshopper, differing often in colour, structure, physiology, and behaviour but actually a form or phase of the same species**

  - **Solitary phase**
  - **Gregarious phase**



14

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- Great height many swarms fly, the wind speed is greater than the maximum speed of the insects
- Wind is determining factor in the distribution and not any power of orientation in the locusts

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Migration of adults depends on meteorological conditions

- The migration of solitary adults occurs at night, usually 20 minutes after sunset when the air temperature is above 20-22 °C and the wind is less than 7 m/s.
- It is reported that 100% of the adults take off at > 27°C and the direction of the flight is downwind.

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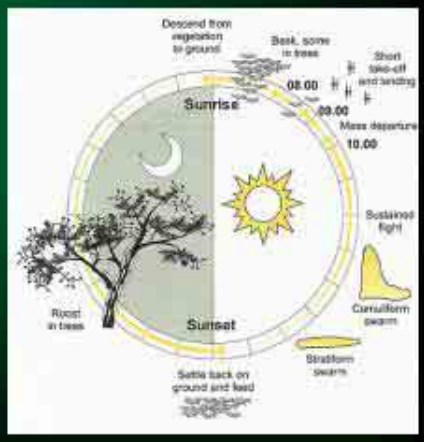
Structure of the swarms depends on meteorological conditions

Cool, overcast weather favours stratiform swarms while convective updrafts on hot afternoons promote cumuliform swarms.



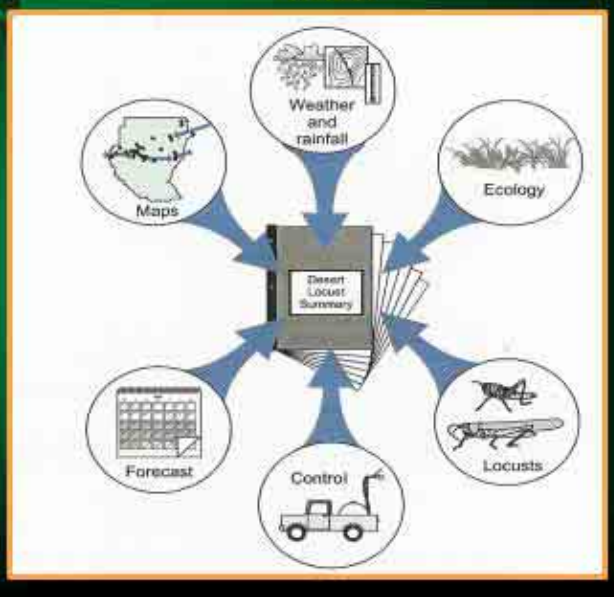
17

Swarms of locust

- Stratiform swarm : flat
- flying within few meters of the ground level
- Locusts are highly concentrated with densities 1-10/m^3
- Formed in absence of temperature gradient
- Cumuliform swarm : towering
  - ✓ towering 1000m above the ground
  - ✓ locusts are widely dispersed with densities 0.001-0.1/m^3
- Formed in presence of temperature gradient

18

Meteorological information is crucial for locust monitoring and control



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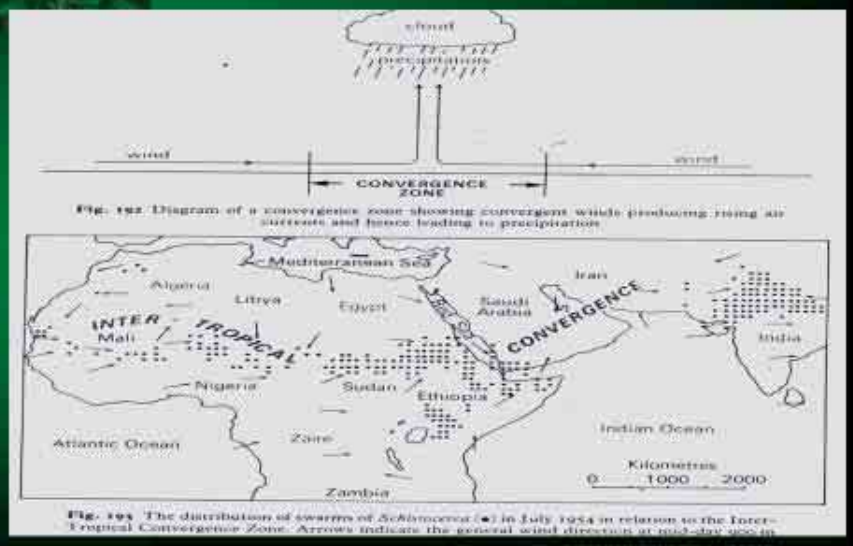
Distribution of *Schistocerca* in relation to ITCZ



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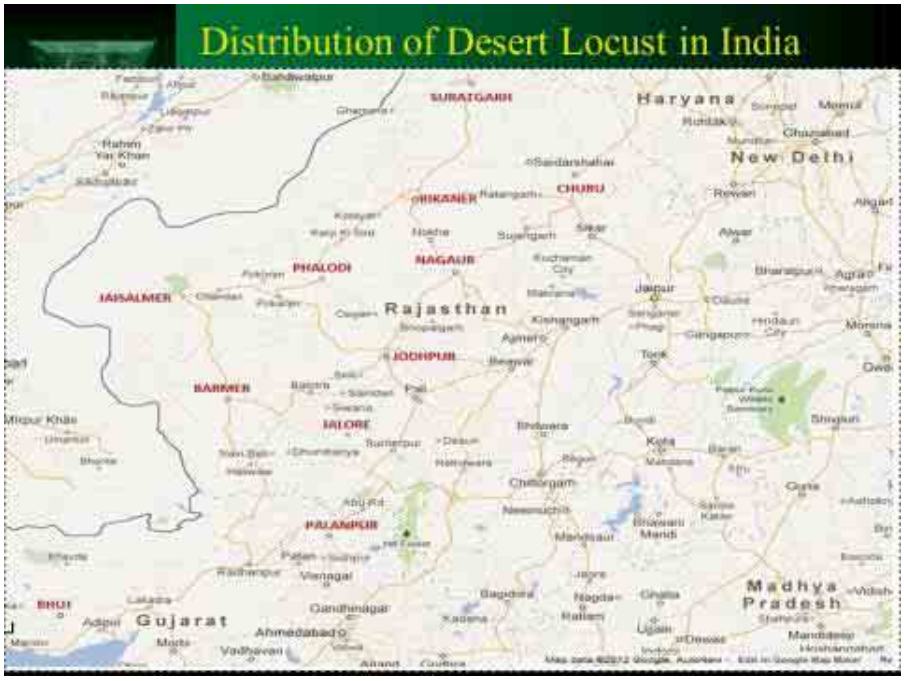

Distribution of Desert Locust in India
SURATGARH
Haryana
New Delhi
BIKANER
CHURU
NAGAUR
PHALODI
JAISALMER
Rajasthan
JODHPUR
BARMER
JALORE
PALANPUR
BHUJ
Gujarat
Madhya Pradesh

DESERT LOCUST LIFE CYCLE

PRESENTED BY:

BALDEV SINGH

ASSISTANT PLANT PROTECTION OFFICER, (E)

(LOCUST MASTER TRAINER BY FAO)

FSIL, BIKANER

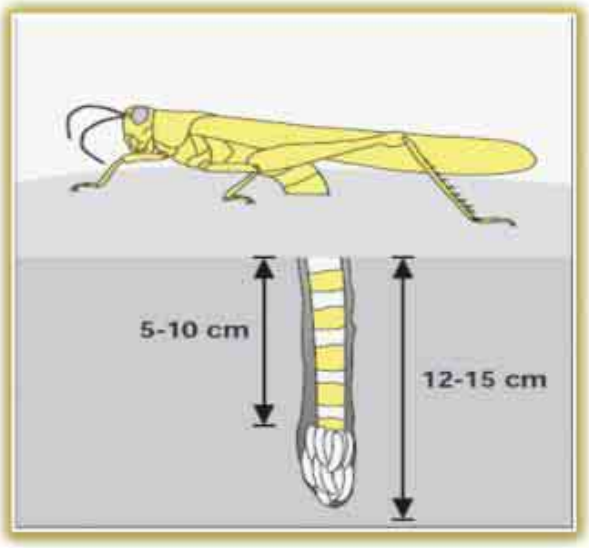
DESERT LOCUST (*Schistocerca gregaria*-F) HAS A SIMPLE LIFE CYCLE.

- EGGS
- NYMPH (HOPPERS)
- ADULTS

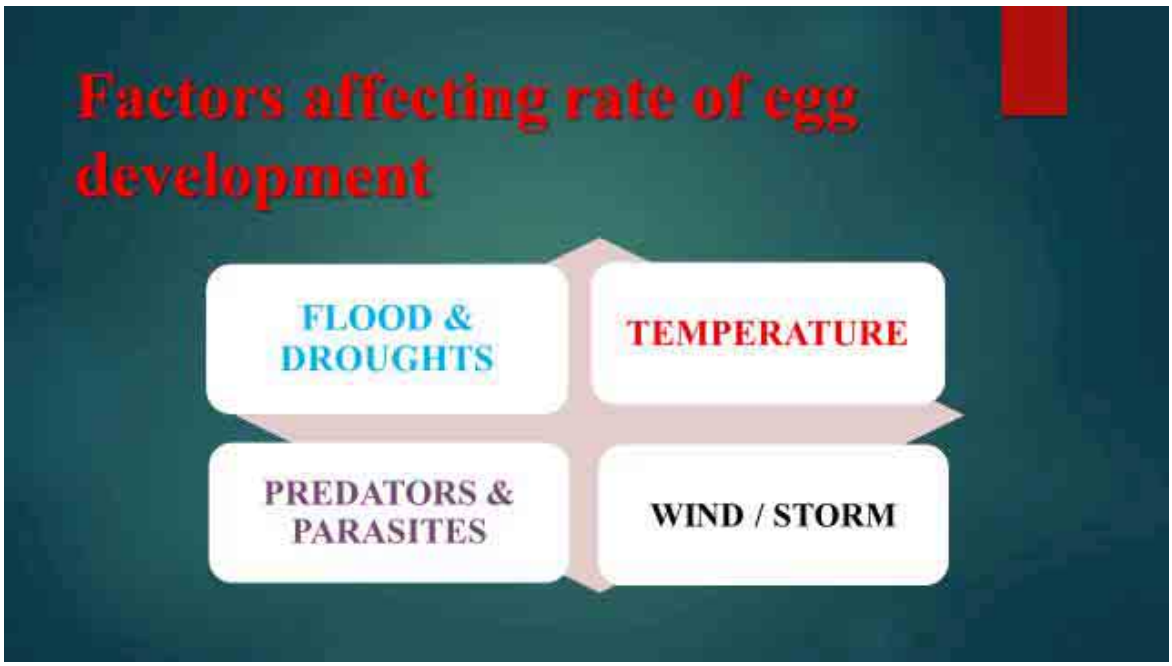
LIFE CYCLE

EGGS

- After mating and laying, egg hatching depends on temperature and soil moisture.
- 10-12 days at soil temperature 32-35^0 Celsius.
- Eggs do not hatch at more than 35^0 Celsius and less than 15^0 Celsius.
- Egg hatching duration would be 10-65 days depending on soil temperature and humidity.



DEPTH OF EGG LAYING



HOPPERS

- Hoppers moult five (gregarious) to six time (solitarious) depends on locust phase:
- Gregarious hoppers are generally yellow with black spotting, solitary hoppers are green in the first 3 instars and might continue green or changed to brown in older instars.
- Low temperature prolong the hopper stage, about 70 days at 22^0 Celsius and 22 days at 37^0 Celsius
- The final moult from fifth or sixth instar hopper to winged adult called fledgling,

- The fledgling adult is initially sexually immature.
- Maturation in favourable conditions could take 3 weeks but could take more than 8 weeks in unfavourable conditions, in cold dry conditions could reach 6-8 months for maturation.
- Immature gregarious swarms migrate thousands of kms to locate favourable conditions otherwise will never mature sexually.

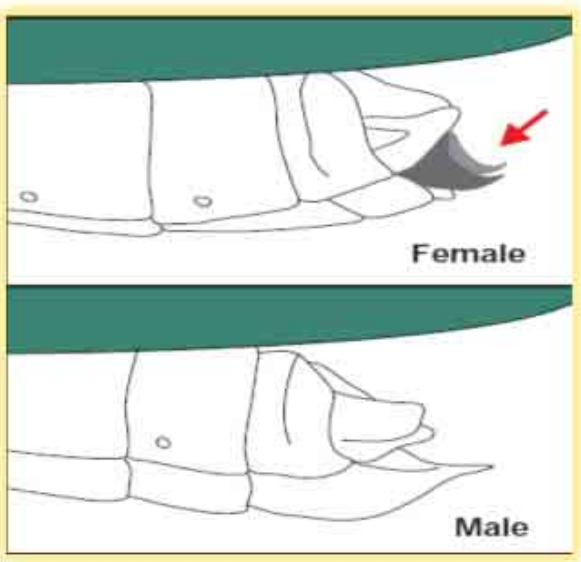
ADULTS

- Gregarious immature adults pink in color, gregarious mature adults yellow in color.
- Gregarious female lays 2-3 egg pods of 60-80 eggs in each at a depth of 5 - 15 cm in soft sandy moist soil.
- Solitary adults are grey/brown in color.
- Solitarious female lays 3-4 egg pods, of 90-160 in each, at a depth of 5 - 15 cm in soft sandy moist soil.
- Female egg laying duration is 7-10 days, Locust could have three generations in the year.

- Adult duration is 3-5 months.
- Adults remain immature until they encounter condition that stimulate maturation.
- The period for maturation is highly variable, depending on habitate conditions, 3 weeks in favourable conditions and might reach 8 weeks in unfavourable conditions.
- Maturation may involve migration to another more favourable conditions, adults are likely to remain immature for a longer period in cold or dry conditions.
- Male usually becomes sexually mature before female.

COPULATION

- This is the mating act . The male jumps on the back of the female and holds on to her with the front pair of legs The tip of their abdomen come into contact and the male sex cells (spermatozoa) are passed into the body of the female where they fertilize the eggs.
- The time spent in copulation varies from 3-14 hours.



MALE OR FEMALE

LIFE CYCLE PARAMETERS

STAGES	Egg, Hopper, Adult	
DURATION	Egg	10 – 65 days
	Hopper	24 – 95 days (36 days average)
	Adult	2.5 – 5 months
	Laying – Fledging	40 – 50 days
	Adult Maturation	3 weeks – 9 months (2 – 4 months average)
	Total	2 – 6 months
LARVAL MOULTS	5-6 (Solitarious), 5 (Gregarious)	

LOCUST PHASES

PRESENTED BY:
BALDEV SINGH
ASSISTANT PLANT PROTECTION OFFICER, (E)
(LOCUST MASTER TRAINER BY FAO)
FSIL, BIKANER

Locusts have two different states called phases :-

1. **Solitarious** : When locusts are present at low densities, individuals are **Solitarious**.
2. **Gregarious** : As locust numbers increase, they cluster into dense groups and they become **Gregarious**.

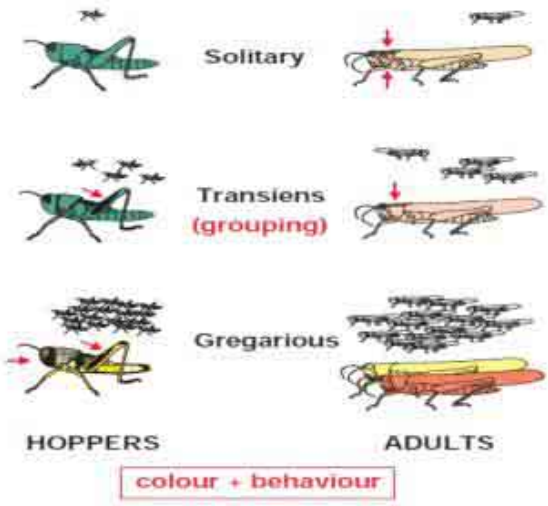
TRANSIENT PHASE

The transition from 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**.

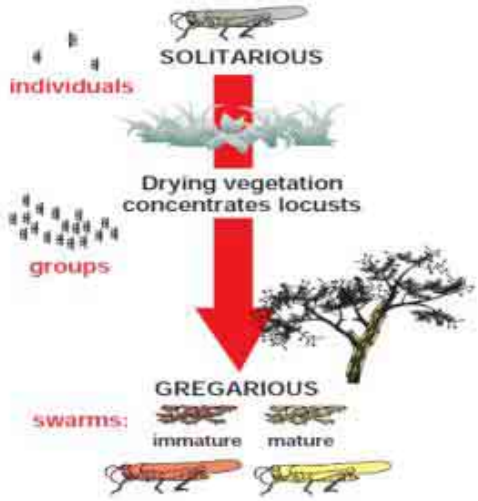
PHASE TERMINOLOGY

SOLITARIOUS	Phase when individuals live mostly separate from each other.
GREGARIOUS	Phase when large numbers of individuals gather together.
TRANSIENS	Intermediate phase when locusts are grouping and starting to act as a single mass and are either changing from solitarious to gregarious (gregarization) or from gregarious to solitarious (dissociation).
CONGREGANS	Part of the transiens phase during which locusts are congregating and are in transition from the solitarious to the gregarious phase. Often used for nymphs.
DISSOCIANS	Part of the transiens phase during which locusts are in transition from the gregarious to the solitarious phase. Often used for nymphs.
SOLITARICOLOUR	Showing types of colour associated with solitarious behaviour.
GREGARICOLOUR	Showing types of colour associated with gregarious behaviour.

LOCUST APPEARANCE



ADULT PHASE



COLOUR

An adult in the solitary phase is likely to be pale grey or beige when immature, with the males becoming pale yellow on maturation. In contrast, an adult from the swarming (gregarious) phase will be bright pink when immature and bright yellow when mature.

BEHAVIOUR

- Solitary locusts live separately, the hoppers do not move together and the adults usually fly individually at night.
- Gregarious hoppers move in marching bands and have distinctive black markings. The brightly coloured adults move together in cohesive day – flying swarms.
- In between the two extremes are locusts exhibiting some characteristics of solitary locusts and some gregarious ones; such locusts are referred to as Transient locusts.

KEY POINTS

- **Morphometric studies (Change in colour and shape) do not always give a completely reliable indication of the behavioural phase.**
- **Changes in behaviour and appearance do not always occur at the same rate.**
- **The environmental conditions during the development of the hopper can affect the morphometrics of the adults.**
- **Behaviour is the best and most useful phase characteristic to use in locust control work.**

Approximate densities at which phase transformation may occur

STAGE	Locusts / m^2	Locusts / ha
Early Instar Hoppers	5	50 000
Late Instar Hoppers	0.5	5 000
Adults	0.025 – 0.05	250 - 500

Migration and Seasonal Distribution of Desert Locust

WELCOME

Dr. R. P. Sharma
Assistant Director (E)
Directorate of Plant Protection, Quarantine & Storage
Faridabad (Haryana)

Dispersal

A. Dispersal through walking

- Immature stages of insects disperse through locomotion
  - Armyworm

B. Dispersal through flying

1.Trivial flight

- Displacement of insects with in breeding or feeding sites
- Usually movement over short distances
- Typically does not involve displacement of entire populations
  - Butterfly feeding, lightning, bug mating

2

2. Migration

- ✓ It involves displacement of **entire populations** - from breeding, feeding and over-wintering sites - flight
- ✓ Hundreds of kilometers
- ✓ Individuals predisposed to flight or transport

  Eg: Non-appetetial behaviours- un distracted by mates, food or oviposition sites
- ✓ Regular feature of seasonal cycle for some insects
- ✓ Can result in substantial mortality, only a minute fraction may locate suitable habitat

3

Migration

Mass movement of entire population where some insects return again to the area from which they had moved.

(Dhaliwal, 2003)

4

What is migration?

1. Persistent prolonged movement
2. Straightened course of movement
3. Undistracted by usual stimuli (e.g. food, mates)
4. Distinct departure and arrival behavior
5. Reallocation of energy in advance of migration

5

Migration within boundary layer

- ✓ That altitude at which wind speed equal to insect flight speed below the boundary layer insects can have direct flight
- ✓ Usually only a few meters high, flight of insect directly observable
- ✓ Insects control their own flight path, seem to maintain the study course

Eg: migrating butterflies (monarch butterfly), dragonflies

6

Migration above the boundary layer

A. Usually combines flight with wind aided transport

- ❖ Insect may not be in control of flight
- ❖ Transported by wind

  Eg: Aphids

B. Aspects of migration above the boundary layer (Muscular system)

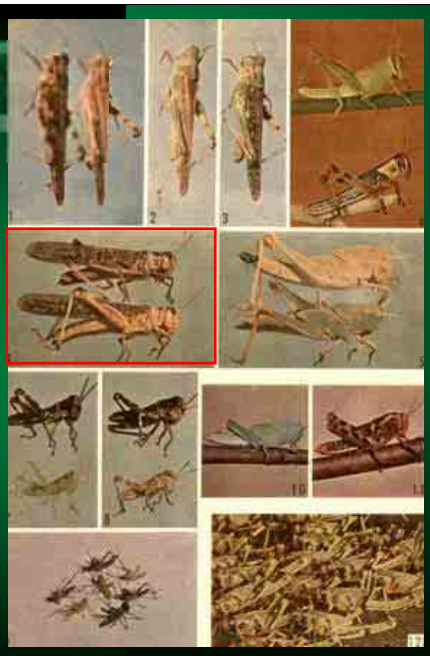
Eg: Desert locust: *Schistocerca gregaria*

7

Migratory Locust, *Schistocerca gregaria* (ORTHOPTERA)

- Gigantic ***swarms***
- Long-distance migration
- Environmentally modulated
- Food- & interaction-stimulated
- Generational ***phase change***
- ***Reproductive diapause***

8



Kentromorphism: polymorphism with generational change from a sedentary to a migratory phase.

9

Some migratory locust swarms may contain hundreds of billions of insects, weighing thousands of tons.

10

How far and how fast can Desert locust Migrate ?

Desert Locusts usually fly with the wind at a speed of about 16-19 km/h depending on the wind. Swarms can travel about 5-130 km or more in a day. Locusts can stay in the air for long periods of time. For example, locusts regularly cross the Red Sea, a distance of 300 km. In the past there have been some spectacular and very long distance swarm migrations, for example from North-West Africa to the British Isles in 1954 and from West Africa to the Caribbean, a distance of 5,000 km in about ten days in 1988. Solitary Desert Locust adults usually fly at night whereas gregarious adults (swarms) fly during the day.

Basic biology of locust migration

Breeding grounds are associated with "convergence zones" that generate predictable cyclical air movement

1) Sedentary phase for several generations.
2) Last generation crowded, female responds to abdominal contact by stress reaction on **CA**, reducing **JH** production.
3) Eggs develop into strong-flying migratory generation.
4) Mature migrants, mutually stimulated, lift off *en masse* with wind.
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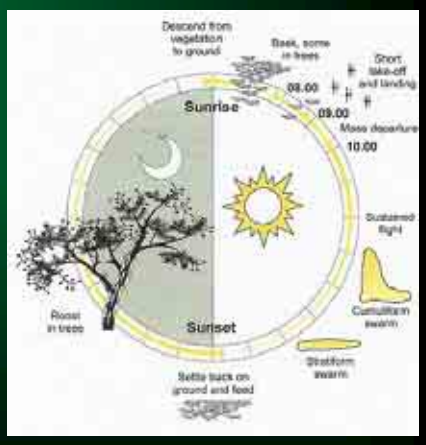
Structure of the swarms depends on meteorological conditions

Cool, overcast weather favours stratiform swarms while convective updrafts on hot afternoons promote cumuliform swarms.



17

Swarms of locust

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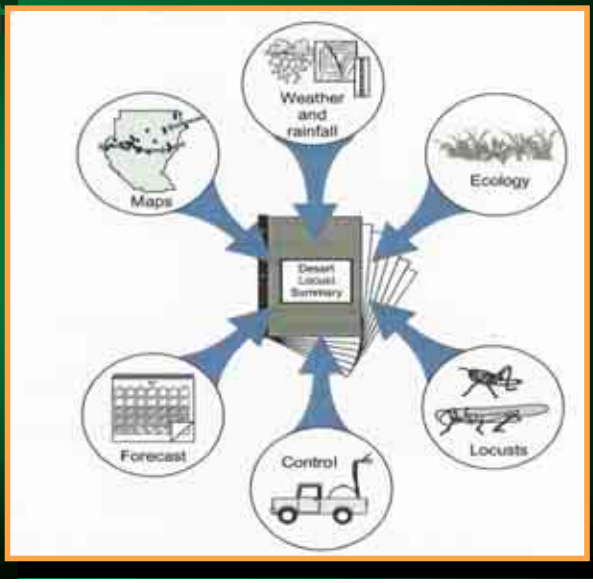
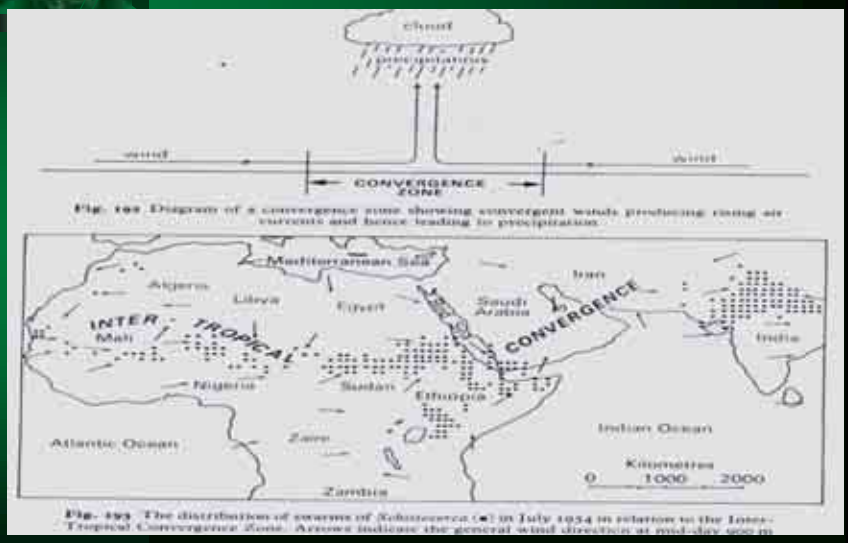


19

Distribution of *Schistocerca* in relation to ITCZ



20

Distribution of Desert Locust in India

DESERT LOCUST SURVEY INTRODUCTION AND SURVEY PROCESS

PRESENTED BY

DHANNE SINGH POONIA
PLANT PROTECTION OFFICER (E)
LOCUST CIRCLE OFFICE, BIKANER

SURVEY PROCESS

- A logical approach is required in monitoring Desert Locusts and their habitat in order to collect the maximum amount of information in the shortest possible time, using the minimum resources.
- Surveys should be planned according to the locust situation, ecological conditions in the field and the risk that populations may develop further and require additional monitoring and perhaps control

STEPS OF SURVEY PROCESS

- Who will make the survey
- Determine where and when to make survey
- Decide which type of survey
- Decide whether the survey is to be done by ground or Aerial
- Prepare the vehicle and necessary equipment.
- Make the rapid assessment survey unless you know that locust are present
- Collect the information and record on the survey form or elocust3
- Transmit the survey report as soon as possible
- If significant population is found in assessment survey , then make a search survey to identify the infested area and the control requirement
- Based on the survey results , we can plan for the timing and location of next survey.

PURPOSE OF SURVEY

- To collect information to assess the locust situation and habitat conditions.
- To collect information for planning
- To identify the control targets *i.e.* the area where control operation is to be undertaken.

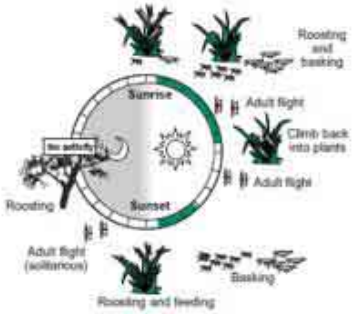
WHERE AND WHEN TO MAKE SURVEY

Locust survey should be undertaken in the area :

- Where locusts are most likely to be present i.e. in historical habitats (Traditional area).
- In the area where rainfall has occurred and green vegetation is present.
- In the area as per remote sensing imagery
- Remote area:- There is no information from a certain area about rainfall, vegetation conditions or locusts .
- Survey should be undertaken during rainy season.

- The Survey timing will depend on the temperature and weather.
- When temperature is more than 38° C, survey should not be conducted as locust will take shelter in the vegetation.
- It is best to undertake survey from shortly after sunrise to about midday and again in the afternoon a few hours just before sunset.

Where and when to survey during the year



When to survey during the day
(after sunrise to about midday + late afternoon)

TYPES OF SURVEY

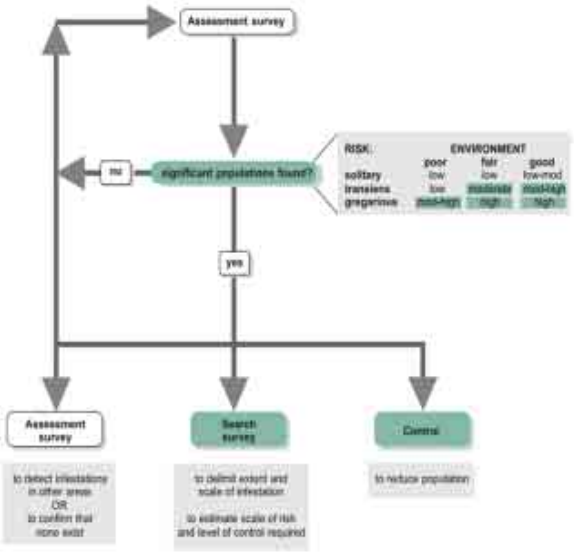
ASSESSMENT SURVEY:

An assessment survey is the first type of survey. Assessment surveys are conducted to monitor the locust population and assess the suitability of the habitat for locust breeding.

SEARCH SURVEY:

Search surveys are conducted in the areas where significant population is present or reported in assessment survey. Search surveys are conducted to estimate the infested areas and to identify the areas that require control operation.

Summary of the Survey Process



Low

Moderate

Moderate-high and

High

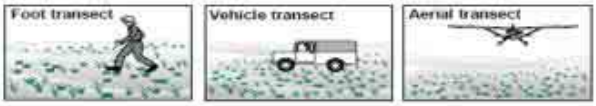
Insignificant populations; unlikely to require any further assessment

Significant populations; requires additional assessment

Significant populations; requires substantial assessment and search

METODS OF SURVEY

There are three survey methods: foot transects, vehicle transects and aerial transects.



Work rate of different survey methods

	Foot	Vehicle	Aerial [1]
Distance travelled/hour	4 km	30 km	200 km
Distance travelled/day	20 km	200 km	600 km
Width of search:			
low density populations	10 m	10 m	n.a.
hopper bands [2]	0.1-2 km	0.1-2 km	0-5 km
settled swarms [2]	0.1-2 km	0.1-2 km	0-10 km
flying swarms (range)	20 km (5-50 km)	20 km (5-50 km)	30 km (5-100 km)
Area of search:			
low density populations	0.2 km²	2 km²	n.a.
hopper bands [2]	2-40 km²	20-400 km²	0-3 000 km²
settled swarms [2]	2-40 km²	20-400 km²	0-6 000 km²
flying swarms (range)	400 km² (100-1 000 km²)	400 km² (1 000-10 000 km²)	18 000 km² (3 000-50 000 km²)

[1] fixed-wing aircraft

[2] including information from local inhabitants during foot and vehicle surveys

Foot transects

Walking a certain distance in the desert and making observations in order to collect data about locusts, rainfall, vegetation and soil.

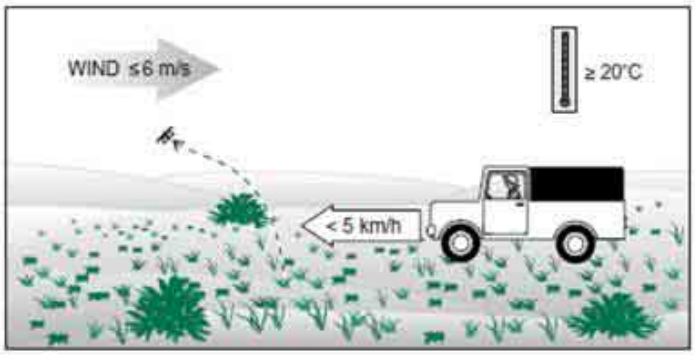
1. Stop in areas where locusts may be present, usually those that are sandy such as plains and dunes and where green annual vegetation is present.
2. After stopping the vehicle, write down the date, the name and the latitude and longitude of the location using a global positioning system (GPS).
3. Walk into the wind (upwind) or crosswind.
4. If more than one person go in a different direction. Start by walking at least 100 m.
5. Observe the greenness and density of the vegetation, check if the soil is moist.
6. Count locusts that fly up in front and to the side.
7. Note locust colour, behaviour and maturity. You may want to try to catch a few.
8. Stop occasionally and closely inspect the ground and the vegetation for hoppers, noting what instar stage, colour, behaviour and number per bush or per square metre.
9. Repeat this up to ten times.
10. The results should be written down on the survey form or entered into a handheld computer before going to the next stop.

How to make a foot transect:

- Walk about 300 m
- count adults that fly up
- estimate transect width (locust disturbance)
- inspect at least 10 bushes or 10 one m2 patches on the ground for hoppers
- check soil moisture
- count when temperature >20°C and wind <6 m/s

Vehicle transects

- Vehicle transects are a useful to determine if adults are present over a large area. By counting the adults, an estimate can be made of how many are present in the transect.
- Estimates of adults can be made from a vehicle by looking out of the front window and counting adults that fly up in front of the vehicle in a strip equal to the width of the vehicle, about 1.5 m in most cases .
- The vehicle must be driven at a walking pace in low gear.
- It should be driven upwind or crosswind to reduce the number of adults that are counted more than once.
- Most of the adults in the strip will fly up if it is sunny and warmer than 20°C and wind speed is less than 6 m/s (20-25 km/h).
- If you drive too fast (more than 5 km/h), the adults will not fly up and you will think that there are no locusts present.
- Vehicle transects should be at least one km in length.
- Results from vehicle transects should be noted in *FAO Desert Locust Survey and Control Form*, simply stating the number of locusts seen in the distance (km) travelled.
- Vehicles can also be used to measure the sizes of settled swarms and large hopper Bands and to delimit target blocks of bands or a scattered swarm for control.



How to make a vehicle survey:

- drive upwind or crosswind for at least 1 km
- drive at a walking pace in low (4WD) gear
- count adults that fly up in front of the vehicle's hood
- keep track of the distance driven using the odometer
- count only when the temperature is above 20°C and wind speed less than 6 m/s

AERIAL SURVEY

- Helicopters can be used to identify areas of green vegetation and locust infestations such as swarms and hopper bands from the air.
- They can be used to flush out moderate to high numbers of individual adults from vegetation.
- Helicopters can also be used to verify unconfirmed reports of infestations and visit areas that are difficult to access by vehicle.
- The main advantage of using a helicopter when compared to fixedwing aircraft is its ability to land almost anywhere and allow the Locust Field Officer to get out and make a foot transect in the area of interest.
- For identifying areas of green vegetation, the helicopter should fly about **300** metres above the ground in a straight line, similar to that for fixed-wing aircraft.
- Settled swarms and large hopper bands should also be visible by looking down at an angle from this height.

- To determine whether an area of green vegetation contains individual locust adults, the pilot should first identify the green area.
- Then drop down to just a few metres above the ground (as low as safely possible and not higher than 5 metres above the ground).
- Reduce the speed to 40-50 km/h and fly over the vegetation and swing the tail from side to side.
- This will disturb any locusts that may be present and they will fly up from about midpoint under the helicopter.
- The observer should look out of the window towards the rear to see if locusts fly up behind the helicopter.
- Upon reaching the end of the green vegetation, the pilot should increase altitude and speed.

DESERT LOCUST SURVEY

PRESENTED BY

DHANNE SINGH POONIA
PLANT PROTECTION OFFICER (E)
LOCUST CIRCLE OFFICE, BIKANER

- " Why make Survey"
- " How to plan a Survey"
- " How to organize a survey''
- " What information to collect"
- " How to report survey Results"

WHY MAKE SURVEYS

To collect information in order to assess the locust situation and habitat conditions in the field.

Based on the results of a survey, the need for further surveys or the initiation of control operations can be determined.

During surveys, control targets may be identified that so that the decisions can be made on the most suitable control method.

- To assess locust Situation and habitat conditions.
- Monitor changes in populations.
- Provide early warning of increase.
- Identify control targets.
- Allow better planning.
- Make accurate forecasts.
- Inform other countries.

HOW TO PLAN A SURVEY

In order to make survey more effective and to use resources as efficiently and economically as possible, survey should be well planned.

- Who to make a survey
- Where to make a survey
- When to make a survey
- Which type of survey (Assessment or Search Survey)
- Decide whether the survey is to be done by ground or Aerial
- What equipment is required for the survey

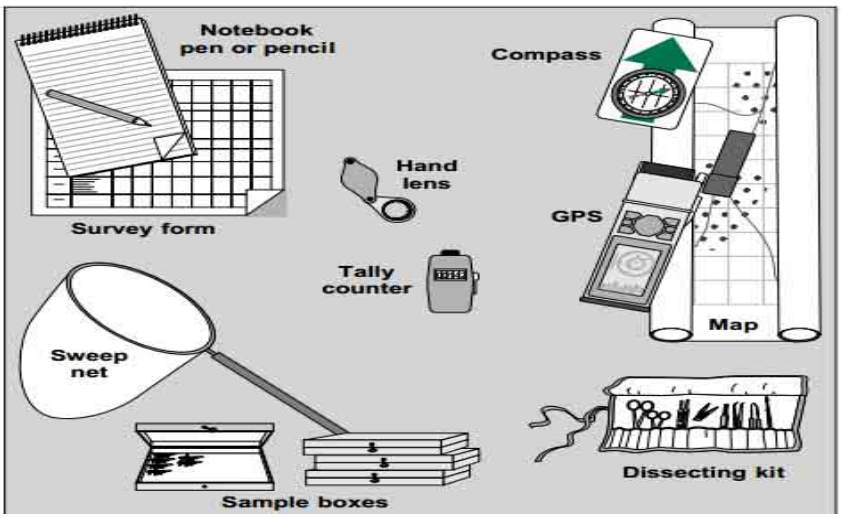
HOW TO ORGANIZE A SURVEY

- One Vehicle
- One Locust Field Officer per Vehicle
- Remote Areas : Two Vehicles
- Establishment of seasonal Base Camp
- Check Green Vegetation areas
- Two Vehicle : Use leapfrog method

EQUIPMENT TO BE TAKEN ON A SURVEY

1. Note Book, Pen or Pencil
2. FAO Desert Locust Survey and Control Form
3. Compass
4. Hand Lens
5. Hand Tally Counter
6. Map
7. eLocust3
8. Global Positioning System (GPS)
9. Sweep Net
10. Sample Box
11. Dissecting Kit

Some essential items that should always be taken when going on a survey.



WHAT INFORMATION TO COLLECT

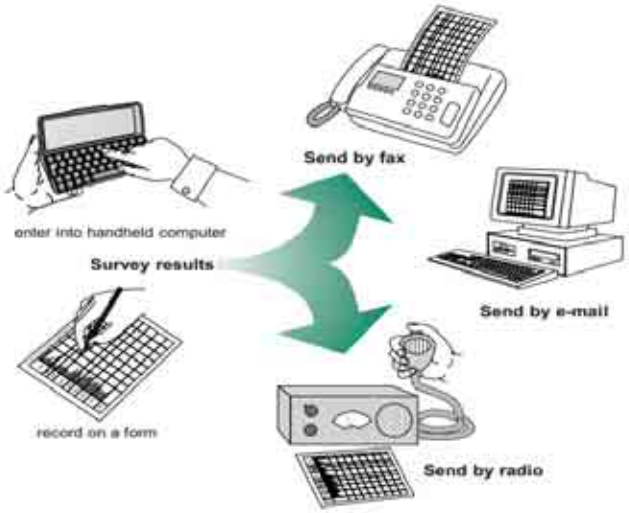
- Date and Location
- Rainfall
- Vegetation
- Soil moisture
- Locust (Presence or Absent)
- Appearance (Solitary or Gregarious)
- Behaviour (Isolated, Scattered or Groups/Swarm)
- Maturity
- Density

An example of a completed *FAO Desert Locust Survey and Control Form* used for recording information.

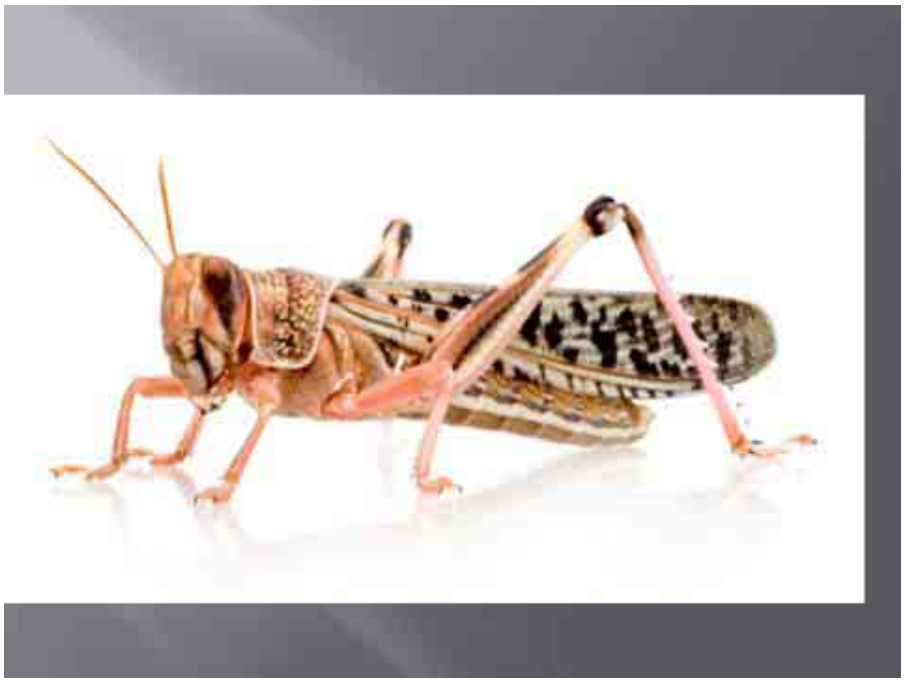
HOW TO REPORT SURVEY RESULTS

- Fill up the Survey Report in eLocust3 in the field (at Survey Stop).
- Transmit it to the National Locust Unit Head Quarter by e Locust 3.
- Keep record of reports for reference .

How to record and send survey and control results to the National Locust Unit headquarters.



An overview on eLocust3 & RAMSES : P.K.Gour, SA



What is RAMSES

- One kind of Software used to analyse locust survey data to be used for forecasting and early warning

RAMSES

- Recognisance and management system on the environment of Schistocerca

In RAMSES we do

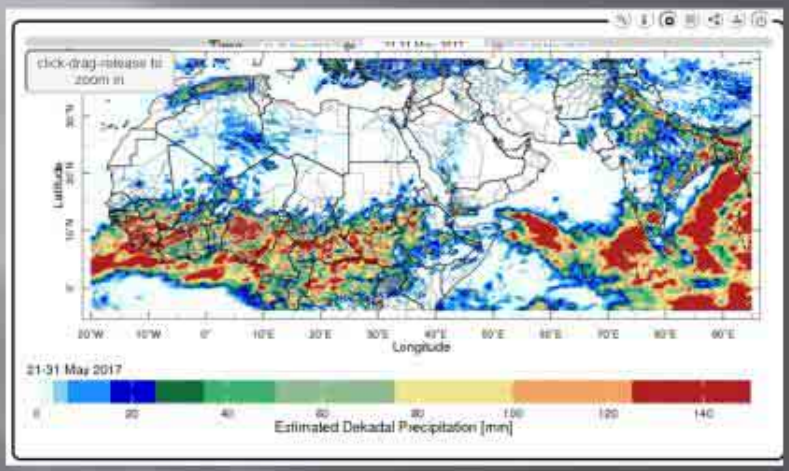
- Data compilation and maps preparations to understand the situation of the area

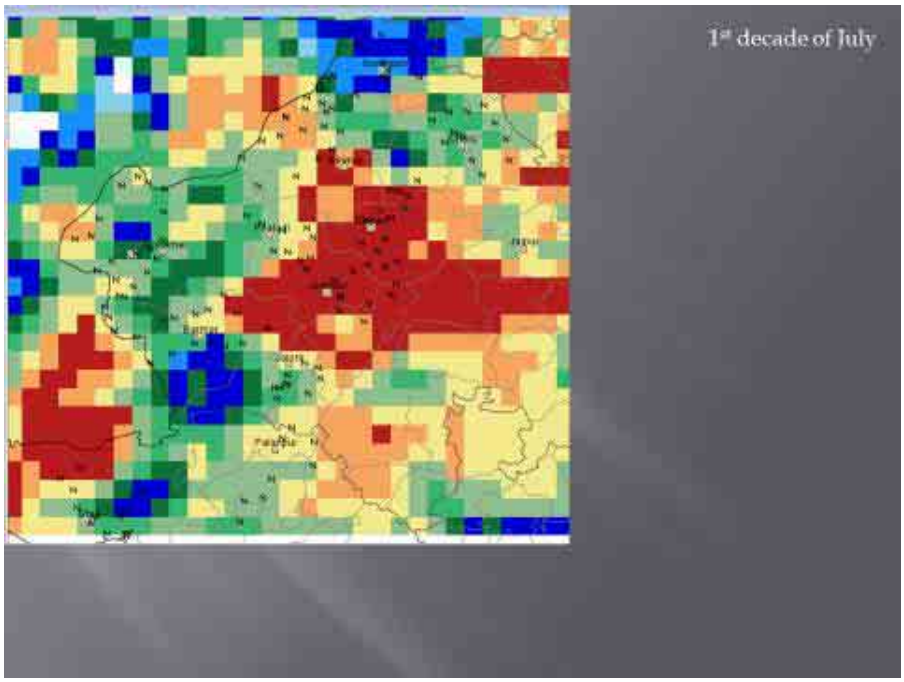
Source of Data:- Surveyors and FAO web sites

MAPS

- Rainfall Estimation shows the rainfall whether it is light, moderate or heavy or Nil/ traced.
- Greenness map shows the greenness of areas along with age of vegetation and its density.

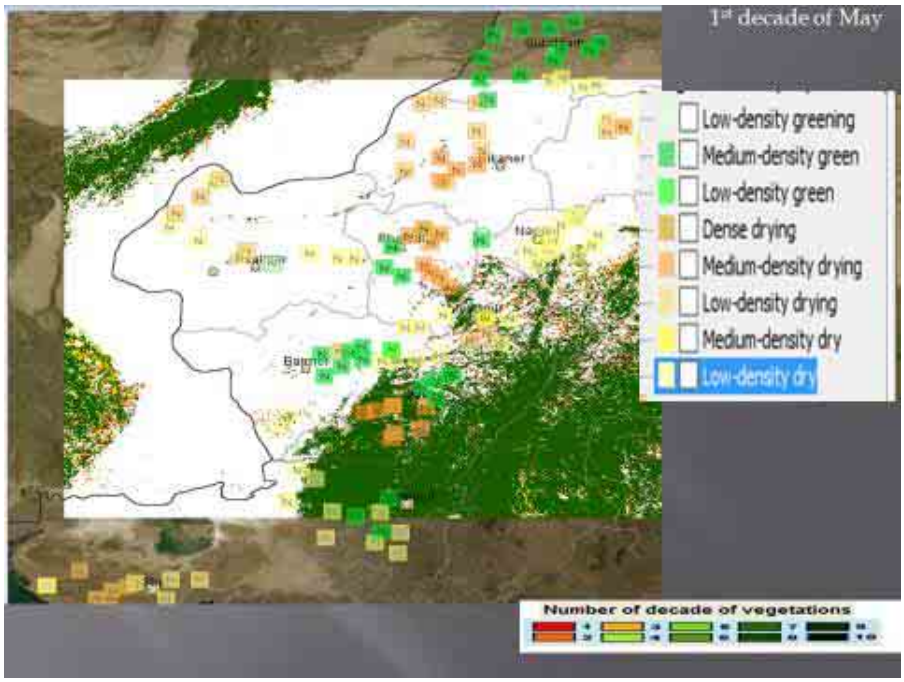
(Both maps are prepared by downloading Satellite imagery provided by FAO periodically) Three imageries in a month on interval of 10 days (decadal)





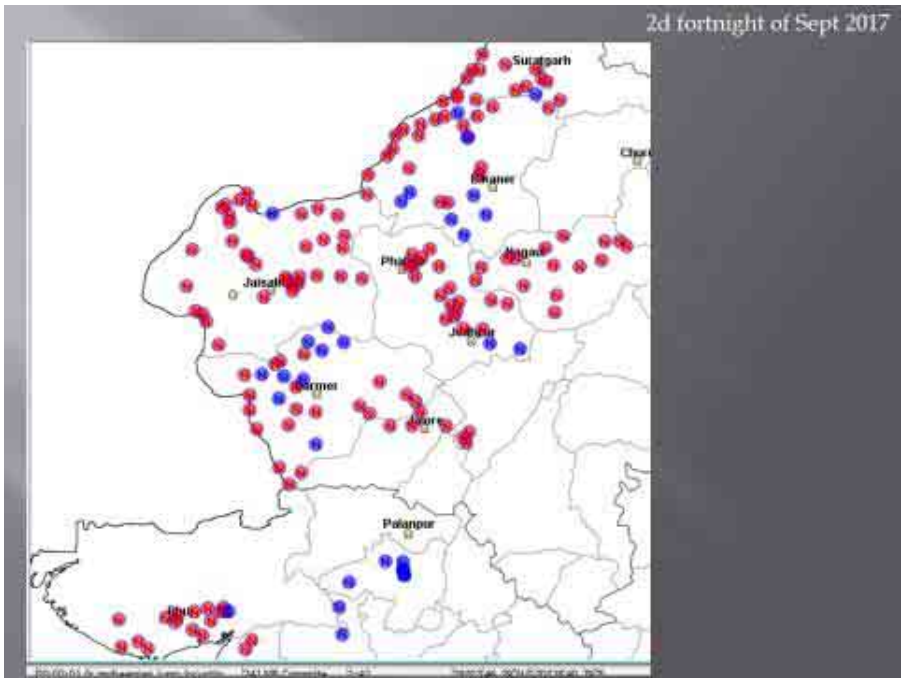
- Greenness map:-
  Vegetation is green, greening, dry, drying & Density like low medium or dense.

(See attached Map)



Following Maps can be prepared by the observations collected and transmitted by the Locust survey teams when they are in the field

- Soil moisture map
- Presence of locust and its behaviour (Solitary, Transient, gregarious), (Adult/ Hoppers) (Mature/ Immature), (Stages of Hoppers) and many more (attached Excel file for reference) (Cont.)


2d fortnight of Sept 2017
Suratgarh
Bikaner
Jaisalmer
Jodhpur
Barmer
Jalore
Palanpur


eLocust3 electronic device
eLocust3

- Keep the eLocust3 unit charged in advance & during transmission of data, tablet should be charged more than 20%
- First plug in the antenna and then "Press & Save" button
- Any other antenna should not be there during transmission other wise data can be transmitted by other Antenna/ ID.
- When cable is to be connected with antenna it requires half turn only. Due to previous practice some of surveyor used to turn two to three rounds which are major reason of fault in antenna/ cable. Due to such bad practice most of cable of antenna is not in good position

Suggestion

- It is better if Data is transmitted on every location or twice a day. Do not send all 4 data in same time. There may be long queue on satellite and it may create problem
- Take at least a pic in a day of survey. It will be remained in tablet. You may save in office computer. During saving please give the name of Pic "yyyyMonthDateNumber" so that the pics will always be in order. This folder can be used for future.
- Have a separate bag for Tablet if possible.
-

Be patient before press send button. Check the data before sending. By mistake if you have clicked "send" button and you need any correction, please un plug the cable soon and go to Report list and delete the data.

- Then fill the form again and send it.

Calculation of Locust population

- Divide one survey spot in 10 Part of (100X10 metre). Calculate density of locust population
- Locust population/ Hactare =No of locust seen X 10000/ (lengthX width)
- RAMSES calculate density it self but for office record and PAR this formula requires.

Error: Missing coordinates Be careful because there is no use of such data (Useless)

How to check data

- This is whole responsibility of surveyor for correct data.
- After every data he will have to check for having correct/ missing coordinates
- If coordinates are missing/ incorrect(Repeated), plug off the antenna soon. Go to report list icon & click on the small box of data then click on delete.
- After delete the data, check the new coordinates appeared than re-enter the data and transmit it.

- In case if data do not transmit
- Make sure all cable connected properly
- Antenna is not far from Tablet
- Bluetooth is on.
- In case problem continues unplug & re-plug all cables
- Change the place from where you are trying to transmit data.

Measuring of distance

- Distance can be measured by eLocust3 unit not only during the foot surveys but also during the travel in the vehicle.

Annexure - VI

Photographs taken during two days national training workshop


Pre-evaluation Test


Lectures through PPT


Group formation


Different groups ready for field exercise

Field exercise : Desert Locust Survey

Observation of soil moisture


Use of eLocust 3


Group discussion


Post evaluation test


Group presentation and Feedback