

# The Honey Bee's Needs: Nectar and Pollen

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## Outline

- Introduction to bees
- Bee nutrition
- Pollen and nectar to a plant and bee
- Plant selection





## What is a bee?

- Order: Hymenoptera
  - Ants, bees, wasps
  - Immatures: grub-like
  - Adults: 6 legs, 4 wings
- Vegetarian
  - Provision nests with pollen
- Great pollinators!
  - Pollen sticks to feather-like hairs





Slide adapted from: Dr. Hannah Gaines Day

### **Bees: distinguishing characteristics**

| Bees                      | VS. | <u>Wasps</u> |
|---------------------------|-----|--------------|
| Robust                    |     | Slender      |
| Hairy                     |     | Smooth       |
| Flat rear legs            |     | Slender legs |
| Feed on nectar and pollen |     | Predators    |



Slide credit: Dr. Christelle Guédot



## Social behavior of bees

- Solitary (majority of species)
- Social (only 10%)
  - Honey bees (NOT native)
  - Bumble bees







Slide credit: Dr. Hannah Gaines Day

## How many bees are there?

- ~20,000 species worldwide
- ~4,000 species native to North America
- ~500 species native to Wisconsin





Slide credit: Dr. Hannah Gaines Day





University of Wisconsin–Extension

Smallest North American bee (*Perdita minima*) on largest female carpenter bee

## The Honey Bee

Apis mellifera: the "honey-bearing bee"

Honey bees account for 84% of all insect pollination



- 7 species of honey bees
- Western honeybee, *Apis mellifera* only species in North America
- Non-native, introduced in 1600s
- Social colonies founded by single queen
- Colonies are perennial
- Hive with typically 30 to 50,000 workers



Slide credit: Dr. Christelle Guédot

## The Honey Bee





Adapted from slide by Dr. Christelle Guédot

### **General characteristics:**

- Medium size, medium build
- Abdomen black and orange-brown stripes

### **Specific characteristics:**

- Pollen baskets (corbicula) on hind legs
- Long(ish)-tongued



http://www.nhm.ac.uk/natureplus/blogs/diptera-blog/tags/bees?fromGateway=true



## Honey Bee Nutrition

Nutritional requirements of a honey bee:

- Carbohydrates (sugars)
- Protein
- Lipids (fats)
- Vitamins/minerals
- Water





## Worker Bee Nutrition



- Food: pollen converted into bee bread/royal jelly
  - All nutrients  $\rightarrow$  development

- Food: nectar converted into honey
  - High in sugar  $\rightarrow$  energy



## What is Pollen and Nectar (to a plant)?

 Pollen = male gamete- must be moved to the female part of the flower for fertilization • Nectar = "reward" to pollinators





## What is Pollen and Nectar (to a bee)?

### POLLEN

- Main source of protein for bees
  - Especially important for young bees
- Also contains fats, minerals, and vitamins
- Brood rearing is reduced when colony has a low protein intake<sup>1</sup>



- Bee's main source of carbohydrates
- Also contains essential minerals like calcium, copper, potassium, magnesium, and sodium
- Hygienic behavior increases with nectar flows<sup>1</sup>





<sup>1</sup>Somerville, Doug. 2005. Fat Bees, Skinny Bees

## Quality Matters!!

### POLLEN

- Protein levels vary- may be similar within plant genera
- Ideal: >25% protein<sup>1</sup>



- Sugar concentration can vary from 5-75%
- Ideal: >20% sugar<sup>2</sup>

Not everything that is blooming provides bees with pollen and/or nectar





<sup>1</sup>Huang, Z. 2010. Honey Bee Nutrition; <sup>2</sup>Vidal et al. 2006. Nectar and pollen production in pumpkin (*Curcubita pepo* L.).

## Plant selection

### Variety, variety, variety!!

- Attractive flower colors and shapes (to a bee)
- Select range of plants that flower at different times in the summer
- Plant in clumps
- Plant within a reasonable proximity to hive
- Remember, not all plants have equivalent resources or equivalently accessible resources
- Avoid toxic plants (rare in America)





|                  |                                       |   | Pollin                             | ator Synd                                       | Irome   |  |                                    |                                       |
|------------------|---------------------------------------|---|------------------------------------|---|---|--|------------------------------------|---------------------------------------|
| Trait            | Bat                                   | Вее   | Beetle                             | Bird  | Butterfly                                     | Fly  | Moth                               | Wind                                  |
| Color            | White, green or<br>purple             | Bright white, yellow,<br>blue, or UV          | White or green                     | Scarlet, orange, red<br>or white                | Bright red and purple                         | Pale,or dark<br>brown, purple                    | Pale red, purple,<br>pink or white | Pale green,<br>brown, or<br>colorless |
| Nectar<br>guides | None                                  | Present                                       | None                               | None  | Present                                       | None   | None                               | None                                  |
| Odor             | Strong and musty;<br>emitted at night | Fresh, mild,<br>pleasant                      | None to strongly<br>fruity or foul | None  | Faint but fresh                               | Putrid   | Strong sweet;<br>emitted at night  | None                                  |
| Nectar           | Abundant;<br>somewhat hidden          | Usually present                               | Sometimes<br>present               | Ample; deeply<br>hidden                         | Ample; deeply<br>hidden                       | Usually absent                                   | Ample; deeply<br>hidden            | None                                  |
| Pollen           | Ample                                 | Limited; often<br>sticky, scented             | Ample                              | Limited   | Limited                                       | Limited  | Limited                            | Abundant;<br>small, smooth            |
| Flower<br>Shape  | Bowl shaped;<br>closed during day     | Shallow; with<br>landing platform;<br>tubular | Large and bowl-<br>shaped          | Large, funnel -like;<br>strong perch<br>support | Narrow tube with<br>spur; wide landing<br>pad | Shallow; funnel-<br>like or complex<br>with trap | Regular; tubular<br>without a lip  | Regular and small                     |
|                  |                                       | ****  |                                    |   |   | The second                                       |                                    |                                       |

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WWW.POLLINATOR.ORG

| NECTARY CALENDAR                          |                   |                   |                  | -                           |  |             |                      |                |                    | -   |  |
|---|-------------------|-------------------|------------------|-----------------------------|--|-------------|----------------------|----------------|--------------------|-----|--|
| Latin Name                                | ecialist<br>ctary | neralist<br>ctary | Humming-<br>bird | Approximate Flowering Times |  |             |                      |                |                    |     |  |
|   | Sp                | Ge                |                  | Apr                         | May  | Jun         | Jul                  | Aug            | Sept               | 0   |  |
| Acacia angustissima and hirta             |                   | •                 |                  |                             |  |             | 1. Contraction       |                |                    |     |  |
| Acer spp.                                 |                   | •                 | 1000             | 1000                        | 1000   |             | 1                    |                | 10.000             |     |  |
| Achillea spp.                             |                   | •                 |                  |                             | 1. 2.  |             |                      | Contraction of | Contraction of the |     |  |
| Agastache foeniculum                      |                   | •                 |                  |                             |  |             | 10000                | 1.0 10-        |                    |     |  |
| Alcea rosea                               |                   | •                 |                  |                             |  |             |                      | -              | -                  |     |  |
| Allium spp.                               | _                 | •                 | 1                |                             | 1  |             |                      |                |                    |     |  |
| Alnus spp.                                |                   | pollen            |                  |                             |  |             |                      |                |                    |     |  |
| Amelanchier spp.                          | -                 | •                 |                  |                             | 1 million  |             |                      |                |                    |     |  |
| Amorpha spp.                              |                   | •                 |                  |                             |  |             |                      |                |                    |     |  |
| Andropogon gerardii                       |                   | pollen            |                  |                             |  | Lat         | tin N                | ame            |                    |     |  |
| Antennana spp.                            |                   | •                 |                  | 1                           | 1100   | Sec.        |                      | 100015-0       | _                  |     |  |
| Apros spp.                                | -                 | •                 |                  |                             |  | Aci         | acia a               | nous           | tissim             | a : |  |
| Aquilegia canadensis                      |                   | •                 | • E              |                             | KG PL  |             | arcia a              | angus          |                    | 0.0 |  |
| Arabis caucasica                          |                   | •                 |                  |                             | 1  | Ace         | er spr               | ). (N          | <b>Aap</b>         | le  |  |
| Aralia cordata                            | •                 | •                 |                  | -                           |  |             |                      |                |                    |     |  |
| Aralia elata                              | •                 | •                 |                  |                             |  | ACI         | hillea               | spp.           | (Yar               | rc  |  |
| Aralia hispida                            | •                 | •                 | 1                |                             |  | 1           |                      | h . 1.         | 10000000           | 1   |  |
| Aralia nudicaulis                         | •                 | •                 |                  |                             | 1000   | Ag          | astaci               | ne ro          | enicul             | un  |  |
| Aralia racemosa                           |                   |                   | -                | 1                           |  | Ale         | 03.00                | co.3           |                    | 1   |  |
| Auctostaphylos uva-ursi                   |                   |                   | •                | 1000                        |  | AIC         | ea ru                | sea            | 1000               |     |  |
| Arnogiossum atriplicitolia                | •                 | •                 | -                |                             | -  | Alli        | um s                 | nn.            | Oni                | O   |  |
| Actomicia and                             |                   | •                 |                  |                             | 1000   |             | 0                    | PP.            |                    |     |  |
| Artembia spp.                             | •                 | •                 | -                |                             |  | Aln         | US SD                | p.             | Alde               | er  |  |
| Asoaragus officiaalie                     |                   |                   | _                |                             |  |             |                      |                |                    | -   |  |
| Actor con                                 | -                 |                   |                  | -                           |  | Am          | eland                | thier s        | spp.               |     |  |
| Actranalius son                           | -                 |                   |                  |                             | -  | A           | and h                |                | in the             | -   |  |
| Potragalus spp.<br>Rokomorbino contittato | -                 |                   |                  |                             | 1  | АЛ          | orpn                 | a spp          | 8< - I             | 1   |  |
| Banticia con                              | -                 |                   | -                |                             |  | An          | droor                | ma             | noran              | dü  |  |
| Bollis parannis                           |                   |                   |                  | Contractor of               | And in case of the local division of the loc |             | nope                 | yon            | yeravi             | un  |  |
| Berberis canadensis                       |                   |                   |                  |                             |  | Ant         | tenna                | ria sn         | 0                  |     |  |
| Retula con                                |                   | nollen            |                  | Contractor of               |  | -           | Certification of the | une ale        | -pri               | 1   |  |
| Blenhilia son                             | -                 | ponen             |                  | -                           |  |             |                      |                |                    |     |  |
| Borago officinalis                        |                   |                   |                  |                             |  |             |                      |                |                    |     |  |
| Brassica son                              |                   |                   | -                |                             |  |             |                      |                |                    |     |  |
| Bunium hulhocastanum                      |                   |                   |                  |                             |  | Contract of | 1000                 |                |                    |     |  |
| Camassia son                              |                   |                   | -                |                             | -  |             |                      |                |                    |     |  |
| Campanula son                             | 1.7               |                   |                  |                             | 100  |             | -                    | COLUMN STATE   | Summers.           | -   |  |
| Caragana sop.                             |                   |                   |                  |                             | -  |             |                      |                | 1000               | 1   |  |
| Carex pensylvanica                        |                   | pollen            |                  |                             |  |             |                      |                |                    |     |  |
| Carva spp.                                |                   | pollen            |                  |                             | 1000   | 12.5        |                      |                |                    | -   |  |
| Castanea son                              | 10000             | pollen            |                  |                             |  | -           | 12.20-11             |                |                    |     |  |

## Nectary Calendar

| Latin Name                    | Specialist<br>Nectary | Generalist<br>Nectary | Humming-<br>bird | Approximate Flowering Times |       |     |     |     |                |     |
|-------------------------------|-----------------------|-----------------------|------------------|-----------------------------|-------|-----|-----|-----|----------------|-----|
|                               |                       |                       |                  | Apr                         | May   | Jun | Jul | Aun | Cant           | 0.4 |
| Acacia angustissima and hirta | 1.10                  |                       |                  | -                           |       |     |     | nug | sept           | od  |
| Acer spp. (Maple)             | Call III              | •                     | 1.500            | 1 1 14                      | -     |     | -   |     |                |     |
| Achillea spp. (Yarrow)        | •                     | •                     | 1                |                             | 10000 |     |     | -   | -              |     |
| Agastache foeniculum          |                       |                       |                  | -                           |       |     |     |     |                |     |
| Alcea rosea                   | 1000                  | •                     | 1000             |                             |       |     |     |     |                |     |
| Allium spp. (Onions etc.)     | 1                     |                       |                  | 1000                        |       |     |     |     |                |     |
| Alnus spp. (Alder)            | Service Service       | pollen                | (Ling)           |                             | -     |     |     |     |                |     |
| Amelanchier spp.              | A Station             | •                     |                  | 100                         | -     |     |     |     | 1              |     |
| Amorpha spp.                  | 21211                 |                       | and see          |                             |       |     |     | -   |                | -   |
| Andropogon gerardii           |                       | pollen                |                  | 1000                        |       |     | -   | -   | Contraction of | -   |
| Antennaria spp.               | •                     | •                     |                  |                             | 10000 |     |     |     | -              |     |



Jacke, D. and E. Toensmeier. 2005. Edible Forest Gardens Volume 2.



## Early Season/Spring Plants



### Trees/Shrubs

- Pussy willow
- Hawthorn
- Basswood
- Maple
- Chokecherry
- Plum/cherry
- Raspberry

### Herbaceous plants

- Lanceleaf coreopsis
- Penstemon
- Wild Lupine
- Virginia waterleaf
- Siberian squill
- Brassica spp.

- Early figwort
- Phacelia
- Fireweed





## Mid-Season/Summer Plants



### Trees/Shrubs

### Herbaceous plants

- Leadplant
- New Jersey tea
- Prairie rose

- Butterfly milkweed
- Mints
- Clovers (not red clover)
- Joe Pye weed
- Wingstem
- Bergamot

- Hyssop
- Coneflowers
- Beebalm
- Vetch
- Sunflower
- Jewelweed



## Late Season/Fall Plants



### Herbaceous plants

- Aster
- Goldenrod



## Plants to avoid:

- Rhododendron spp.
  - Rhododendron
  - Azalea
- Astragalus or Oxytropis spp.
  - Locoweed
- Kalmia sp.
  - Laurel
- Aesculus spp.
  - California buckeye





Oertel, E. 1980. Nectar and Pollen Plants. Beekeeping in the United States Agriculture Handbook Number 335.

## Avoid Pesticide Drift

### Welcome to FieldWatch<sup>™</sup> 2016

#### Communication + Cooperation + Collaboration = Successful Co-existence

This site is a voluntary communication tool that enables crop producers, beekeepers, and pesticide applicators to work together to protect specialty crops and apiaries through use of mapping programs. It is not a substitute for any state regulatory requirements.

For more resources and information, please visit FieldWatch, Inc.





### www.fieldwatch.com; www.beecheck.org





## Additional Resources

Xerces Society- <a href="http://www.xerces.org/">http://www.xerces.org/</a>

www.ScientificBeekeeping.com

Planting guide packet- email me adeutsch@co.door.wi.us

Somerville, Doug. 2005. Fat Bees, Skinny Bees- a manual on honey bee nutrition for beekeepers. Rural Industries Research and Development Corporation.



## Summary

- Bees need a balanced diet: pollen AND nectar
- Provide a variety of plants that bloom throughout the summer



- Adequate nutrition allows bees to reproduce and stay healthy
- When there is surplus of honey, we can benefit









## Examples of protein content of pollen:

Good protein source: >25% protein

- Asteraceae spp. (asters, daisies): 14.5-24.5%
- Canola (brassica napus): 10-27%
- Sunflower (Helianthus annuus): 13-18.5%
- Pinus spp. (pine trees): 7%
- White clover (*Trifolium repens*): 22.5-26%
- Vicia spp. (vetch): 24%
- Corn (*Zea mays*): 14-15%



Ref: Somerville, Doug. 2005. Fat Bees, Skinny Bees



## Calculation Example in Pumpkins:

- 1 honey bee colony requires 44-66 lbs pollen/yr
- 1 pumpkin flower produces 0.0001 lbs (1/100<sup>th</sup> of a teaspoon) pollen/yr
  - Need 638,298 flowers to produce enough pollen
- Pumpkin plant makes ~205 male flowers during crop cycle
- Would require 3,114 plants for pollen requirement
- At their planting density they had 6,733 plants/ac
  - 1,380,265 flowers
- 1 ac of pumpkin could support ~2 honey bee colonies



Adapted from: Vidal et al. 2006. Nectar and pollen production in pumpkin (Curcubita pepo L.).