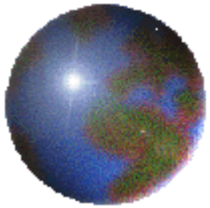
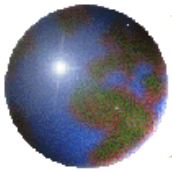


# *PREDICTING BIOLOGICAL EVENTS*

## DEGREE DAYS (DD's) AND PLANT PHENOLOGY

# THE DEGREE DAY CONCEPT

- Factors affecting growth of organisms
  - **Time**
  - **Temperature**
  - Both factors are dramatic for cold-blooded animals (ie. plants, insects, mites)
    - Cool temperatures delays growth
    - Warm temperature accelerate growth
- **Physiological growth**
  - Combination of growth and time

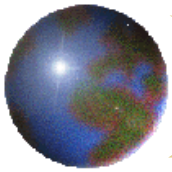


# *THE DEGREE DAY CONCEPT*

- Degree days used to predict physiological time

- **Degree days (DD's)** – accumulation of heat units above some minimum temperature for a 24 hour period

- $$DD_{50} = \frac{Temp_{max} + Temp_{min}}{2} - 50^{o}F$$

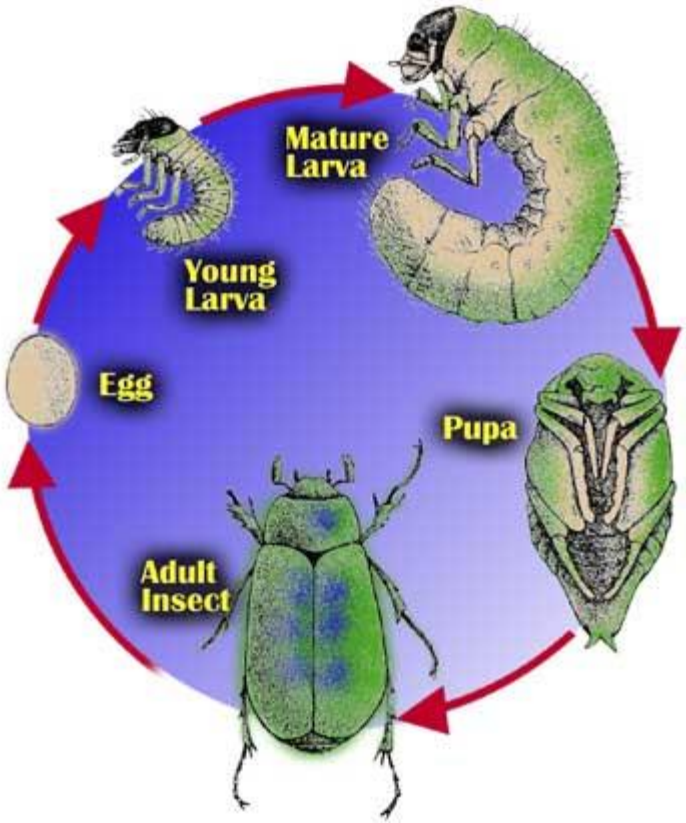


# *THE DEGREE DAY CONCEPT*

- Growth only occurs within a range of temperatures
- **Minimal developmental threshold**
  - Minimum temperature below which no growth occurs
  - 50$^{o}$F for insects
  - 30-32$^{o}$F for plants
- **Maximum developmental threshold**
  - Maximum temperature above which no growth will occurs

# THE DEGREE DAY CONCEPT

- **Thermal constants** – Degree day accumulations for a certain stage of an insect's development
  - Differ for different life stages and between species



# METHODS OF CALCULATING DEGREE DAYS

- **Average Method**
  - Use average temperature and compare to 50$^{o}$F
  - Tends to underestimate DD's
  - **5 DD's** = (65+45)/2 - 50

# METHODS OF CALCULATING DEGREE DAYS

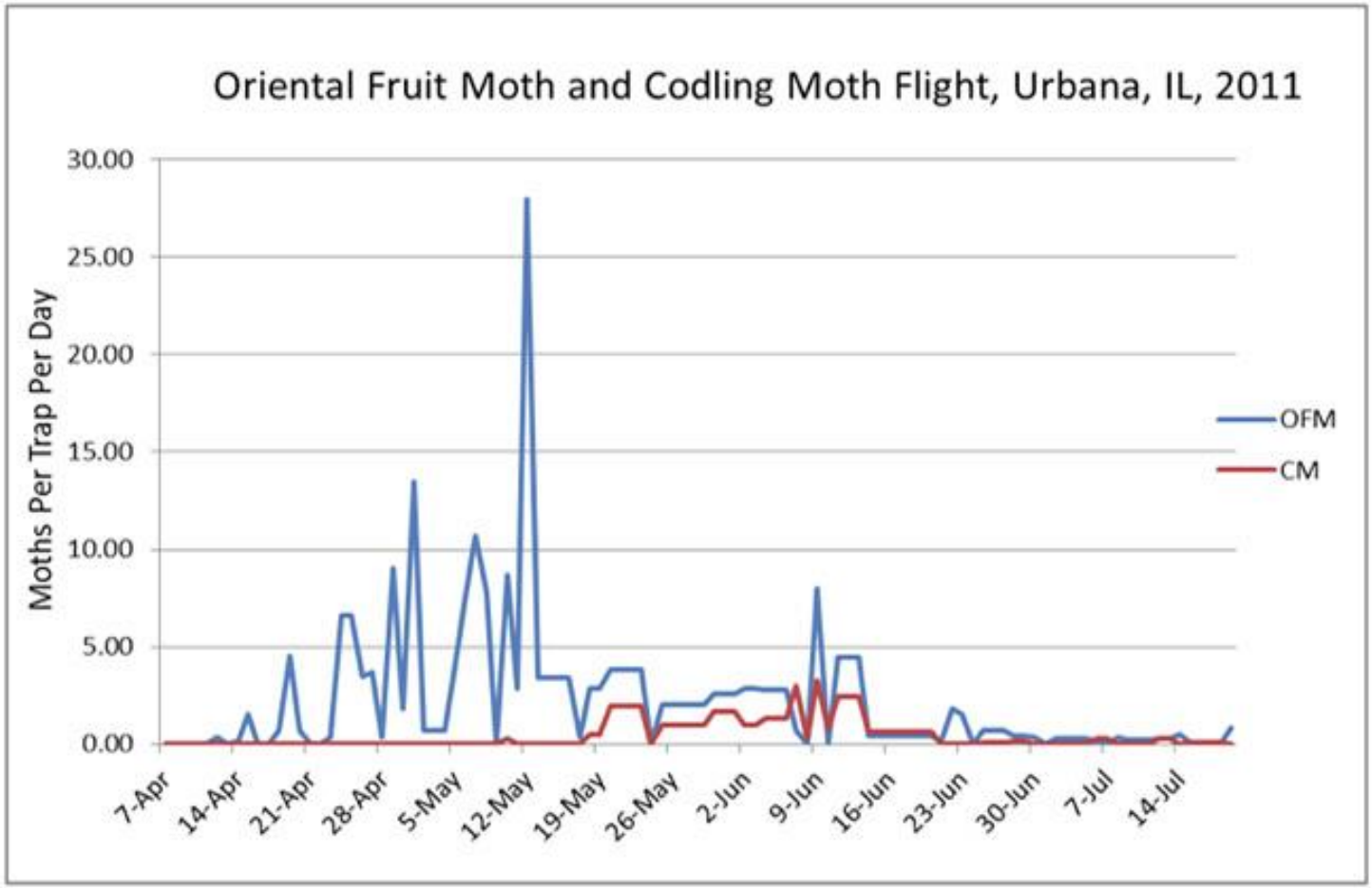
- **Modified Average Method**
  - Base temperature is substituted for minimum temperature
  - DD's = (Max Temp + Base Temp)/2 – Base Temp
  - **7.5 DD's** = (65+50)/2 - 50

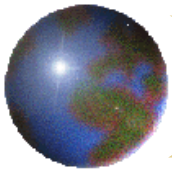
# METHODS OF CALCULATING DEGREE DAYS

- **Modified Sine Wave Method**
  - Even more accurate
  - Calculates area under temperature curve and above base temperature
  - Usually requires a computer

# *THE DEGREE DAY CONCEPT*

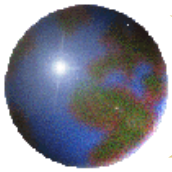
- **Use of DD's in Pest Management**
  - Timing of the scouting of pest species
  - Eliminates unnecessary scouting
  - Avoids overlooking injurious pest populations
  - Aids in making better management decisions


Oriental Fruit Moth and Codling Moth Flight, Urbana, IL, 2011
Moths Per Trap Per Day
30.00
25.00
20.00
15.00
10.00
5.00
0.00
7-Apr
14-Apr
21-Apr
28-Apr
5-May
12-May
19-May
26-May
2-Jun
9-Jun
16-Jun
23-Jun
30-Jun
7-Jul
14-Jul
OFM
CM



# *HOW TO SET UP A DD MODEL*

- Identify and monitor phenological events
- Determine appropriate base temperature
- Select starting date for DD accumulation
- Record daily max and min temps



# *HOW TO SET UP A DD MODEL*

- Calculate DD's
- Note corresponding phenological events with DD's
- Use DD values to predict events in future years

# *USING THE DEGREE DAY CONCEPT AND PLANT PHENOLOGY*

- **The "Coincide" System**
  - Developed by Mr. Don Orton, IDA
  - Combines plant phenology, DD's, and insect development
    - Bud break
    - Flowering
    - Petal fall
    - Egg hatch
    - Larval feeding
    - Pupation
    - Adult emergence

# *SUMMARY*

- Definition of Degree Days (DD's)
- Calculating degree days
  - Minimum developmental threshold
  - Maximum developmental threshold
  - Thermal constants
- Benefits of using DD's in pest management decision making

# *END OF PRESENTATION*