Emergency Queen Replacement

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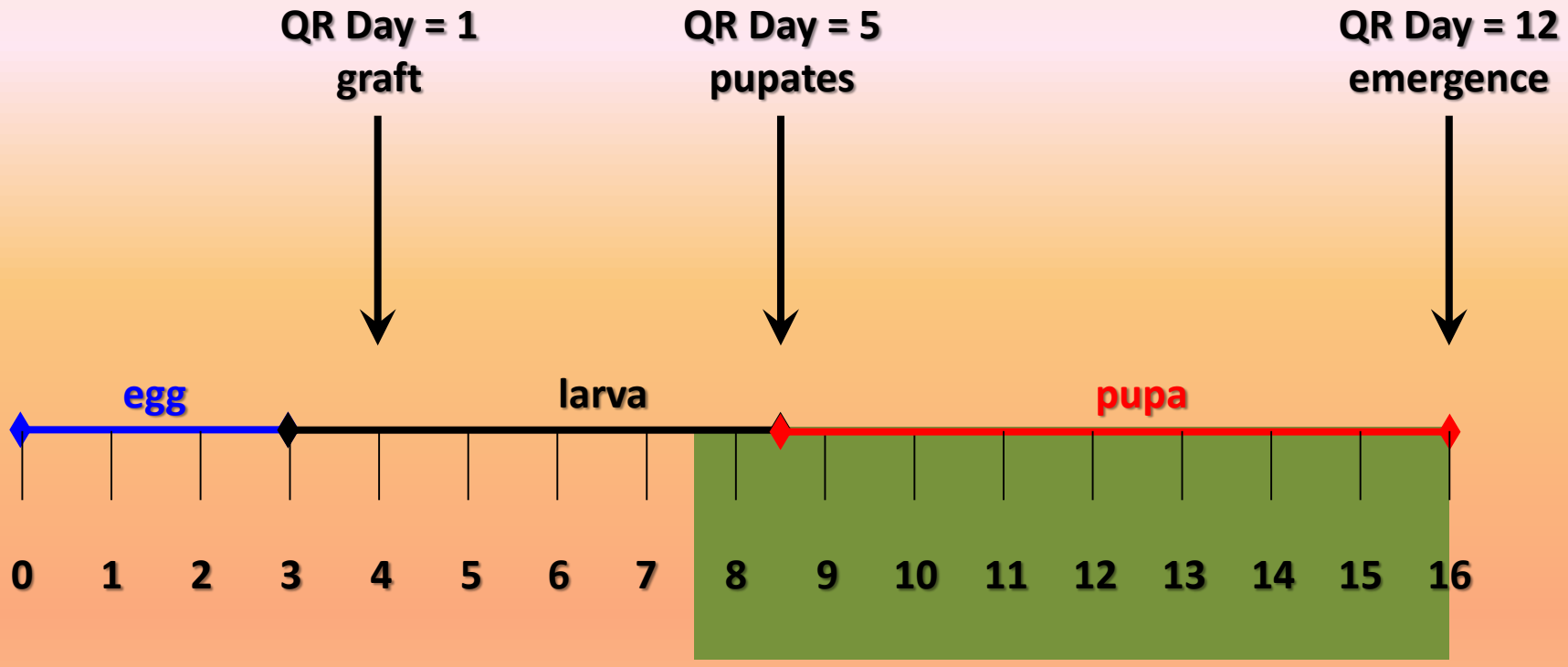
Queens

Life Cycle of Queens

- Mates when 6 – 8 days old
- Mates while flying (12 – 90 ft. above ground)
- Mates on multiple days & with multiple drones (if present)
- Diverse drone populations are better (genetic diversity)
- Mates when weather condition is acceptable (rainy days affect success)
- Properly mated queens are fertilized with over 5 million sperm
- Pheromones, Chemical Substances & Worker Bee Activity
- Avg. eggs/day = 1200 to 1800 (Spring & Early Summer)
- Avg. Reproductive Life Span 1 – 2 yrs.
- Avg. Life Span (subspecies influence) 3 – 5 yrs.

Drones



orientation and mating flights: 5-6 days post-emergence

queen begins egg-laying: 3-5 days post-mating

Mating Yard

- Install bees and queen cells and do not bother for 3 days
- Check Only to see if Queens emerged
- Wait 21 days to catch and cage queens

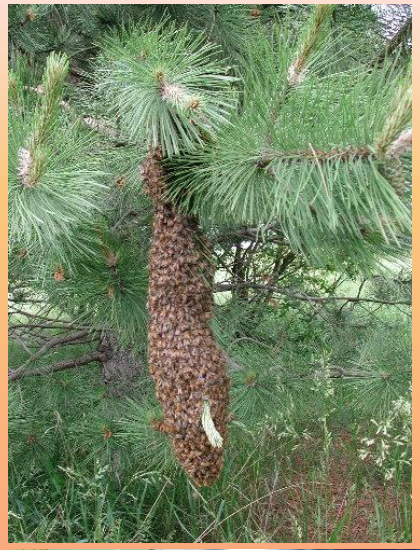
Natural Mating

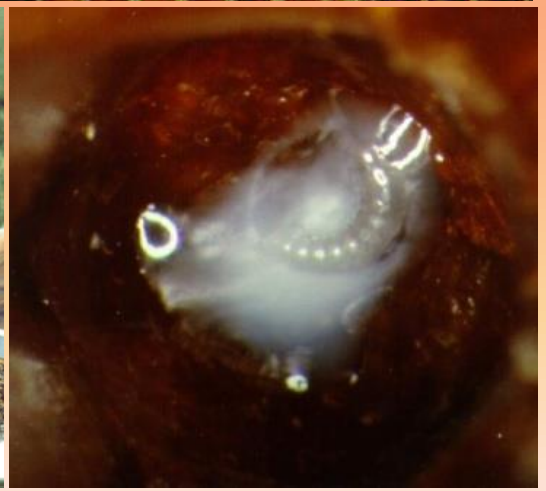
- High in the air at DCAs
- Drones fly to DCAs close to home
- Drones only mate with queens in DCAs
- Queens tend to visit DCAs farther from home

When Bees Replace Queens:

- Emergency – sudden loss of queen
- Supersedure – replacing a failing queen
- Reproductive Swarming – natural spring event
- Overcrowding Induced Swarming – not necessarily during the spring season

Key Ingredients





Quality of Cells

Swarm Cells usually from good nutrition

Supersedure Cells often formed during periods of poor nutrition

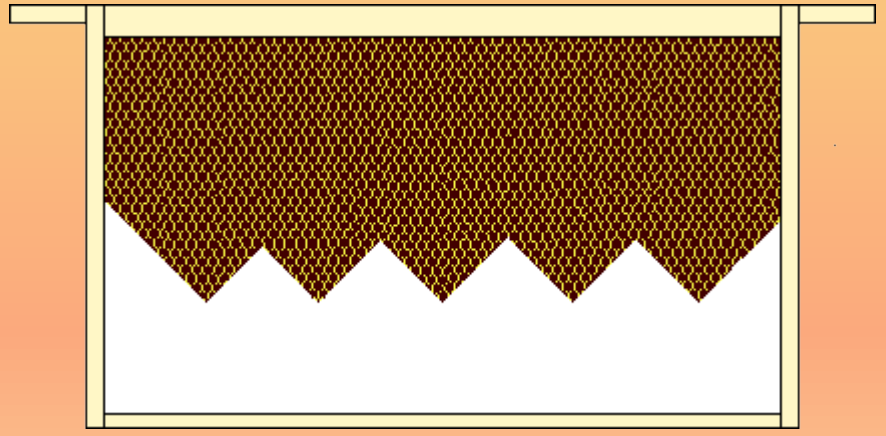
Non-Graft Methods

Bee Density

Charles C. Miller (1911)

Miller Method

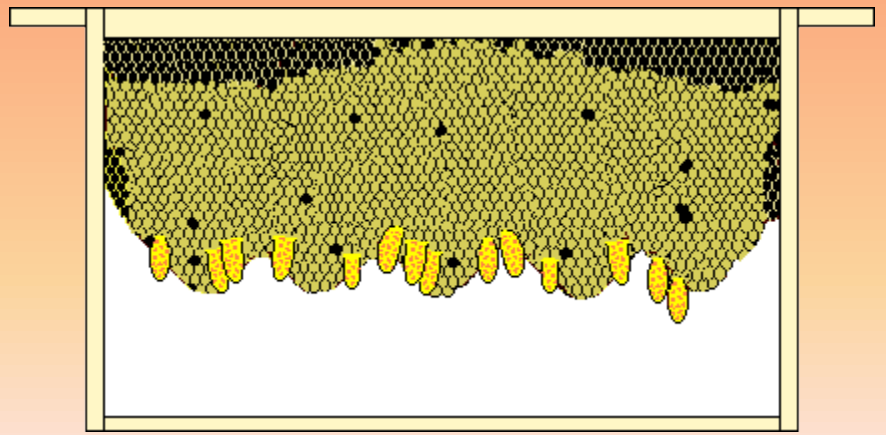
- Choose strong parent colony with desired traits
- Insert frame with foundation triangles into center of nest
- Check every 2 days to see if bees draw comb
- Look for appearance of eggs in new comb



Miller Method

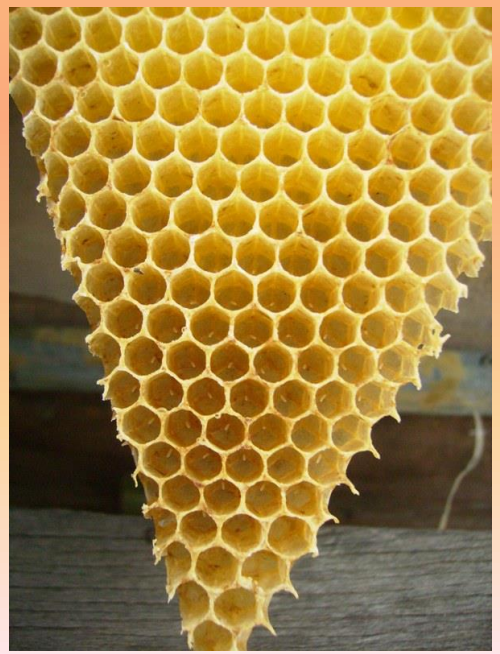
- Prepare CELL STARTER about 24 hours before eggs should hatch

- Remove drawn frame from parent colony and cut drone comb back to original shape of foundation

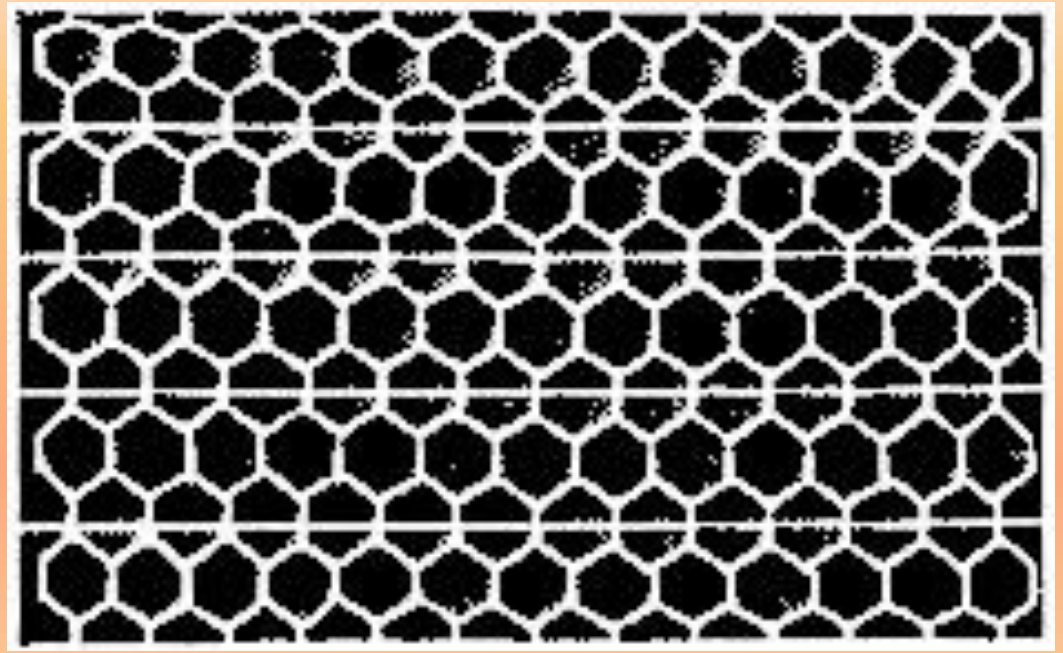


- Some people will also kill worker larvae to leave space for queen cell construction

Miller Method



Henry Alley(1883)



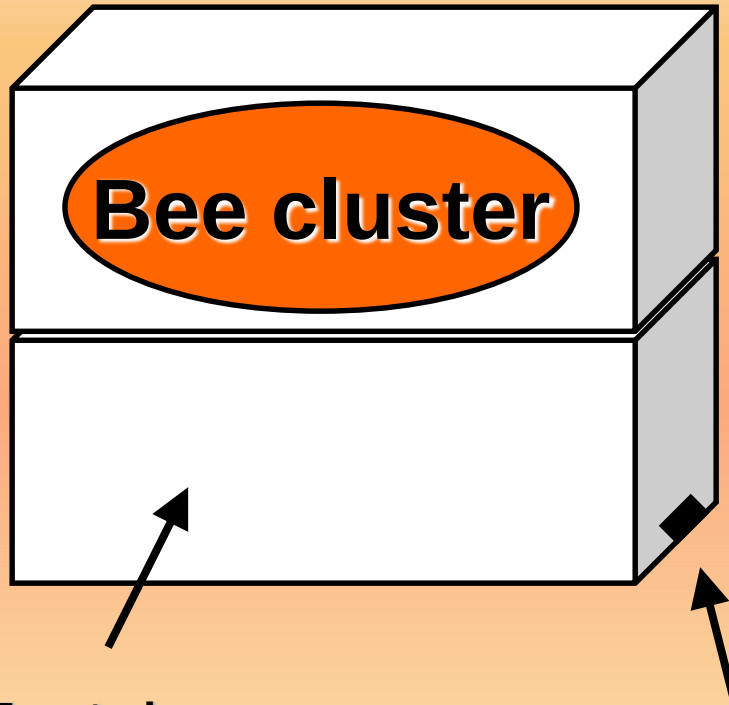
Isaac Hopkins (1886)

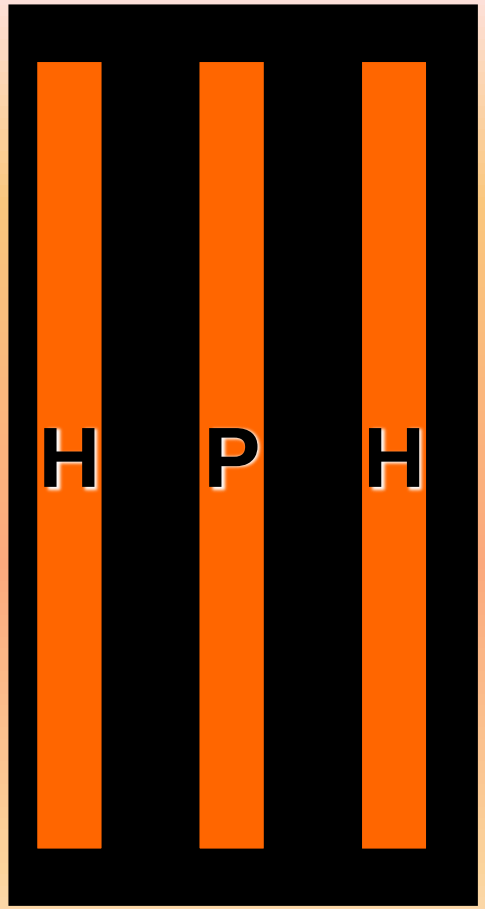
A ventilated swarm box.

Swarm Box

- Collect 2-3 lbs. of bees into a deep 5-frame nuc box a few hours before the graft (without a queen)
- Fit the nuc with either an empty rim, or a screened chamber (for cluster expansion)
- Provide honey and pollen combs; water on a clean sponge inside box; also feed syrup
- Do not allow bees to fly freely

Swarm Box





(view from top)

Mark and Clip Your Queens

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Swarm Induction

- Pick strong colony with desired genetics
- Be sure the queen is clipped and marked
- Allow colony to become crowded (do not super)
- Monitor daily until it swarms (queen will fall to ground)
- Harvest cells with a pocket knife

Alternative Swarm Induction

- You have discovered a colony that has prepared queen cells for swarming
- Locate and verify queen (some people isolate in a nuc)
- Harvest all frames with queen cells into nucs (with adhering bees)
- Allow queens to emerge and mate
- Retain queens as emergency replacements

Timing and Queen Replacement

Replacing Unit	Time to New Queen	Time to Mate	Time to Lay Eggs	Total Time until New Brood
Mated Queen	2-5 days	---	3-5 days	5-10 days
Mature Queen Cell	2 days	6-8 days	3-5 days	11-15 days
Eggs	12-16 days	6-8 days	3-5 days	> 21 days

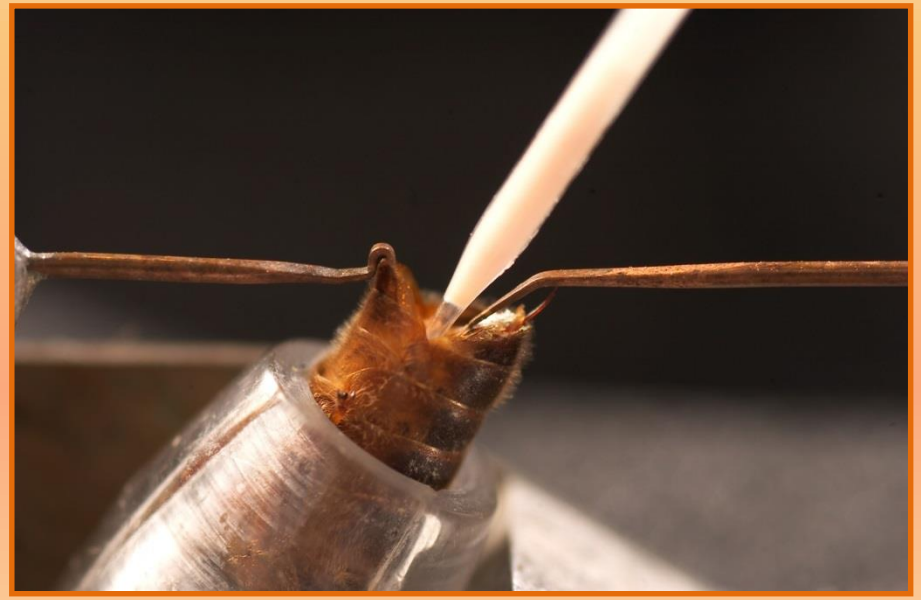
Final Suggestions

- NEVER cut queen cells until you verify a queen is present!
- A supersedure queen is better than no queen!
- Get in the habit of always producing a few extra queens from a colony with swarm cells.
- Nothing lost by doing so. Foolproof requeening by transferring an entire nuc into a larger hive.

Controlled Matings

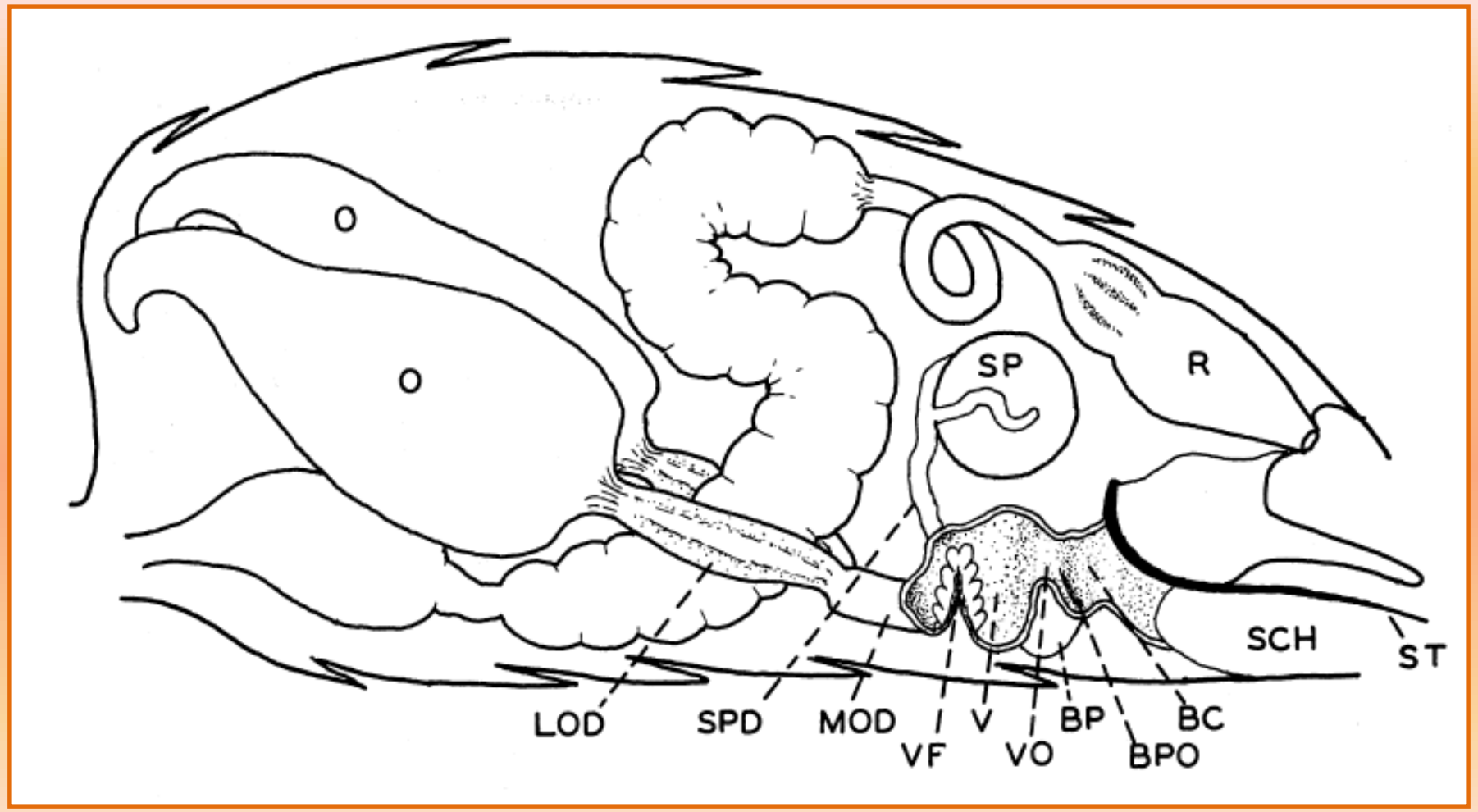
- Bee breeding requires controlled crosses
- Isolated islands
- Drone saturation of semi-isolated areas
- Instrumental insemination

Instrumental Insemination



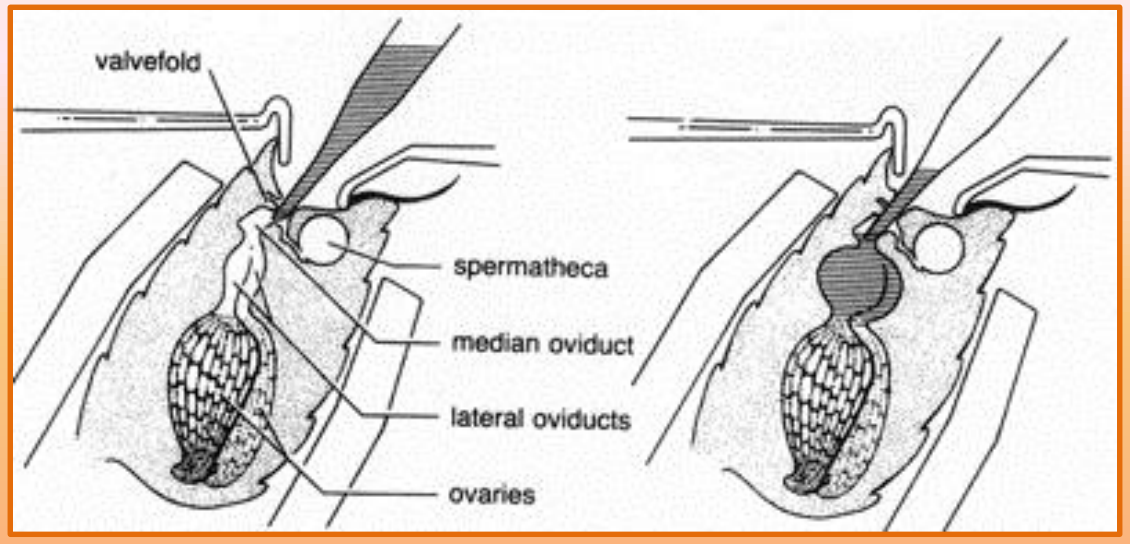
- Delivering semen to queen's oviducts
- Device to immobilize and position queen
- Syringe for collecting and delivering semen
- Carbon dioxide

Reproductive Organs of Queen



Mackensen and Tucker, Instrumental Insemination of Queen Bees, USDA Agricultural Handbook 390, 1970.

Instrumental Insemination

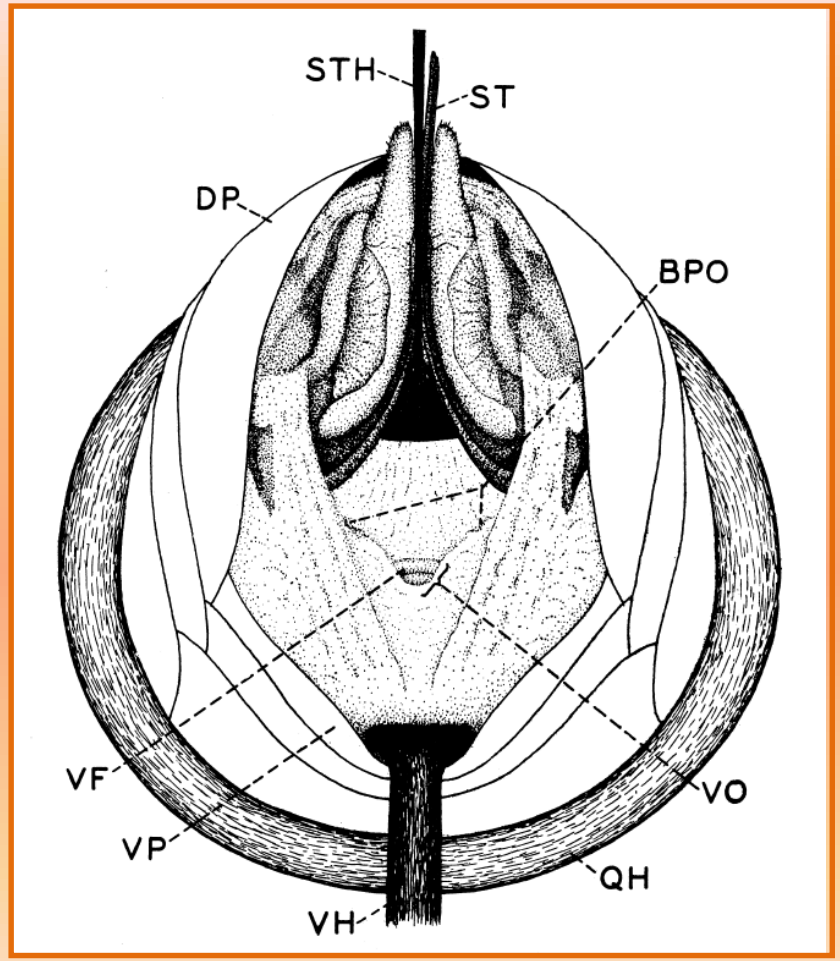


- **Hooks used to open vagina for insertion of glass tip through valve fold**
- **Semen floods medial and lateral oviducts**
- **Each drone produces 7.5 million sperm per microliter (up to 10 million from 1 drone)**
- **About 5 - 6.5 million sperm stored in spermatheca of naturally mated queen**
- **Queens are best inseminated with 8 – 10 µl**

John Harbo, Instrumental Insemination of Queen Bees – 1985; *American Bee Journal*, pp. 197-202 and 282-287.

Instrumental Insemination

- **All devices use a ventral hook or a clip to secure ventral plate**
- **II devices vary in methods for holding sting**
- **Mackensen device uses sting hook positioned at base of sting**
- **Other devices use a forceps to grasp sting**
- **My forceps is a self-closing one glued to the Mackensen device**



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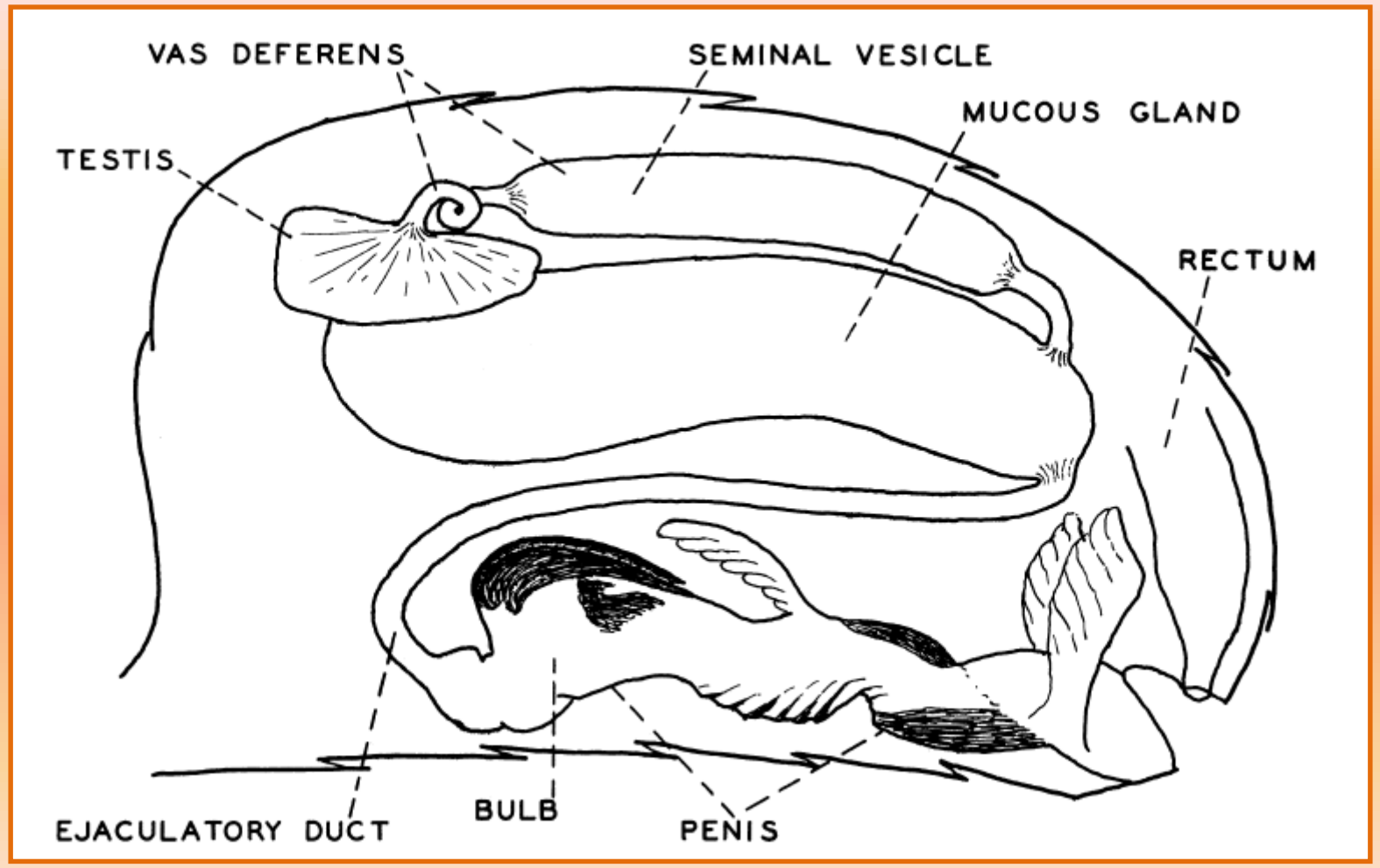
Queen Sexual Maturity

- **Optimal age for insemination is 6 – 14 days old**
- **Young queens cannot tolerate large semen volumes**
- **The best inseminations occur from free-running queens aged 7-8 days in nucleus colonies**
- **Queens can be banked for long periods (up to 5 weeks) before insemination**

Reproductive Organs of Drone



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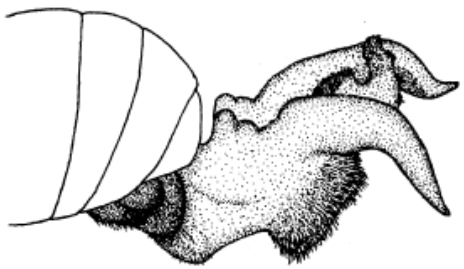
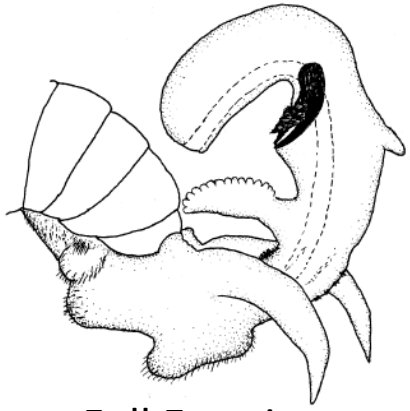
Drone Sexual Maturity

- **Drones are not sexually mature when they emerge from brood cells**
- **Sperm begins to migrate from testes to the seminal vesicles when drones are 3 days old**
- **Complete filling of the vesicles occurs within 6 days of age**
- **However, it is best to use drones that are 10-21 days old for inseminations**

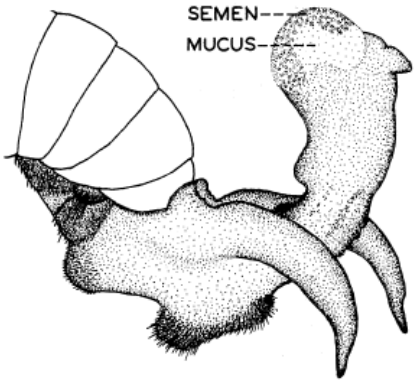
Eversion of Endophallus



Partial Eversion



Full Eversion



Semen on Mucus

Mackensen and Tucker, Instrumental Insemination of Queen Bees, USDA Agricultural Handbook 390, 1970.

Eversion of Endophallus

Immature Drone

Mature Drone

Semen Collection

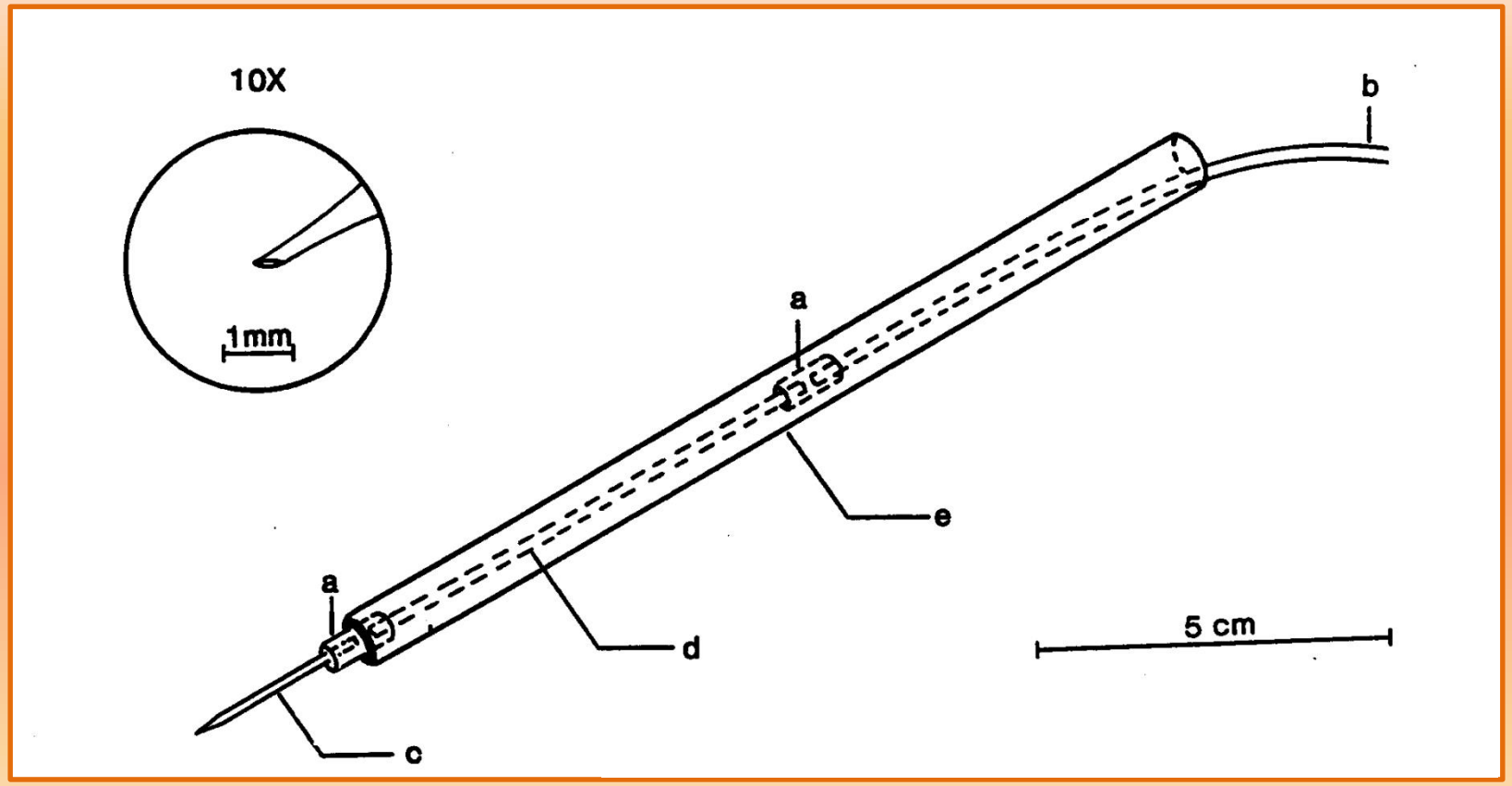
Full Eversion

Drawing Semen into Glass Capillary

Semen Collection

- **Boil saline for use in syringe barrel; add antibiotic after it has cooled**
- **Prime syringe with boiled saline; no air bubbles in saline column**
- **Leave a 2-3 µl air between saline column and semen**
- **Use a small amount of saline to touch semen from 1st drone**
- **Keep syringe tip clean and wet with saline in between drone collections**
- **Avoid air bubbles during semen collection**
- **Avoid mucus – this will clog tip during insemination and risk losing semen when trying to remove blockage**

Harbo Syringe



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Features of Harbo Syringe

- **Allows large capacity collection of semen (> 100 µl) and mixing**
- **Allows single-drone inseminations**
- **Permits collection, packaging and shipment of semen**
- **Tip dimensions: ID (0.15-0.20 mm) and OD (0.26-0.32 mm) at opening; fire polished**
- **Buy tips or obtain pipette puller to make your own**
- **Hydraulics driven by micro-burette or large capacity and threaded Hamilton syringe**

Insemination Saline

- Simple saline
  - Use distilled and/or purified water
  - 0.85% NaCl (4.25 grams in 500 ml total volume)
  - 0.25% dihydrostreptomycin sesquisulfate (1.25 grams in 500 ml total volume)

John Harbo, Instrumental Insemination of Queen Bees – 1985; *American Bee Journal*, pp. 197-202 and 282-287.

Insemination Saline

- Buffered saline (adjusted to pH = 8.6)
  - Use distilled and purified water
  - NaCl (1.1 g in 100 ml total volume)
  - Glucose (0.10 g per 100 ml)
  - L-Lysine (0.01 g per 100 ml)
  - L-Arginine (0.01 g per 100 ml)
  - Trizma Sigma 7-9 (0.329 g per 100 ml)
  - Trizma HCl (0.329 g per 100 ml)
  - Gentamicin (0.02 g per 100 ml)

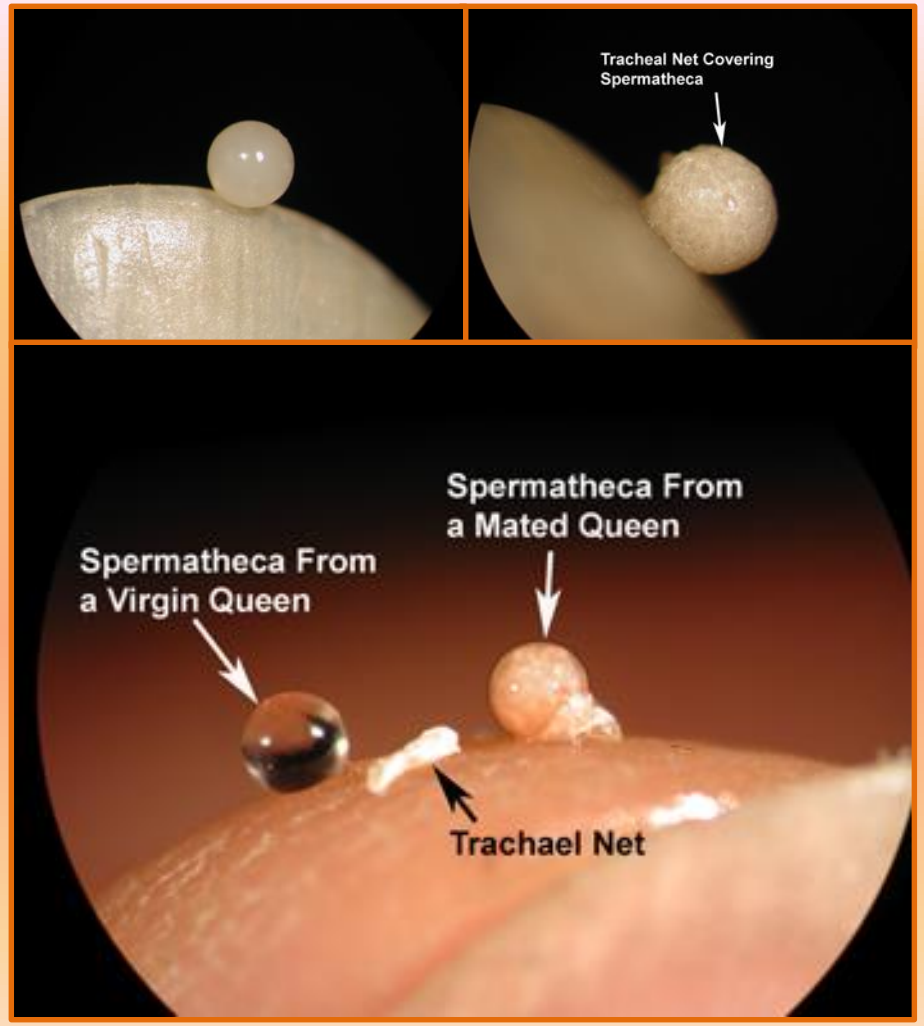
General Precautions

- **Cleanliness and sanitation are paramount; work area should be cleaned with bleach or similar sanitizer before each session**
- **Frequently wash hands while collecting large volumes of semen**
- **Never collect semen that has touched external surface of a drone**
- **Clean apparatus before each insemination bout**
- **Store glass insemination tips in undiluted bleach (5% sodium hypochlorite)**
- **Free flying drones have less feces**
- **Risks of fecal contamination increases with banking of queens and drones**

Checking for Insemination Success

Sue Cobey at www.honeybee.breeding.com

Checking for Insemination Success



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