Seasonal Cycles of the Honey Bee Colony: Genetical, Environmental and Seasonal Aspects

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The Honey Bee Colony

Three casts of honey bee:

- The queen (One queen)
- The Drone (Several hundreds/thousands)
- The worker (Majority of the colony)
  - 10,000-15,000 bees (Winter)
  - 60,000-80,000 bees (Summer)

Worker (Sterile female)  
Queen (Fertile female)  
Drone (Male)
The Developmental Stages of the Honey Bee

Let us do the math

工人: 21
女王: 16
雄蜂: 24

卵期 | 蛹期 | 成虫期
"BEE ATTITUDES" Blessed are for they pollinate our crops, produce our honey, and are fascinating to watch.  

Rick Green 1998
Factors Affect Colony Development

Bees
- Prolific queen
- Bee population

Resources
- Adequate resources
- Favorable climate

Space & Time
- Space
- Time
Colony Population of Steady State in the Absence of Seasonal Effects

https://doi.org/10.1371/journal.pone.0130966
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130966

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Colony Development Under Good Conditions

![Graph showing colony development over days with stages labeled Egg, Larvae, Hive, and Foragers.](image-url)
## Factors Having Influence on the Annual Cycle of Bee Population, Brood Rearing and Colony Weight in Honey Bee Colonies*

<table>
<thead>
<tr>
<th>Factors</th>
<th>Annual Cycle affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude and geographical factors</td>
<td>Climate</td>
</tr>
<tr>
<td>Latitude</td>
<td>Day length</td>
</tr>
<tr>
<td>Climate and weather</td>
<td>• Plant species &amp; growth</td>
</tr>
<tr>
<td></td>
<td>• When bees can fly and forage</td>
</tr>
<tr>
<td></td>
<td>• Winter</td>
</tr>
<tr>
<td>Native and wild plants</td>
<td>Nectar and pollen flow (series or one flow)</td>
</tr>
<tr>
<td>Agricultural crops</td>
<td>Additional major flow</td>
</tr>
<tr>
<td>Genetics of the bees</td>
<td>Starting and stopping brood production/swarming</td>
</tr>
<tr>
<td>Acclimatization of bees</td>
<td>Adaptation of bees</td>
</tr>
<tr>
<td>Bee management</td>
<td>Queen age/making split/</td>
</tr>
</tbody>
</table>

* Colonies are healthy and have adequate hive space, food and water
Comparison of Experimental Data with Model Data for Bee Population Dynamics (Geographical Locations)

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Comparison of Experimental Data with Model Data for Bee Brood Production Dynamics (Geographical Location)

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Effects of Latitude on Bee Colony Population, Brood and Weight
Effects of Latitude on Bee Colony Weight Change (Weekly Weight Change in Kg)

Understanding Bee Forage Regions

https://honeybeenet.gsfc.nasa.gov/Honeybees/Forage.htm

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Understanding Bee Forage and Bee Population Dynamics in Alberta

Modified from Harris, L. 2016. Bee Culture June 2016
Colony Gain Weight in Beaverlodge, AB
Understanding Bee Forage and Bee Population Dynamics in Western Canada

Harris, L. 2016. Bee Culture June 2016
Colony Conditions Contributing to Bee Population Dynamics and the Initiation of Swarming

- Congested adult population
- Old queen
- Genetics
- Poor ventilation
- Large brood population
- Hive space - overcrowded
Mean Frames of Bees (±SD) in Russian, Ontario and Hybrid Colonies Measured Each 14d for 126d
Building Bee Population and Starting to Store Honey in Honey Supers
## Bee Genetics and Impacts of Population Dynamics

Wilson 2004-2005

<table>
<thead>
<tr>
<th>Stock</th>
<th>Honey production (Kg)</th>
<th>Over-wintering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ontario</td>
<td>77.5 ± 37.39</td>
<td>1.8 ± 0.26a</td>
</tr>
<tr>
<td>Ontario X Russian</td>
<td>95.7 ± 30.23</td>
<td>1.8 ± 0.43ab</td>
</tr>
<tr>
<td>Russian X Ontario</td>
<td>61.5 ± 15.26</td>
<td>1.4 ± 0.43ab</td>
</tr>
<tr>
<td>Russian</td>
<td>56.6 ± 16.21</td>
<td>1.3 ± 0.54b</td>
</tr>
</tbody>
</table>

* Differences are noted by different letters α = 0.05
Swarming Impacts on Seasonal Cycles of the Honey Bee Colony: Starting Time, Feeding

Number of Bees

Start of the season

End of the season

Swarming

Honey flow

A

B

C

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Summary of Seasonal Cycles of the Honey Bee Colony: Genetical, Environmental and Seasonal Aspects

![Graph showing population density of brood and bees across seasons](image)

- **Spring**: Brood area increases, leading to a peak in population density.
- **Summer**: Population density peaks with the highest brood production.
- **Autumn**: Population density decreases, and winter bees are formed.
- **Winter**: Population density is low, with minimal brood production.

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Summary of Genetical, Environmental and Seasonal Factors That Impact Seasonal Cycles of the Honey Bee Colony

- **Bees**
  - Genetics - Prolific queen
  - Bee population

- **Resources**
  - Adequate resources: Native plants and agriculture crops

- **Management**
  - Management (Space, feeding, swarming, queen age, etc.)

- **Locations**
  - Latitude
  - Geographic location

- **Climate**
  - Favorable climate

- **Time**
  - Acclimatization of bees
Seasonal Cycles of the Honey Bee Colony in Canadian Parries (Worker Longevity and Survival Through Winter)

Harris, L. 2016. BEE CULTURE June 2016
Seasonal Cycles of the Honey Bee Colony in Canadian Parries (Worker Longevity and Survival Through Winter)
When Do Plant and the Bee Seasonal Cycle Meet?

**Plant Phenology**
- Soil
- Rainfall
- Temperature
- Plant Communities

**Bee Colony Development**
- Colony development:
  - Initial colony
  - Birth rate (egg laying rates)
  - Death rates (natural and diseased bees)
  - Drifting
  - Swarming

- Seasonality
- Climate
- Food Sources

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WHAT

IS GOING ON?

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Many variables control the development and bee population cycle:
- Bee genetics
- Latitude and geographical location
- Climate
- Food sources

Acclimatization of bees and bee management are important for bee population development.

Honey bees live for 4-6 weeks in summer, but in winter they live for several months.

Winter bees are important for colony survivorship through the winter. These bees develop in late August through September.

Many factors are involved in colony health and survivorship.