

# **Meteorological Information for Locust Monitoring and Control**

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# Presentation

- **Objectives of Workshop**
- **Meteorological requirements for different life phases of locusts**
- **Meteorology and migration of locusts**
- **Meteorological Information – opportunities**
- **Forecasting locust migration – opportunities**
- **Conclusions**

**Why are Meteorologists  
and weather information  
needed in Locust  
Monitoring and Control??**

# Classic Disease/Pest Triangle

**For any disease or pest to survive and live, three factors are needed:**

- **Disease/pest needs to be present**
- **Suitable host/food needs to be present**
- **Suitable environment needs to exist during the entire life of the disease/pest**

# Classic Disease/Pest Triangle

Temperature

Humidity

**Environment**

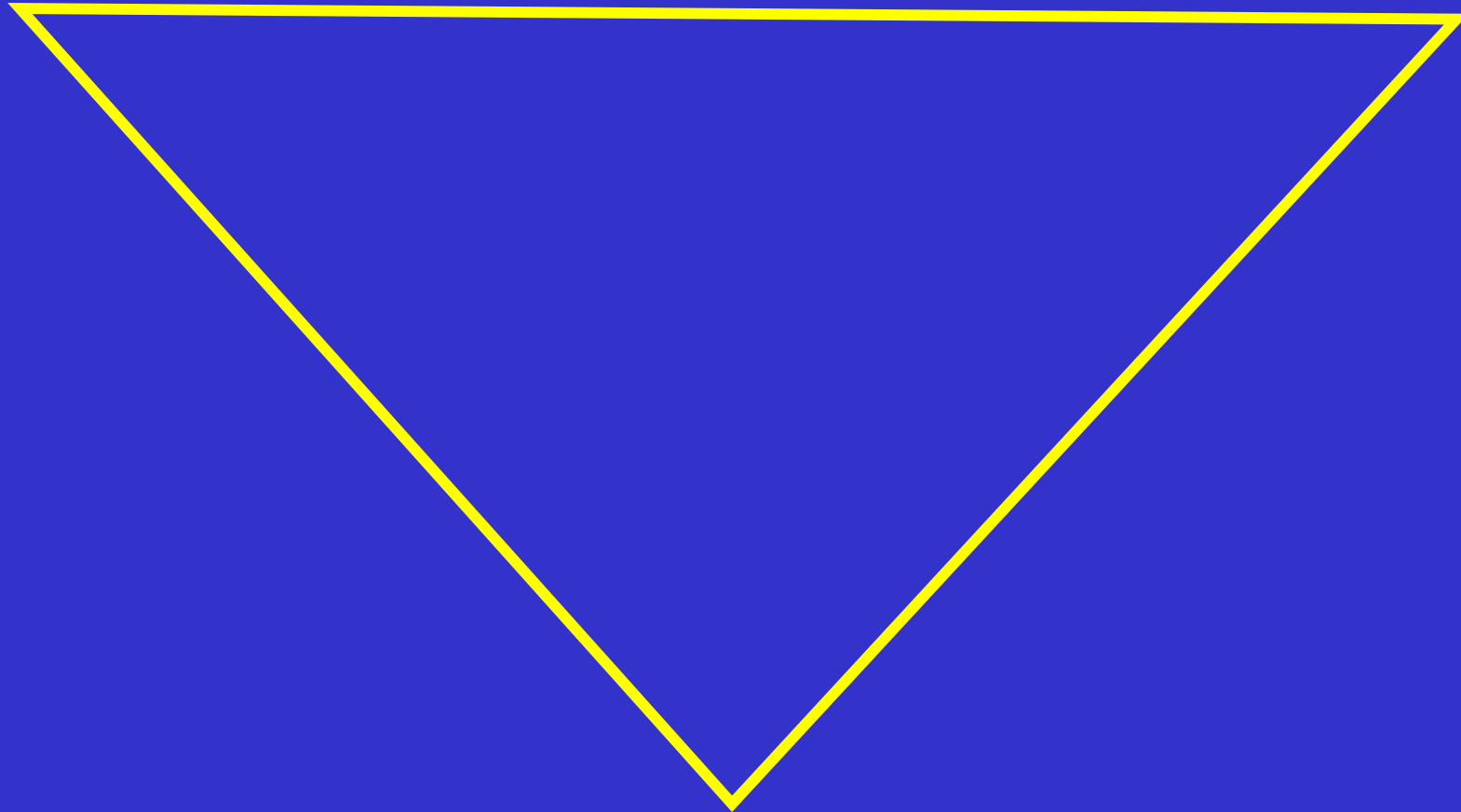
Vegetation

(Rainfall)

**Host**

**Disease/pest**

Locusts

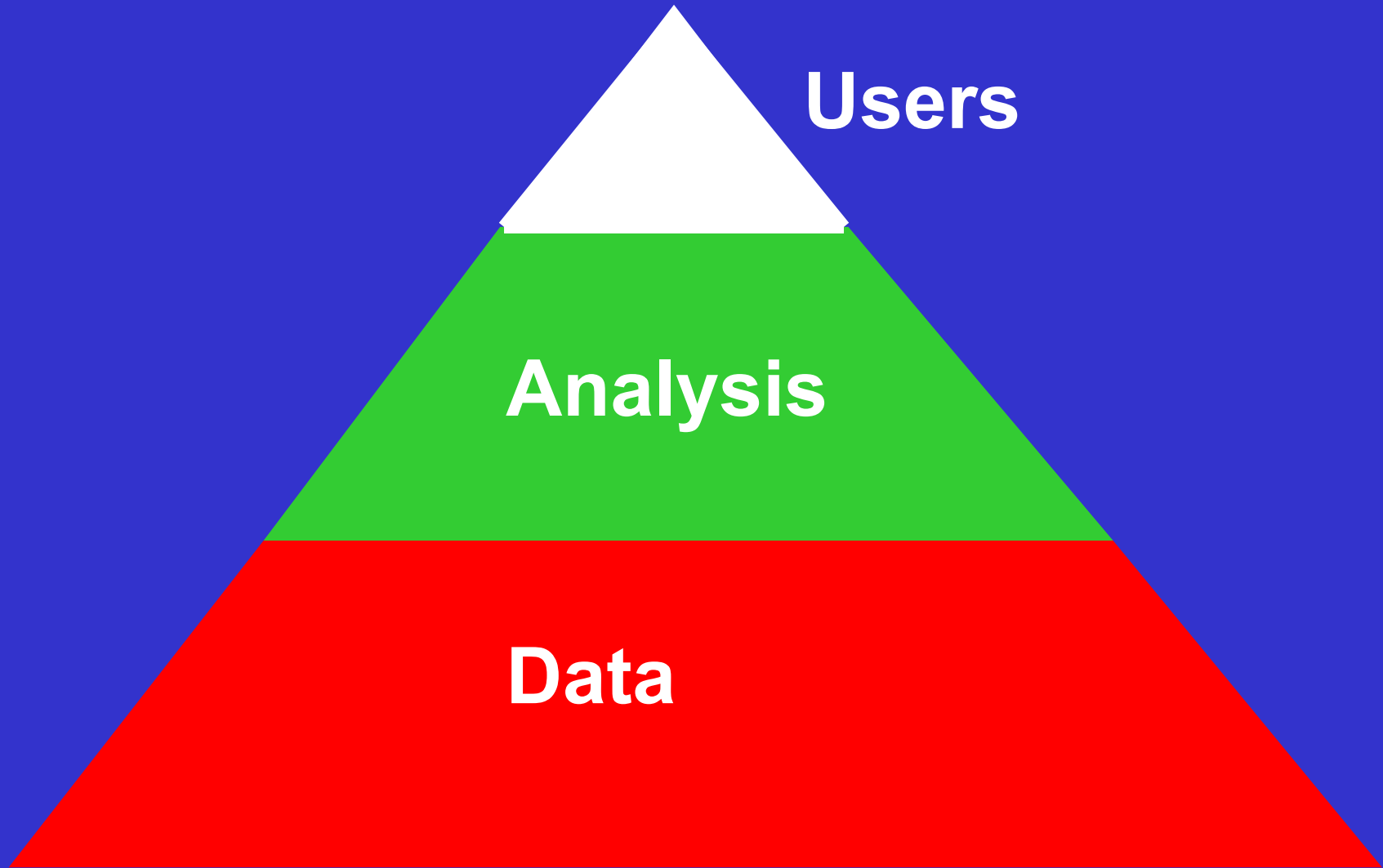


# Applying Weather Information

# **3 Components of Successful Application of Meteorological Information**

- **Data**
- **Analysis**
- **Users**

# Ideal Situation

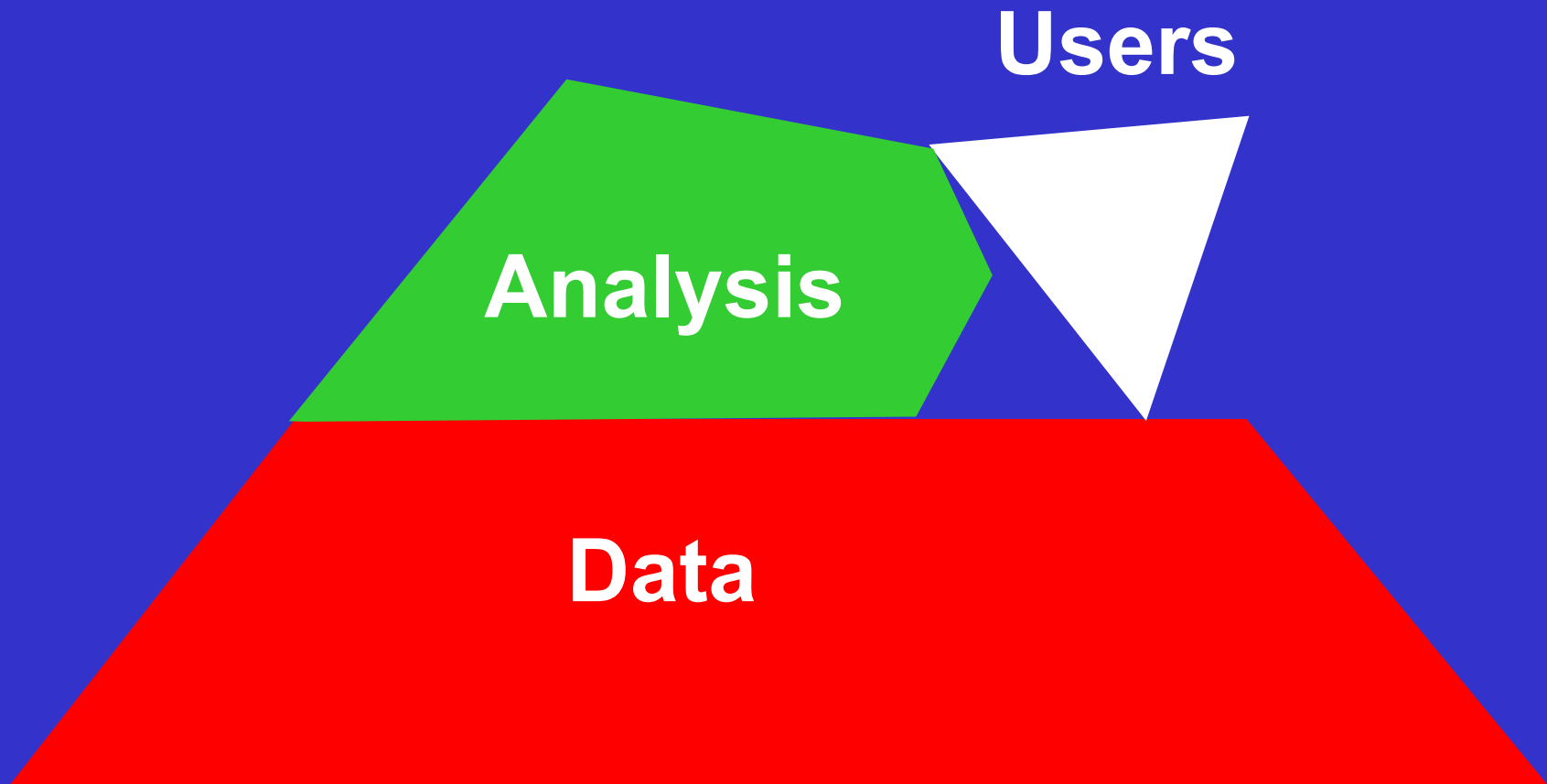




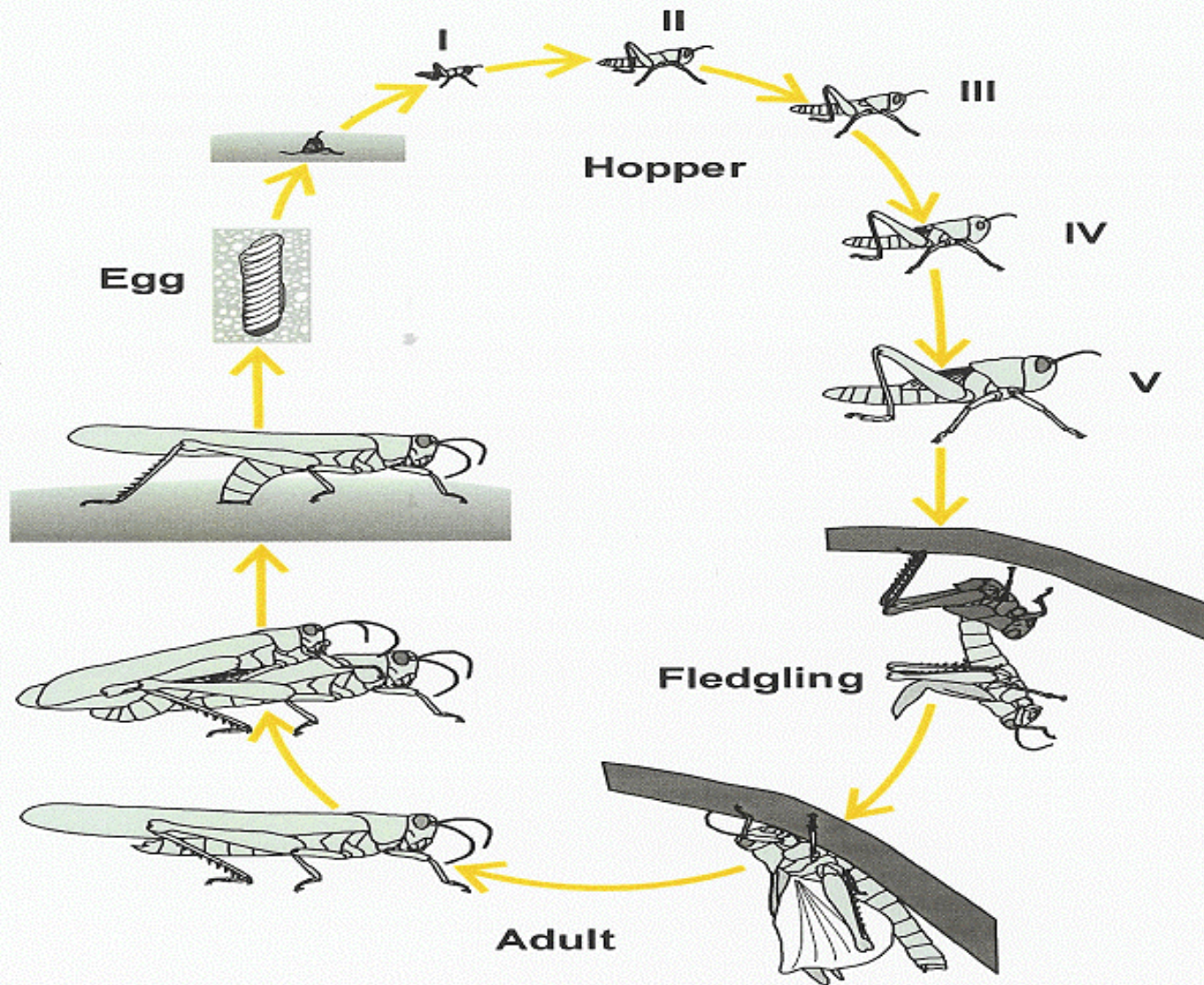
# Bad Situation



# Average Situation



# All the different phases of locust life cycle require ideal meteorological conditions





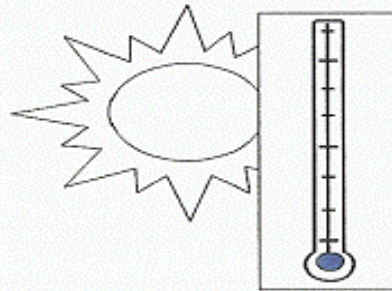
# Hence different meteorological parameters must be measured at different stages



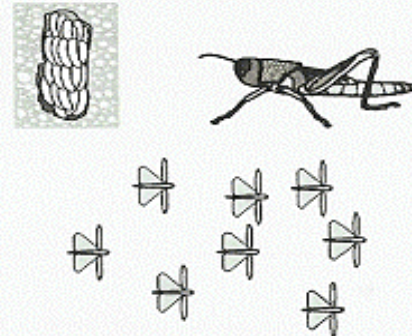
Rainfall and  
humidity



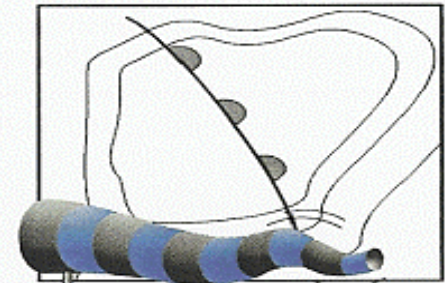
Green vegetation,  
locust presence  
and egg laying



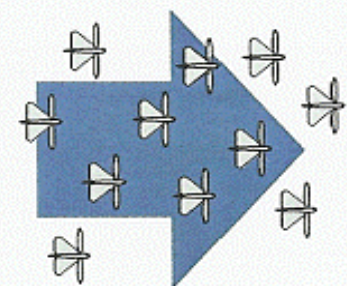
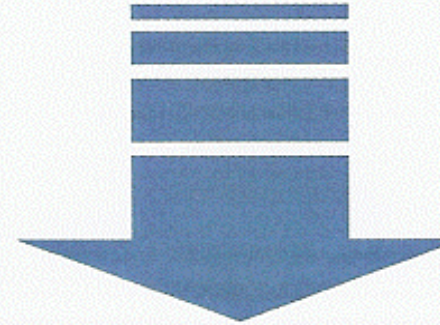
Temperature



Egg and hopper  
development,  
adult takeoff/migration



Air pressure  
and wind

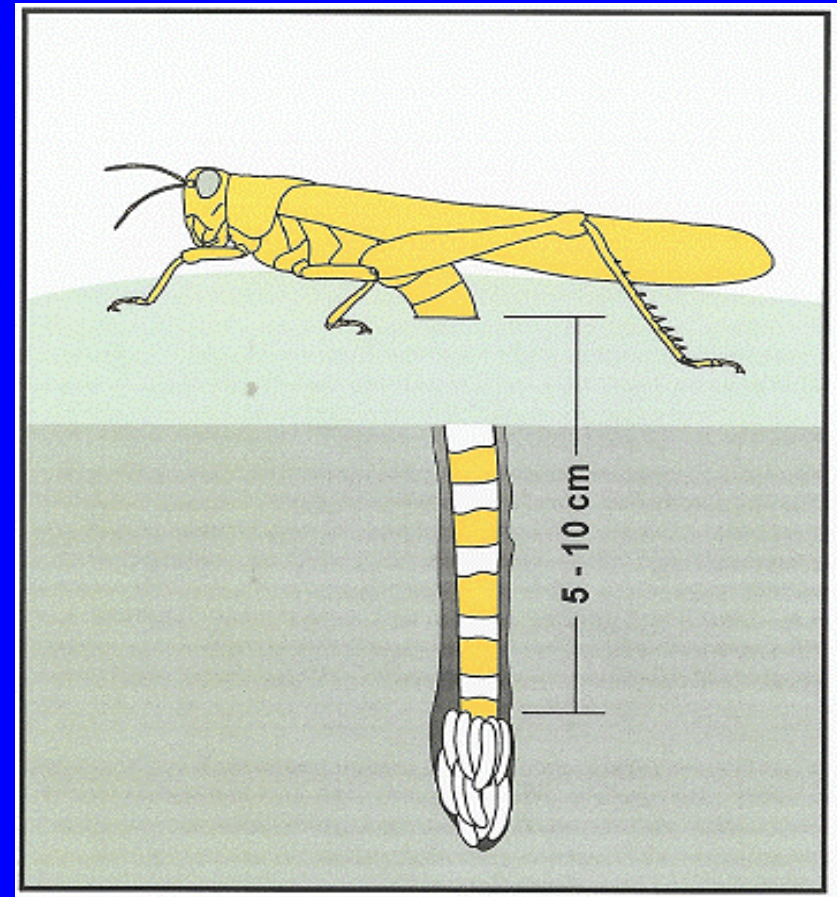


Migration  
and  
invasion

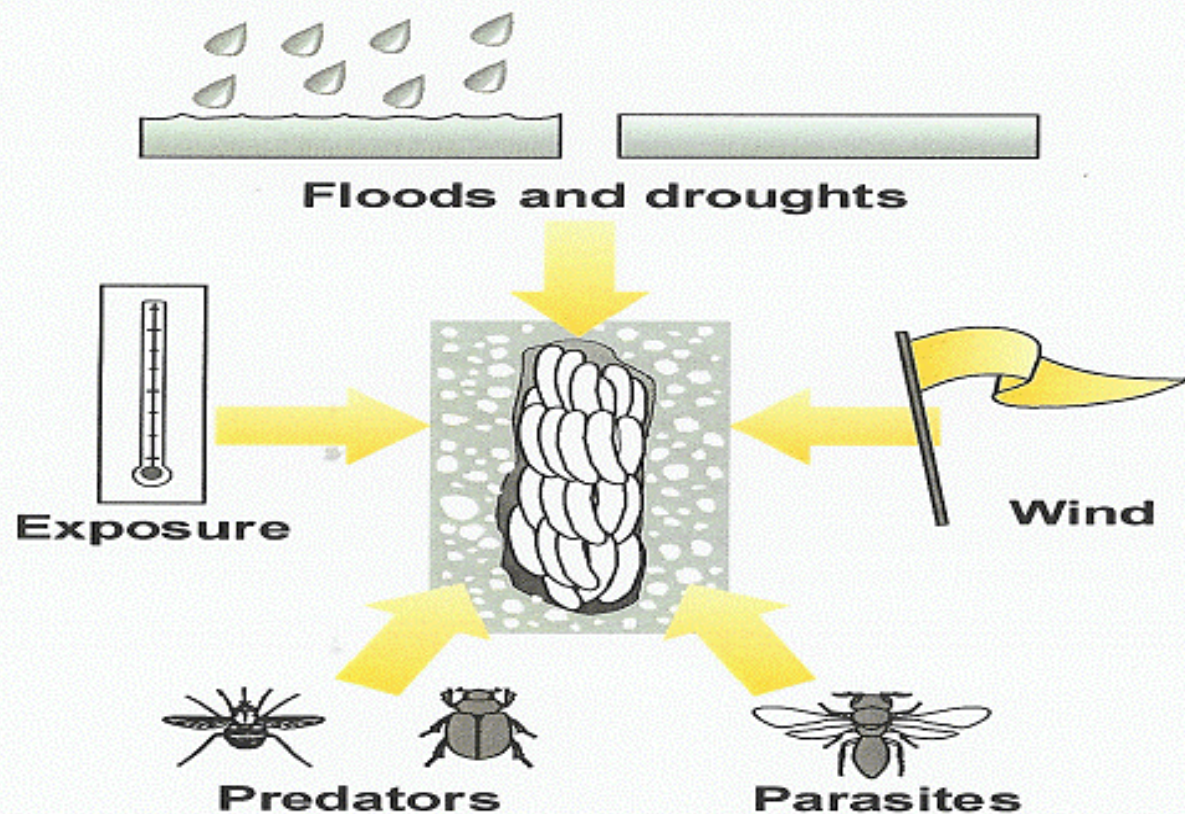


# Meteorological conditions during egg laying phase (Source:FAO)

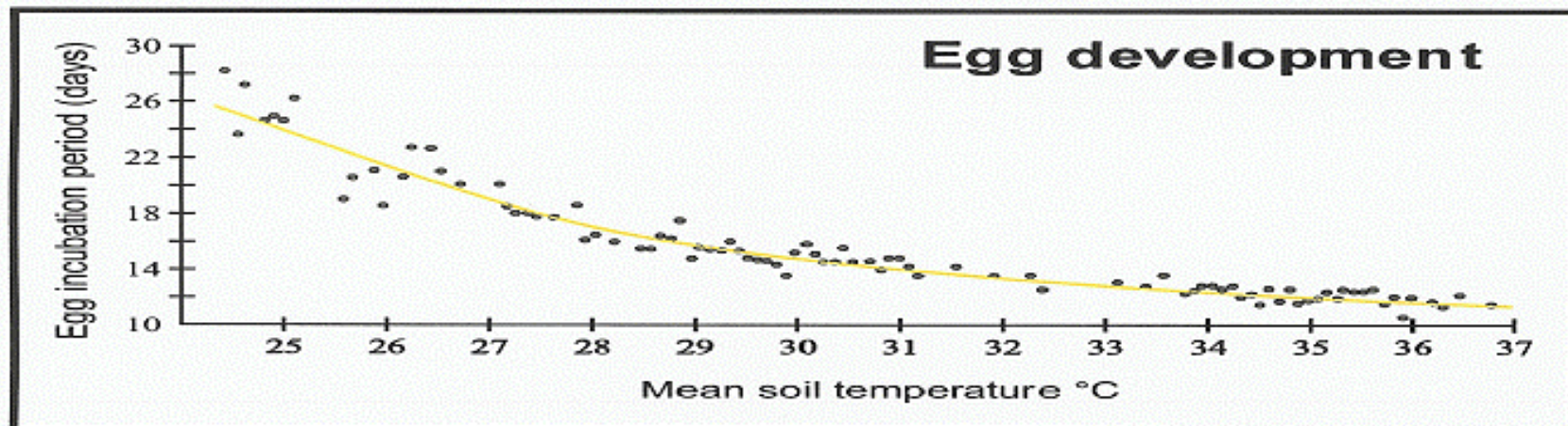
- Moist soil conditions about 5-10 cm below the soil surface required in order to allow the eggs to absorb moisture to complete their development.
- The rate of development of the egg is a function of the soil temperature.
- Eggs can dry up if exposed to wind or can also be destroyed by flooding.
- Under conditions when soil temperatures are above 35 °C, high egg mortality may occur.







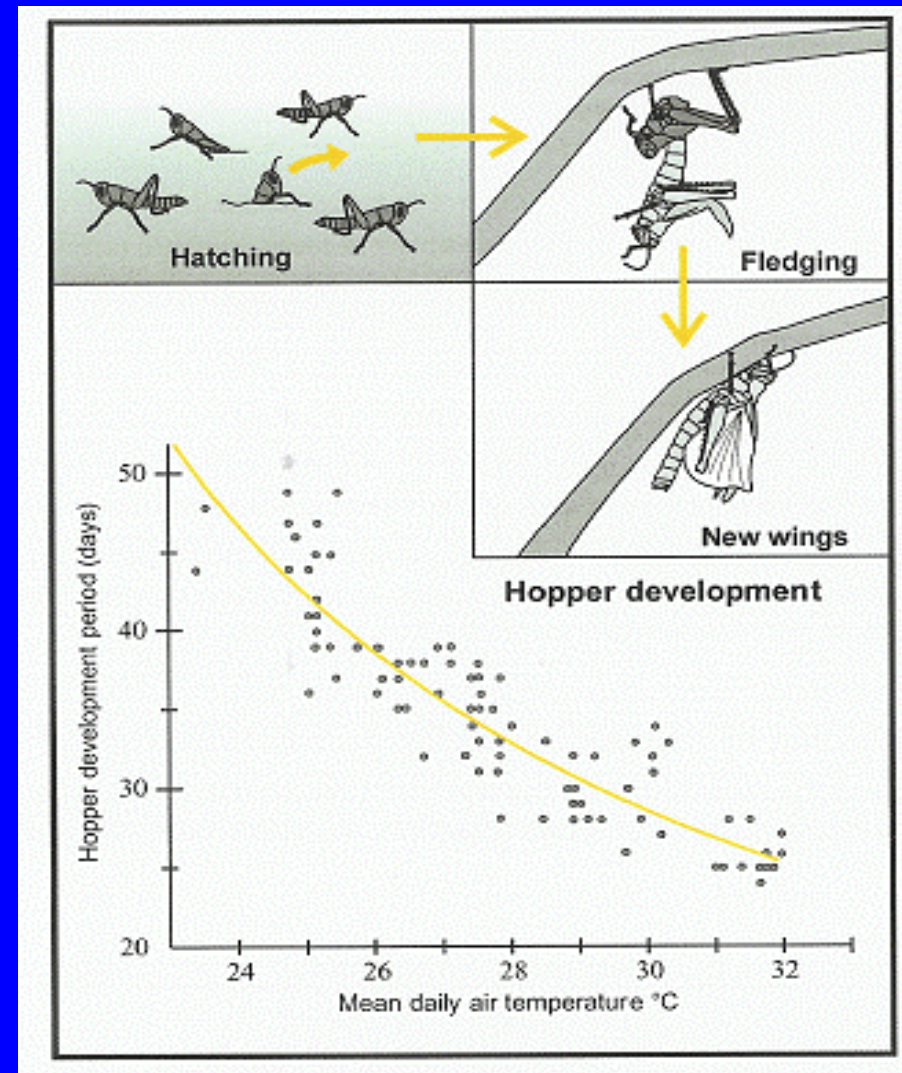
*Note: Illustrations not to scale*





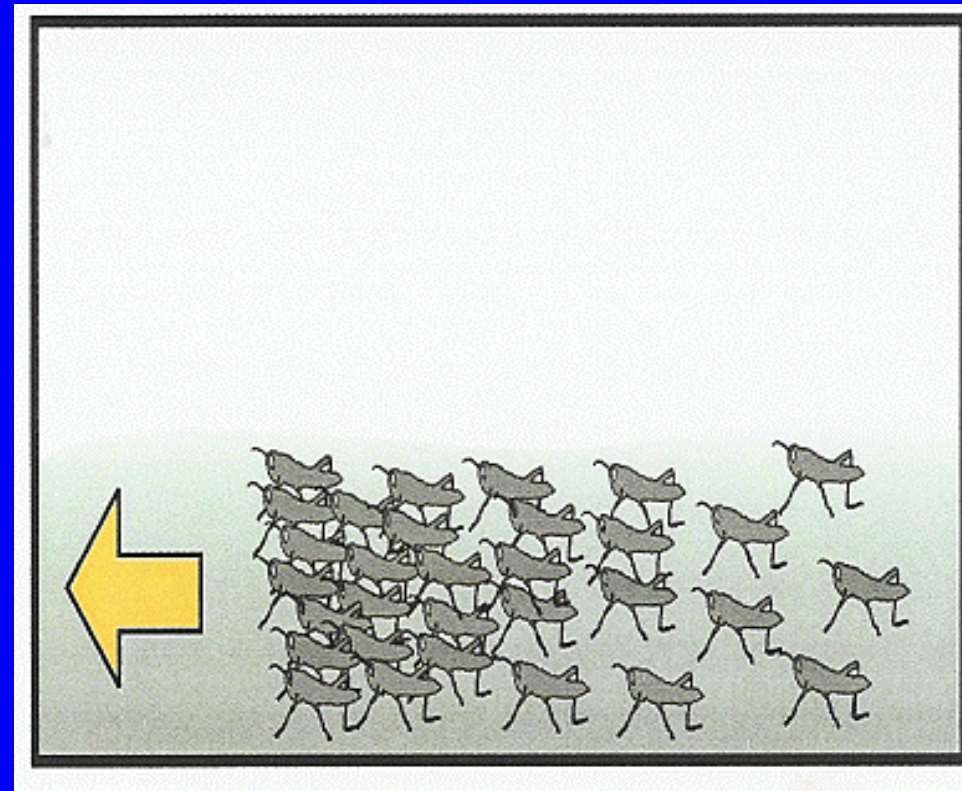
# Meteorological conditions during hopper development phase

- Hopper development period decreases with increasing daily air temperature from 24 to 32 ° C.
- The transition from the first instar to the fifth instar (the period between moulting when the hoppers shed their skin) requires rainy conditions since the hoppers require vegetation for their survival.



# Rate of movement of hopper bands depends on Meteorological conditions

- On warm, sunny days the bands march throughout the day while on overcast days, they do not move very far.
- While very little movement occurs at night, exceptionally high night temperatures do facilitate some movement.
- Band movement is usually downwind. Band densities vary according to weather.





# Importance of rains during maturing phase

- After fledging (the final moult from the wingless fifth or sixth instar to winged adult), the hardening of the soft wings of the locust is stimulated by rainfall.
- Immature adults start to mature when they arrive in an area which received rains recently.



# Importance of rains during copulation and egg laying

- After copulation with the male, egg development in the female depends on air temperature since temperatures below 15°C do not favour egg development.
- Under conditions of high temperatures, the egg development is more rapid.



# Importance of meteorological conditions for egg laying

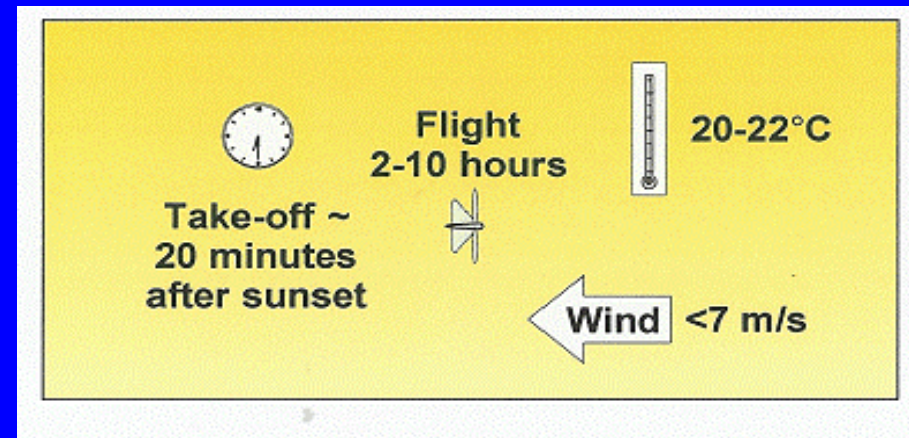
- Appropriate weather conditions such as maximum air temperatures of 35 °C and good rainfall to maintain vegetative growth favour egg laying within three weeks of fledging.
- If the conditions are dry, immature adults can survive upto six months. Hot and dry weather combined with sparse vegetation could lead to death of the adults.





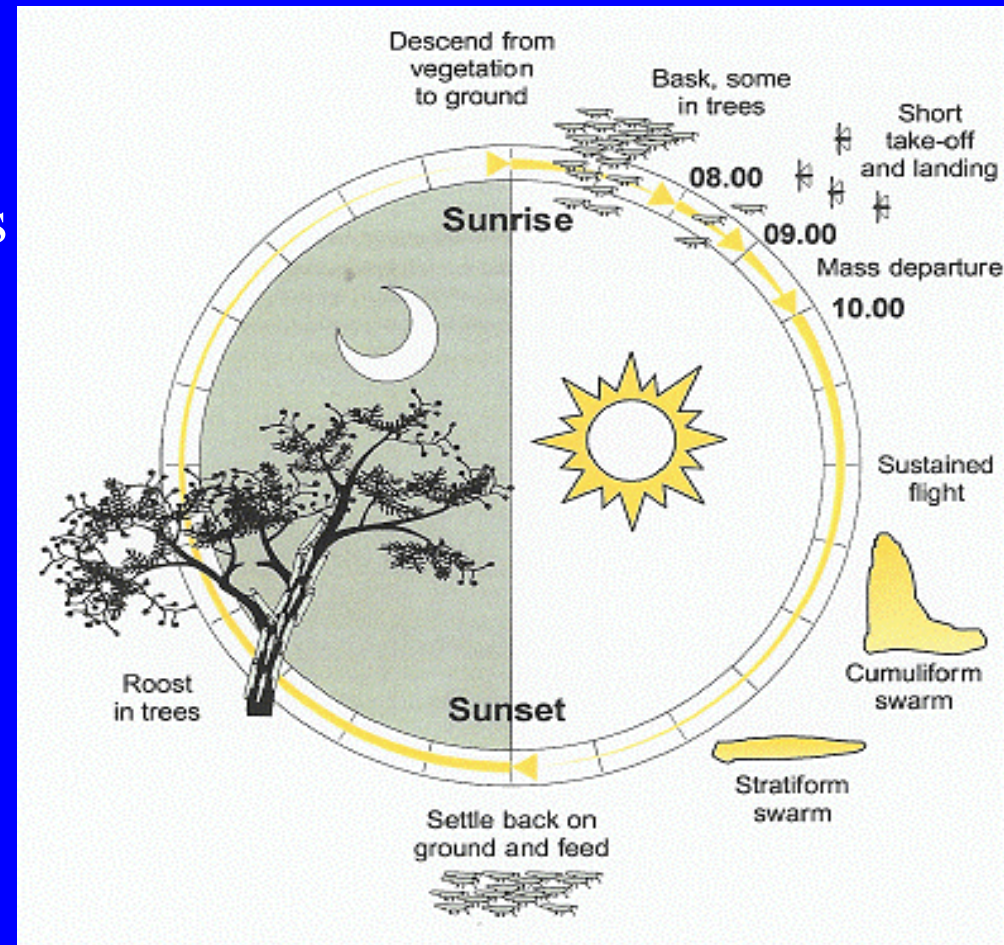
# Migration of adults depends on meteorological conditions

- 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  $> 27^{\circ}$  C and the direction of the flight is downwind.



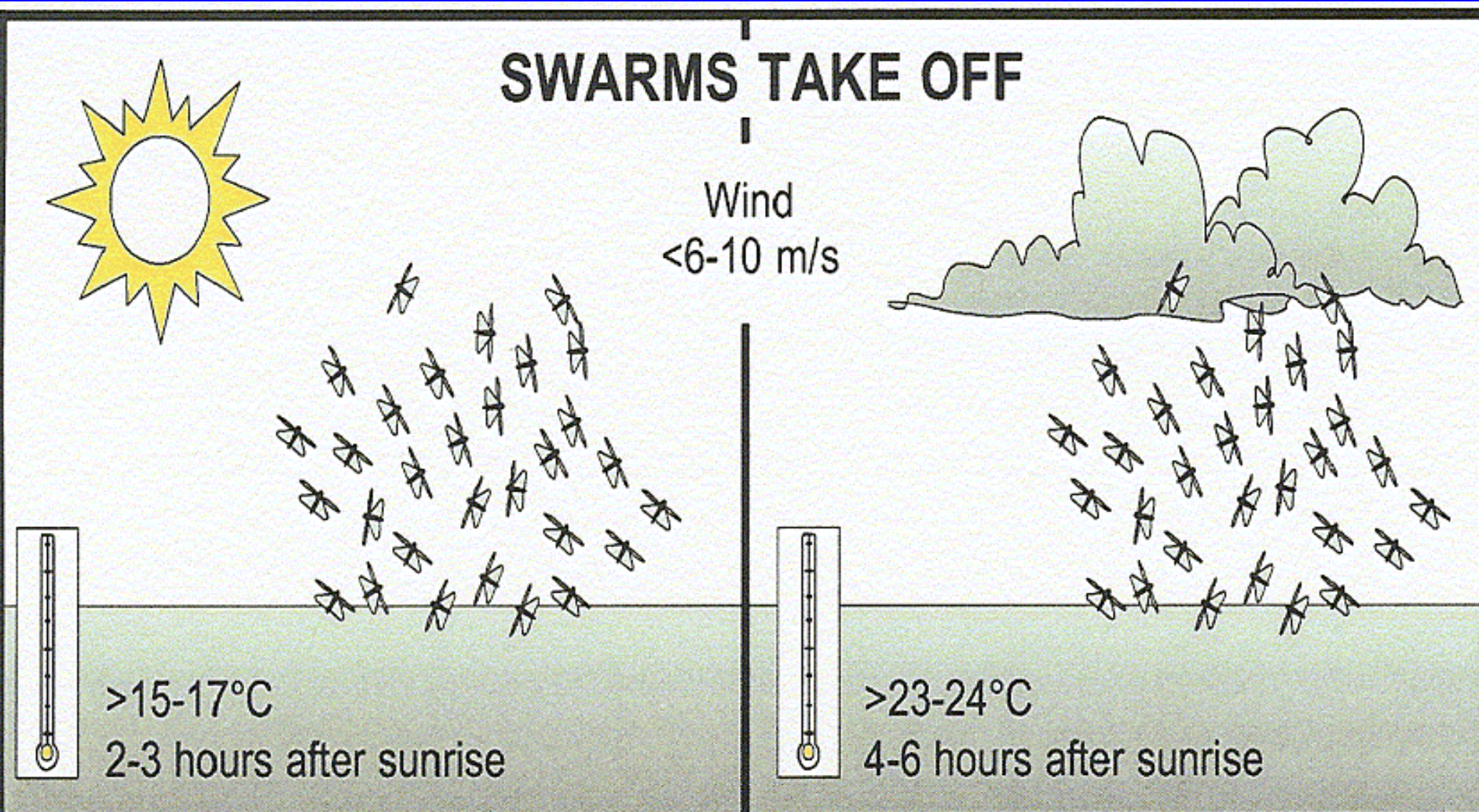
# Structure of the swarms depends on meteorological conditions

- The first swarms form several kms downwind from the main laying area and the structure of the swarms depends on weather conditions.
- Cool, overcast weather favours stratiform swarms while convective updrafts on hot afternoons promote cumuliform swarms.



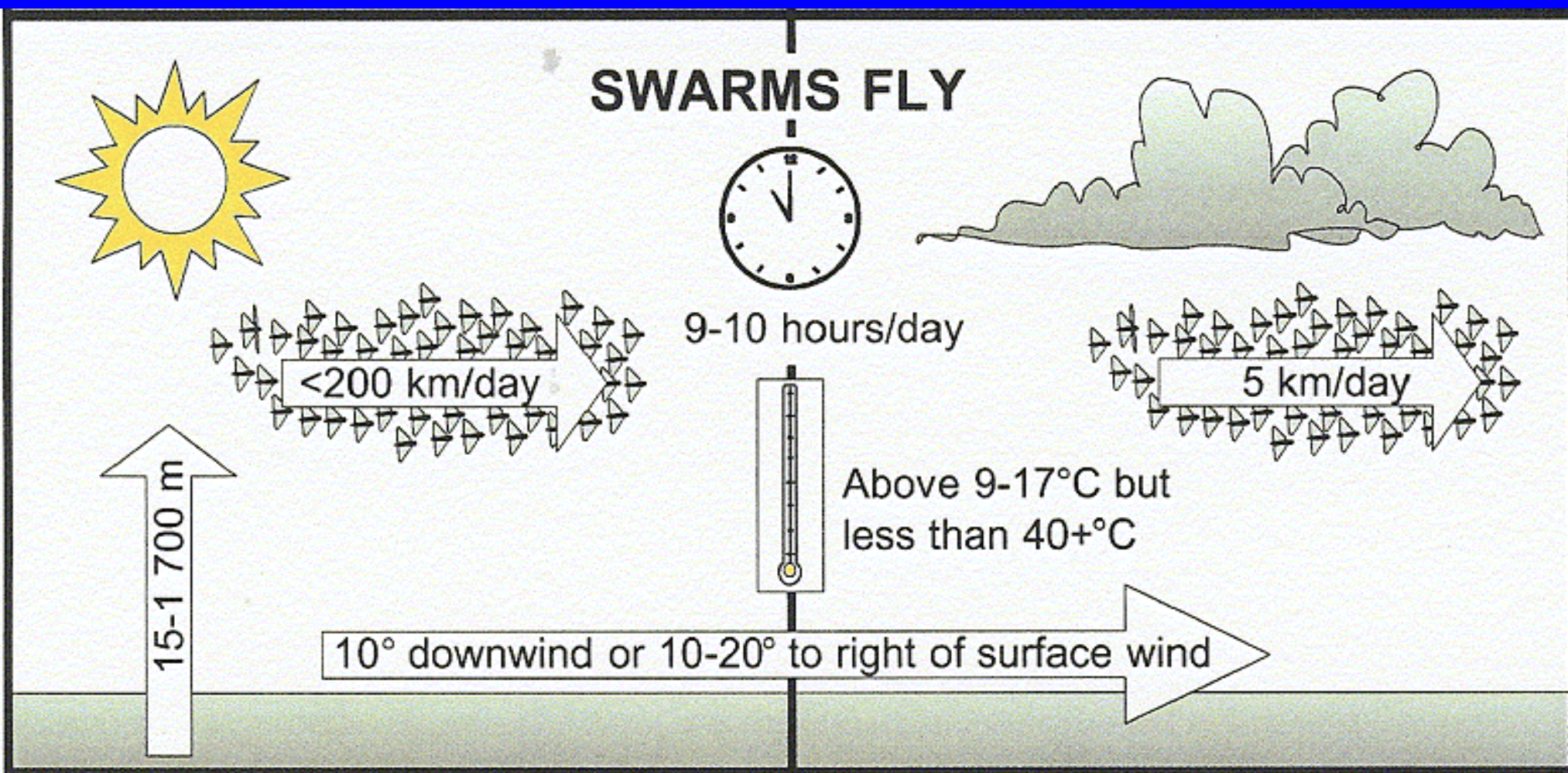


# Take off of swarms depends on meteorological conditions



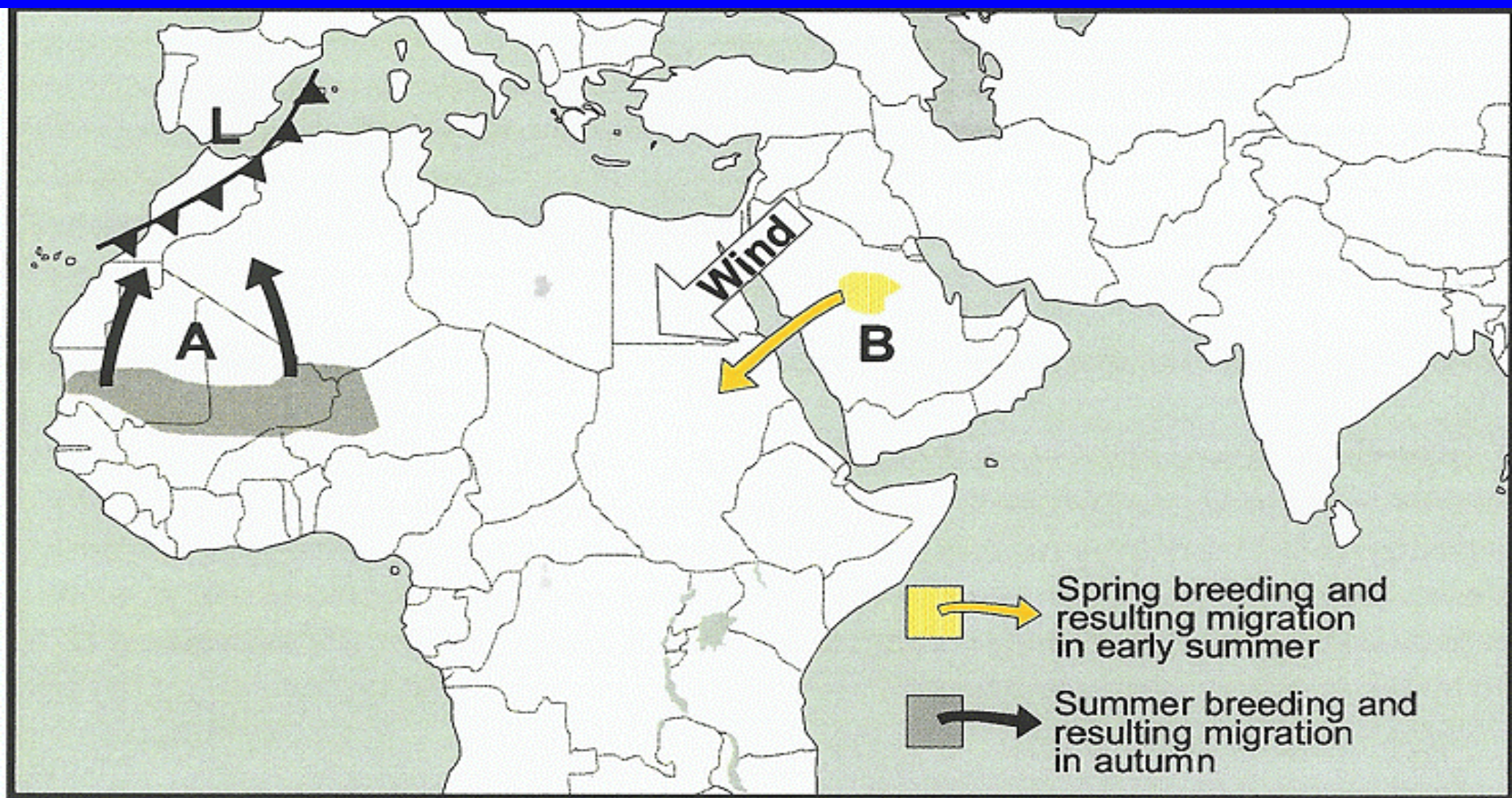


# Swarm movement depends on synoptic conditions





# Seasonal changes in mean wind flow bring locusts into specific zones





# Meteorological Information for Locust control- opportunities

# **Real-time observation & Monitoring**

- **Agronomy: Vegetation growth & development**
- **Insects: Population, migration, (trapping)**
- **Meteorology: Weather & soil elements, synoptic observations, short-term forecasts for control operations**

- Locust control services can plan monitoring, forecasting, and control more effectively by making use of meteorological information for estimating (Pedgley 1997):
  - Where breeding is likely to occur
  - **When next generation is likely to be flying**
  - Where and when that next generation is likely to be reach areas at risk of invasion
  - **Effects of weather on logistics for control (moving of materials and staff, spraying operations, etc)**

# Use of Rainfall Information

- **Daily, weekly, 10-day observations**
- **Warning of occurrence of widespread heavy rains**
- **Warning of continuing poor rains in drought years**
- **Short-term forecasts of widespread and heavy rains  
(control teams in field)**

# Use of Temperature Information

- **Daily mean temperature for calculating development rate and possible flight of new generation**
- Warnings of unusually warm or cool weather indicates changes in development rate or flight duration
- **Warning of continuing poor rains in drought years**
- Short-term forecasts of widespread and heavy rains (control teams in field)

# Use of Wind Information

- **Daily wind maps for estimating the direction and distance of daily swarm movement**
- **Surface, 850mb, and 500 mb can be useful**
- **Warnings of persistent and strong coastal winds (transport locust to islands or out to sea)**
- **Warnings of the occurrence of winds in a markedly different direction from seasonal mean**
- **Forecasts of winds for spraying**

# Database management

- **Historical data : weather, insect, crops**
- **Observed data : weather, insect, crops**
- **Model output : NWP, Crop, Insect**

# Forecasting models

- **Weather: Numerical Weather Prediction Models**
- **Migration : Trajectory models**

**There are new and exciting opportunities offered by NWP and trajectory models**



# In summary, meteorological information is crucial for locust monitoring and control

