

# Improving drone production and quality



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# Drones

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**Localizing Drone  
Congregation Areas for  
a breeding apiary**

**Optimizing Drone  
Fertility with Spring  
Nutritional  
Supplements**

# Breeding program

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**150 colonies under evaluation every year**

- **Hygienic behaviour**
- **Honey production**
- **Spring build-up**
- **Gentleness**
- **Varroa resistance**

**10 colonies for queen rearing**

**10 colonies for drone rearing**

**Instrumental insemination of 2 lines per year**

# Drones

- Drone production according to colony size and resources
- Sperm production during larval stage
- Sexual maturity reached between 8 and 12 days old
- 1.25  $\mu$ L semen 5M sperm



A close-up photograph of a honeycomb structure, showing the hexagonal cells filled with golden honey. A small portion of a honeybee is visible on the right side, partially obscured by the honeycomb.

# Honeybee reproduction

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- 6-21 drones mate with a queen during nuptial flights
- 1-3 nuptial flights to Drone congregation area (DCA)
- 5 - 7 million sperm in the queen's spermatheca
- Mating success of queens is linked to drone numbers and sperm quality

# Drone congregation area

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- Breeding program established in 2010
- Drone flooding and instrumental insemination
- DCA = meeting area of mature drones and virgin queens
- Where is our drone congregation area ?

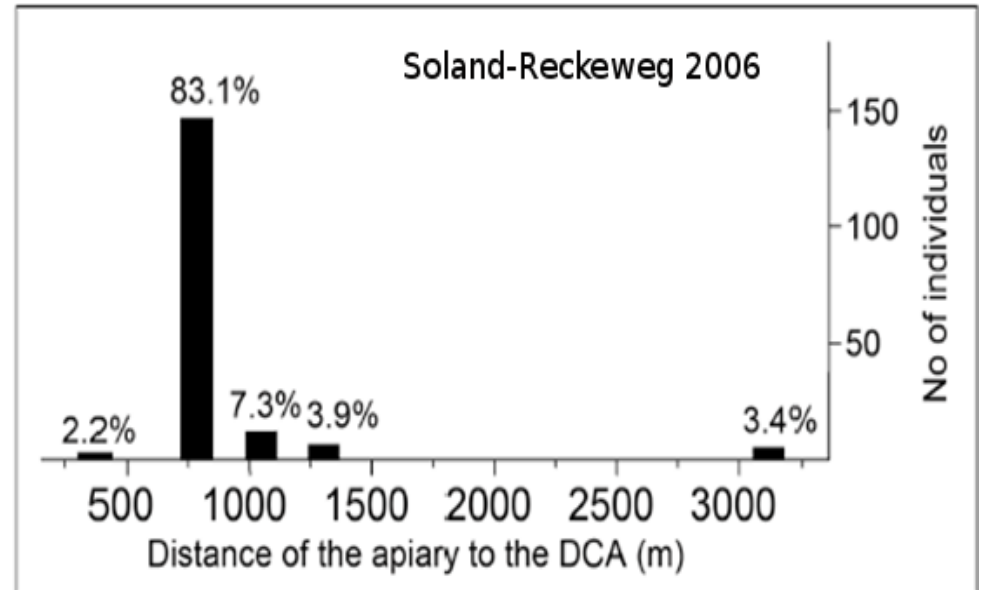
Sorel, A., Martin, G., Houle, E. and P. Giovenazzo (2018). Localizing Drone Congregation Areas for a Breeding Apiary. Bee Culture: July 2018.



# Drone congregation area

## Specifications

- Open area protected from winds and with visual cues
- Area = 100-200m
- Altitude 5-40m
- 14h-17h, 18-38°C, <22km/h
- Distance < 1km

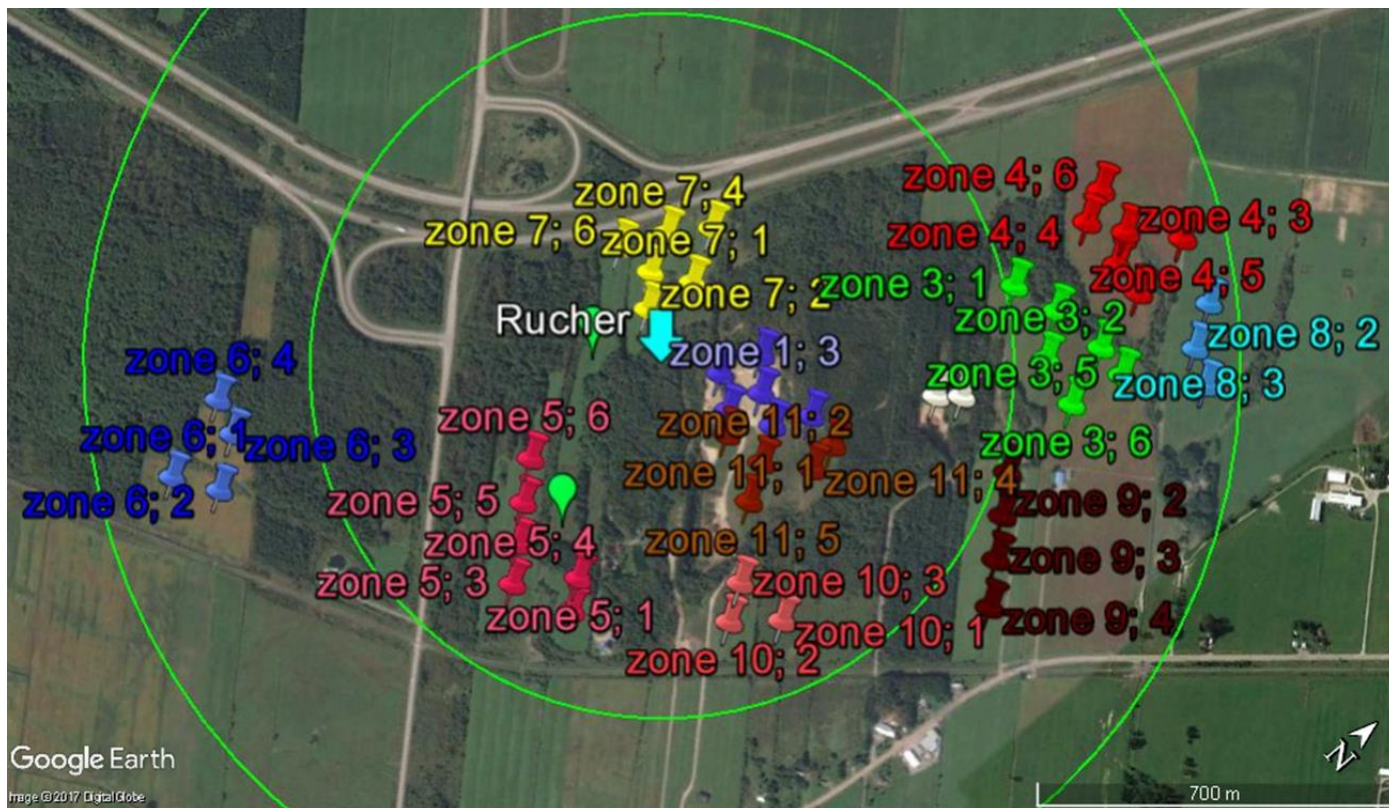




# The Quest

Method adapted from Mortensen et Ellis (2014)

Potential DCA zones localized with Google satellite imagery



⇒ 13 potential zones identified



# The drone traps



# Drone hunting







## DCA hypothesis

### Cast-off



# CRSAD DCA

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## Possibility of a second DCA?

- Zones tested 6/13
- 60m from the breeding apiary
- Average distance between 2 DCA = 3000m
- 3,4% drones > 3000m

## More research to be done

- Check the other potential DCA zones of our breeding apiary
- Find where our virgin queens are going

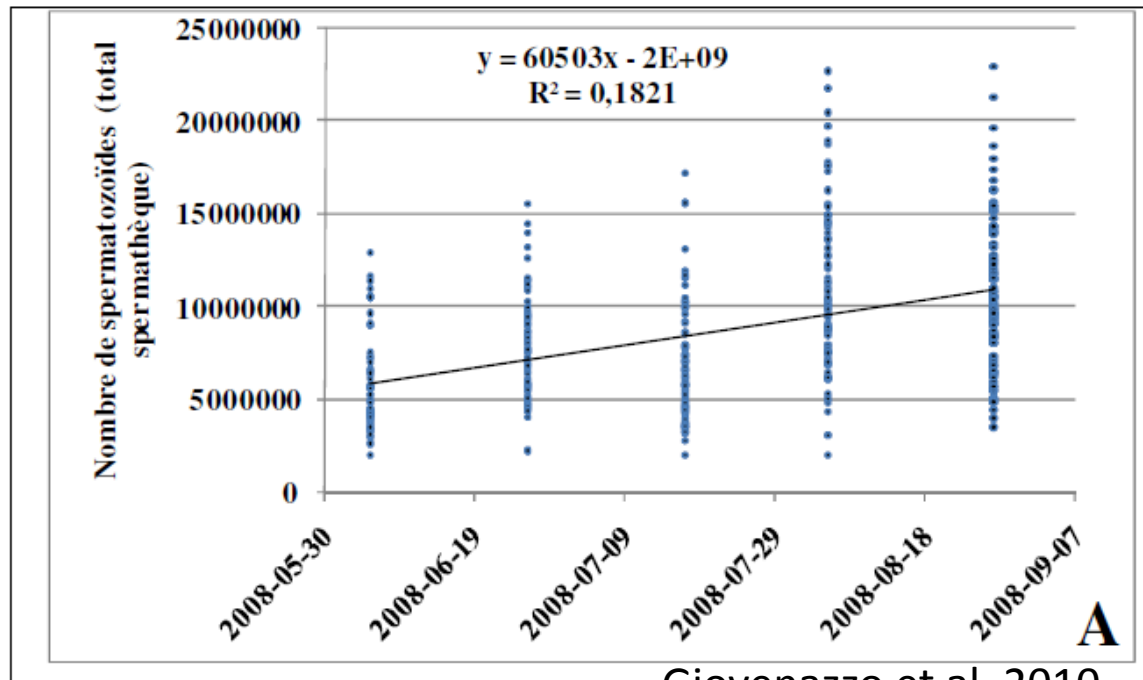
# Optimizing Drone Fertility With Spring Nutritional Supplements to Honey Bee



**Andrée Rousseau, M. Sc.**  
**Pierre Giovenazzo, Ph. D.**

# Drone and queen production

Spring challenges



Giovenazzo et al. 2010





# Drone production and quality

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- Drones production and quality seems to fluctuate during the beekeeping season
- Lower proportion of drones with semen and lower semen volumes at the beginning of the season
- Influence of spring supplementation on drone production and quality?

# Nutritional needs

## Sugar and protein needs of a worker larva vs drone larva



<b>Carbohydrates</b>	<b>59.4 mg</b>	<b>98.2 mg</b>
<b>Protein</b>	<b>25.0 - 37.5 mg</b>	<b>65.0 - 97.5 mg</b>
<b>Pollen</b>	<b>125.0 -187.5 mg</b>	<b>325.0 - 487.5 mg</b>

# Objective

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Evaluate whether supplemental feeding of sucrose and protein to honeybee colonies during drone larval and pupal development in spring affects drone size and reproductive quality post emergence

Rousseau, A. & Giovenazzo, P. (2016). Optimizing drone fertility with spring nutritional supplements to honey bee (Hymenoptera: Apidae) colonies. *Journal of Economic Entomology*, 109: 1009-1014. doi: 10.1093/jee/tow056

# Methods

- 20 honeybee packages
- 5 weeks of experimental treatments (early May)

**Pollen group (P)** : global patties (15% pollen) ad libitum

**Sugar syrup group (S)** : sugar syrup (1 :1, 2L/week)

**Pollen + sugar syrup group (PS)** : global patties (15% pollen) ad libitum + sugar syrup (1 :1, 2L/week)

**Control group (C)**: no supplementation





# Drone rearing and sampling

- One drone frame/colony 1 week after diet supplementation
- Drone rearing recorded each week
- Drone frame placed above the queen excluder before emergence
- Evaluation of the semen quality of 21-25 days old drones
- 50 drones/colony



# Drone evaluation

## Morphometrical measurements (50 drones/colony)

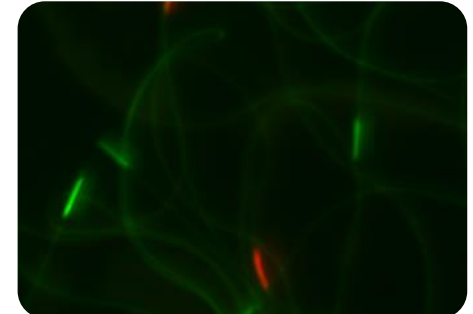
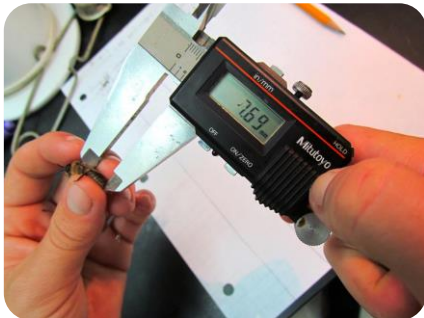
Weight, thorax and abdomen size

## Semen production and quality (7 pool of 5 drones/colony)

Semen volume

Sperm count/drone

Sperm viability % (Live/Dead Sperm Viability Kit)





# Results

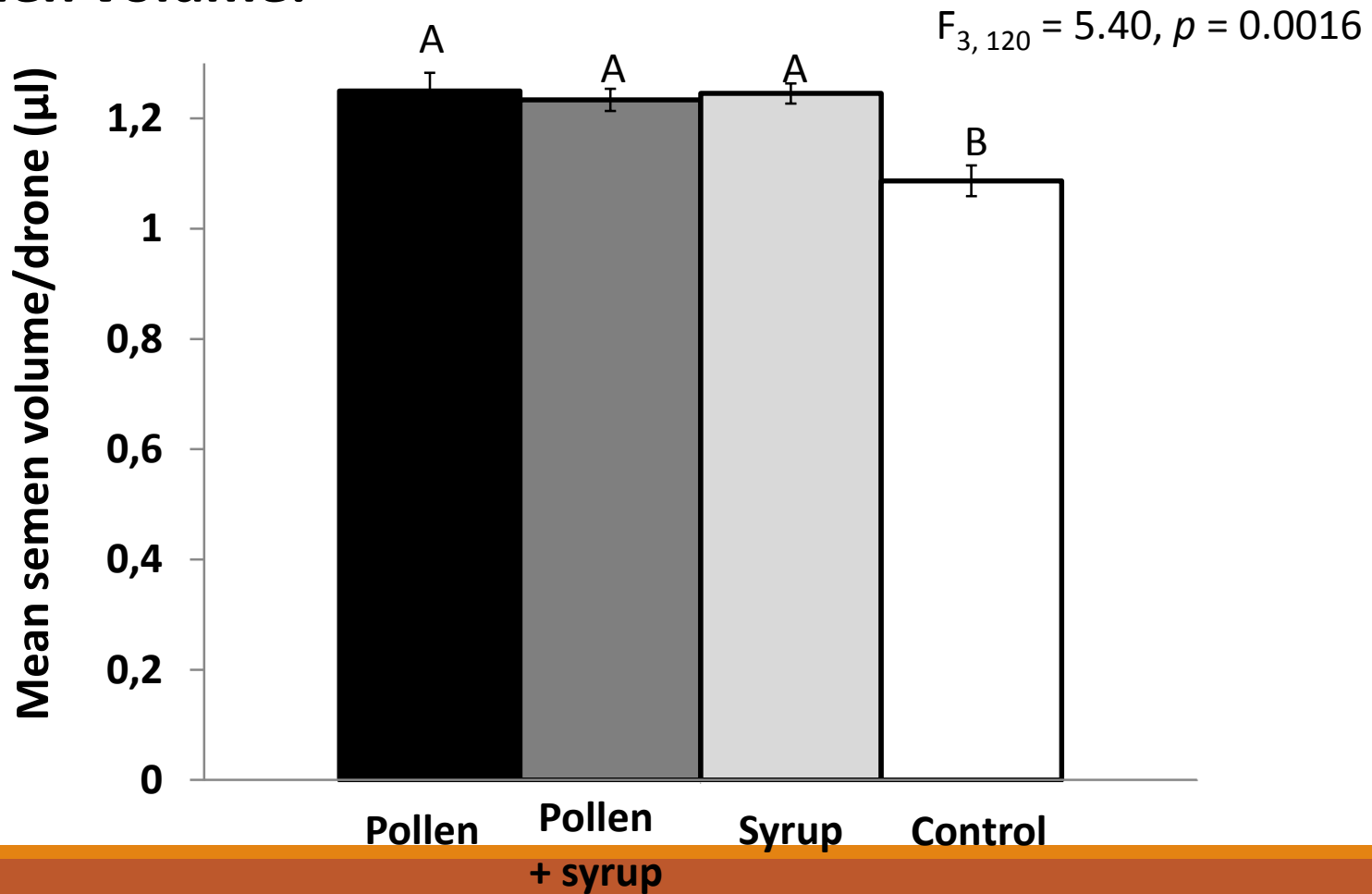
## Morphometrical measurements:

- 917 drones individually evaluated

Treatment	Weight (mg)	Abdominal index	Thorax width (mm)
Control	240 ± 1 (ab)	42.49 ± 0.26 (a)	5.45 ± 0.014 (a)
Pollen	238 ± 1 (a)	43.82 ± 0.26 (b)	5.29 ± 0.021 (b)
Syrup	241 ± 1 (ab)	44.17 ± 0.24 (b)	5.32 ± 0.011 (b)
Pollen + Syrup	243 ± 1 (b)	43.89 ± 0.23 (b)	5.39 ± 0.010 (c)

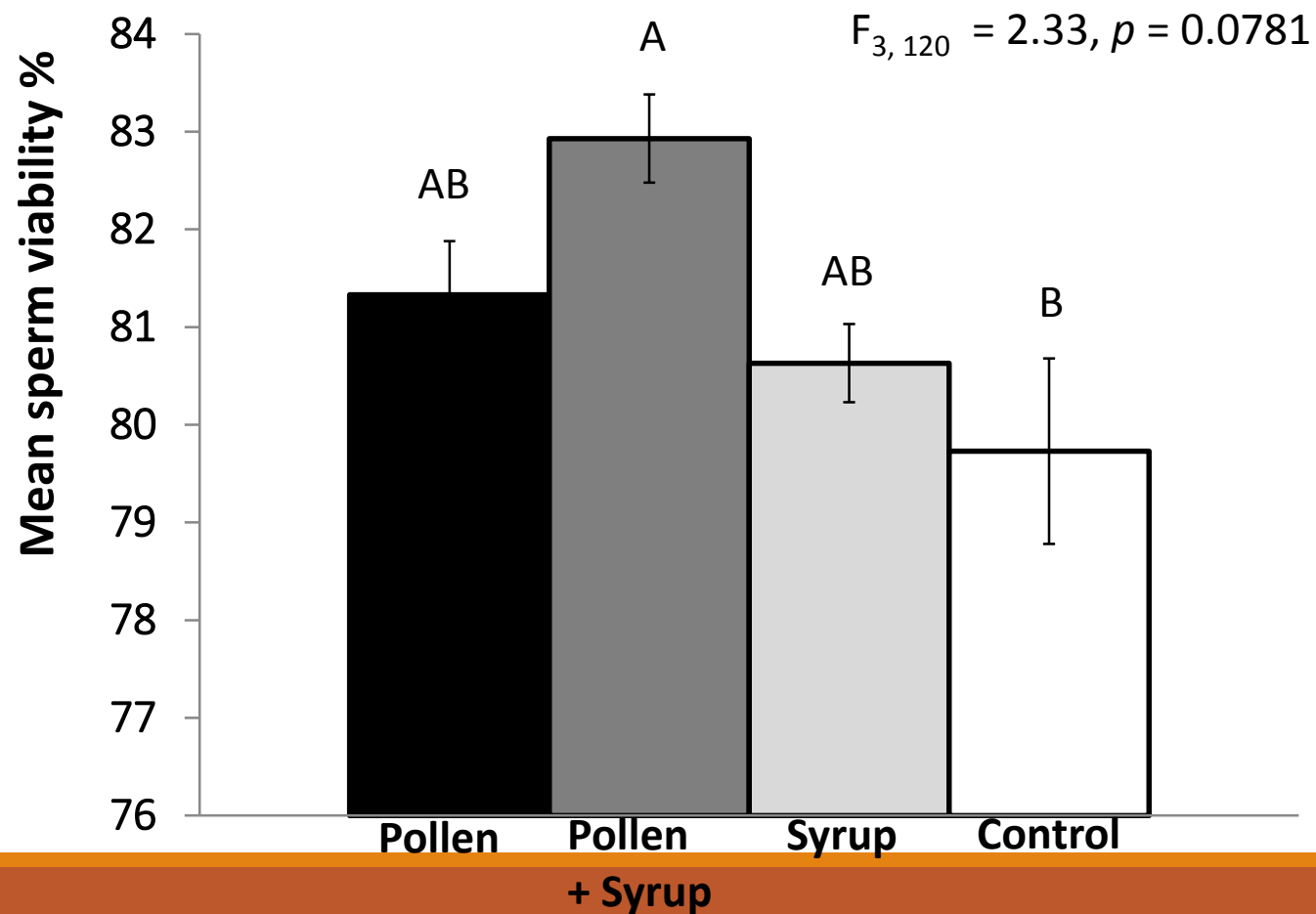
# Results

## Semen volume:



# Results

## Sperm viability:



# Discussion

- Pollen + syrup to drone colonies in spring = heavier drones, higher sperm viability %
- All types of supplementation increased drones abdomen size and semen volume

Rousseau, A. & Giovenazzo, P. (2016). Optimizing drone fertility with spring nutritional supplements to honey bee (*Hymenoptera: Apidae*) colonies. *Journal of Economic Entomology*, 109: 1009-1014. doi: 10.1093/jee/tow056





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