

Apimondia International Beekeeping Congress
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Summer Bee / Winter Bee Physiological & Temporal Comparisons

Successful overwintering is a Honey bee colony's biggest challenge, requiring long-lived bees and internal resources.

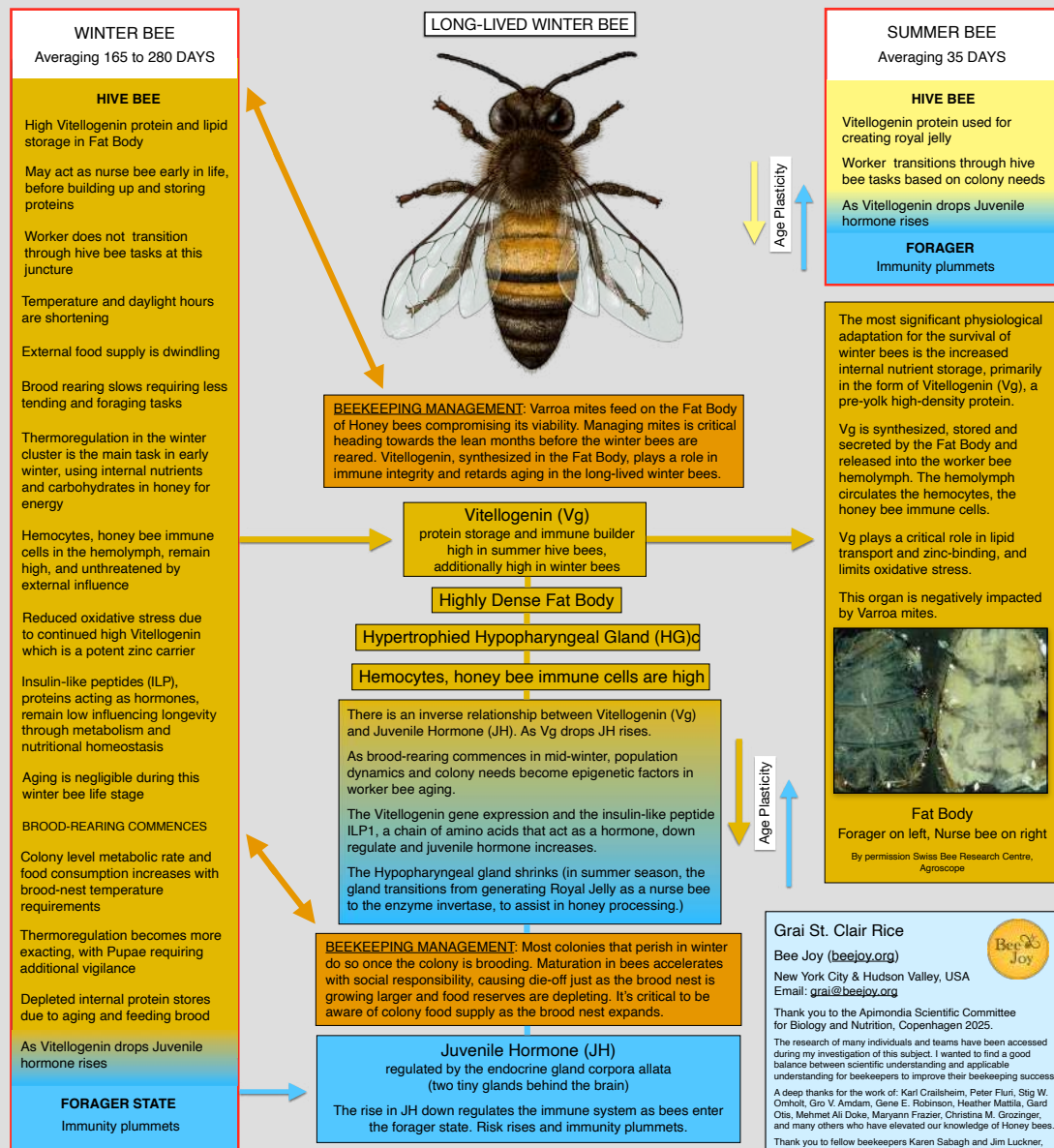
As a beekeeper, understanding the physiological components and the epigenetic factors impacting individual longevity can improve practical management at critical transition points in the colony year.

Specific beekeeping tasks involve managing Varroa mites prior to the winter brood being raised, to attain bees with healthy Fat Bodies, and being mindful of food supply when the metabolism of the colony ramps up with brood-rearing headed into spring, so the colony does not starve and freeze as bees age out.

Apis mellifera, the western Honey bee, has evolved to survive as a superorganism in challenging temperate regions, and other seasonal cycles of dearth, without external resources. Winter survival requires a healthy cohort of diutinus (Latin for long-lasting) worker bees, commonly called winter bees, which can live four to five times longer than summer bees. The DNA for these bee phenotypes are the same, although their seasonal gene expression results in different proteins and physiological traits, as well as behavioral adaptations which affect longevity.

The study of epigenetics has made clear that social and environmental stimuli affects gene expression, and these factors affect the temporal polyethism, or age plasticity, of worker bee life history.

Colony level population dynamics, including brood pheromone or lack thereof, provides internal-hive stimuli which regulate worker bee behavior in response to colony needs, which in turn influences the physiological state of the individual worker bees. External environmental factors provide additional stimuli.



Summer bee Vitellogenin protein level as nurse bee

Winter bee Vitellogenin protein level is higher & Fat Body denser

Inverse relationship of Vitellogenin & Juvenile hormone

High Juvenile hormone represents the forager state

Beekeeping Management Notes

PP-458 [Bee Biology]

Summer Bee / Winter Bee - Physiological & Temporal Comparisons

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Apis mellifera, the western Honey bee, has evolved to survive as a superorganism in challenging temperate regions, and other seasonal cycles of dearth, without external resources. Winter survival requires a healthy cohort of long-lived (diutinus) worker bees, which can live four to five times longer than summer bees.

The DNA for these two types of bees are the same, although their seasonal gene expression results in different proteins and physiologically traits, which affect longevity. Sociogenomics has made clear that external and internal stimuli affect gene expression, and these factors in turn affect the temporal polytheism, or age plasticity, of worker bee life history.

External factors thought to stimulate the onset of winter bee brood production are food availability, daylight length, and temperature. Internal factors involve intricate social regulatory mechanisms operating within a Honey bee colony, which integrate an array of pheromones, hormones, and protein production which are in a feedback loop with population dynamics, and are social drivers of aging influencing worker maturation, and thus lifespan.

Seasonal adaptations for a colony's winter survival are nuanced and multifaceted. Winter bees develop larger fat bodies, which regulate metabolism, energy storage, immunity and endocrine signaling, releasing higher levels of vitellogenin (Vg), an egg-yolk precursor protein, into their hemolymph. This influences anti-oxidant levels and immune responses and, without brood to feed, extends the bee's physiological state which is similar to a nurse bee during summer. Winter bees also exhibit hypertrophied hypopharyngeal glands, and lower immune response on their exoskeletal cuticle, due to the insular nature of the winter nest.

The focus of a winter colony begins with thermoregulation, requiring protein primarily from within the bees and carbohydrates from stored honey. Once brood-rearing expands vitellogenin levels drop and Juvenile hormone rises, jump starting worker maturation.

It is invaluable for beekeepers to understand the links between nutrition, biology, behavior and physiology in the winter bee colony. A time-line comparison will highlight significant physiological and behavioral differences, and their known drivers. This will provide insights into the value of healthy fat bodies going into dearth, and the physiological transitions which can cause colony fragility in midwinter.