



## Honey Bee Drone Husbandry

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Honey bee colony productivity and fitness are influenced by the quality, quantity and genetic diversity of drones mated to the queen. Mating requires massive numbers of drones from numerous colonies to form mating congregating areas, creating a genetically diverse pool. The queen's extreme hyper-polyandrous, risky, in-flight mating behavior produces high intra-colony genetic diversity, enhancing colony fitness. Rearing a plentiful supply of healthy, mature drones from select stocks can be challenging for breeding programs. Drones have a high rate of attrition at every life stage. Often overlooked, drones are highly susceptible to stressors, affected by many concurrent and interacting biotic and abiotic factors. Drone production requires proper attention, as in queen rearing.



### High Vulnerability

Drone mortality risk increases exponentially from early to late life stages. The haploid condition and longer development time increases susceptibility of drones to parasites, pathogens, pesticide residues, temperature extremes and environmental changes. These stressors reduce drone numbers, quality and semen viability. In response, drone brood is cannibalized and adults expelled, as they are not essential to colony survival. Mature drones tend to be sacrificed over developing and young drones. Often exposed to concurrent stressors, affecting drone numbers and quality, there is no recovery. As drones are expendable, quality care is required at every life stage. The fragility of drones, well known to practitioners of Instrumental insemination, is a limiting factor that requires attention.



### Limited Reproductive Season

Seasonally produced, colonies highly regulate drone rearing, dependent upon resources, colony health, population size, queen status and seasonal conditions. Primarily produced in spring and peak in summer, preparations begin in winter to ensure strong, healthy mother colonies. Slower to develop, areas of sealed drone brood are greatest a month before swarm season. Drones require 40 plus days to reach maturity; peak flight is 20 days post emergence. Queens will mate with an average of 15 - 20 drones, up to 77. Of semen collected, 90% is expelled, the queen retains sperm representing all the drones mated, 0.5 to 12 million sperm stored in her spermatheca. To increase drone numbers and health, supplemental feeding is recommended



### Drone Care for Instrumental Insemination

The rearing, care and identification of drones is an essential element of controlled mating. Drones can be marked and caught free flight or confined to nursery colonies for identification purposes. Recovery of mature drones, using either method, tends to be less than 50%. To bank mature caged drones, a well-fed queen-less nursery colony, cell builder or virgin bank is optimal vs a queen-right colony. Avoid temperature extremes in handling and transporting drones. During semen collection, which varies with inseminator experience, anticipate about half the drones will not yield usable semen due to various factors; maturity, quality, contamination during the eversion process. For an adequate supply of drones, prepare to rear 3 to 4 times the numbers required.



### Development and Nutrition

Per colony, hundreds to several thousand drones are produced vs a few queens. Their nutritional requirements, high weight gain during development and numbers are demanding on colony resources. The feeding requirements of drones are comparable to queens, fed high protein royal jelly. Spermatogenesis occurs at the larva stage, completed in the pupa stage. Highest drone larval nutritional demand is 2 to 4 days. Day 6 sperm multiplication is complete, established and unchanged. Nutrition influences semen concentration, viability, body mass, and ejaculate volumes. Temperature is also a critical factor, extremes resulting in sperm mortality. Drone quantity and quality vary, semen volume ranging 0.5  $\mu$ L to 1.7  $\mu$ L, 3 to 12 million sperm. Drone Weight, 200 - 300mg., is similar to queen weight, 175 - 290mg. Ensuring proper colony conditions and high quality nutrition is critical for good drone production. A high ratio of well-fed young nurse bees supplies good nutrition, and a strong colony population maintains a good field force and brood nest temperature.



### Unique Advantages

Drones offer unique opportunities for selection and research. Referred to as "clones," all the spermatozoa of an individual is identical. Instrumental insemination is a proven tool to control mating and enables unique and novel crosses; from the single drone insemination to pooling semen from hundreds of drones to inseminate a batch of queens. Traits occurring in low frequency or not expressed phenotypically can be amplified. Increasingly, molecular tools offer the ability to explore gene expression patterns, identify genetic markers, diagnose colony health and traits of resistance to pests and pathogens. The ability to store semen, short-term at room temperature for several weeks, allows easy transport. Cryo-preservation of semen enables longterm storage, although some damage occurs in the processing. This technique is sufficient for stock reconstruction, conservation and selection across time. Best management practices for successful drone husbandry support research programs, selective breeding and commercial queen production.

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References Available Upon Request



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## Background

Colony productivity and fitness are influenced by the quality, number and genetic diversity of drones mated to the queen. Drones' critical and exclusive function is reproduction. Breeding programs typically focus on queen and colony performance. Drone fertility and production are often overlooked. The quantity and quality of drones produced are highly variable within and between colonies, affected by many interacting factors. Rearing a plentiful supply of healthy, mature drones from select stocks can be challenging.

## Problem

Breeding programs should include management and selection practices to enhance drone fertility and production. Drones appear plentiful during swarm season, although colonies highly regulate their numbers. Drones are costly; their nutritional demands are comparable to queen rearing, and their numbers are more numerous. Their haploid condition and longer development time increase vulnerability to adverse effects of parasites, pathogens, chemical residues and environmental changes. Drones have a high rate of attrition at every life stage. During stressful periods, drone brood is cannibalized and adults expelled. The fragility of drones, known to practitioners of Instrumental insemination, can be a limiting factor.

## Methodology/Discussion

Commercial queen production requires massive numbers of drones from numerous colonies to form drone congregating areas. The inflight, polyandrous mating of queens enhances colony fitness. Semen concentration, volume, viability and drone size are affected by genetic and environmental factors. Management practices that improve rearing conditions, nutrition, and decrease exposure to pesticides, parasites and pathogens, should be implemented. Breeding programs should include these targeted criteria.

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