



## Mejoramiento Genético de abejas



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Prof Titular Apicultura





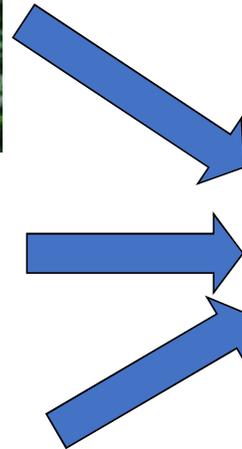
Control  
Sanitario

**Manejo**



Genética

Material vivo  
Certificado



Apiario

Mayor Producción

Mejor Calidad

Mayor Competitividad





# Origen haplodiploide de los sexos



**obreras**

**reina**

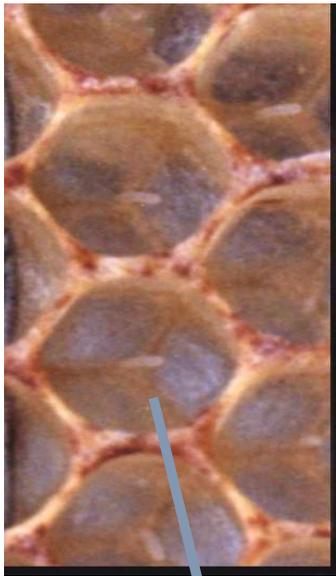
$2n = 32$  cromosomas



**zánganos**

$n = 16$  cromosomas

# Determinación de castas



**huevo fecundado**  
 **$2n = 32$**

**Alimento**



**Reina**



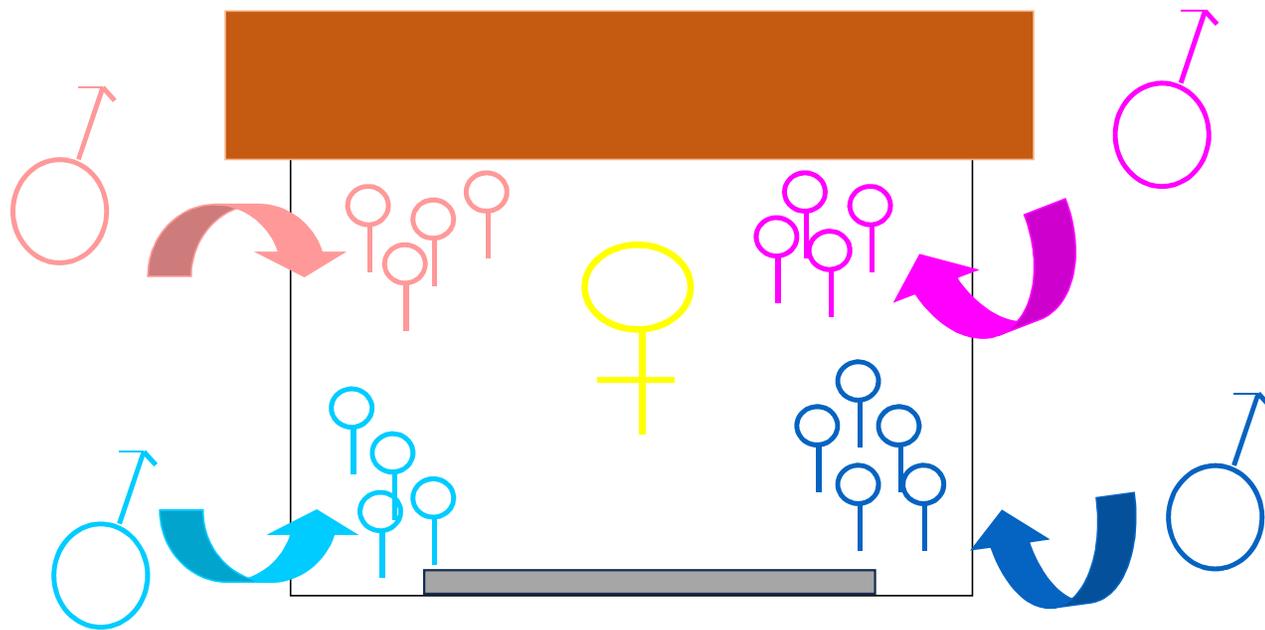
**Obrera**

## Características del apareamiento natural

- en vuelo
- lejos del apiario de origen
- 7-17 zánganos
- áreas de congregación de zánganos



## Composición genética de la colonia



**Una super familia con varias sub-familias**

**(reina común)**

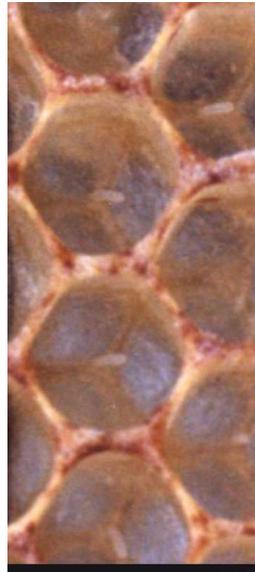
**(zángano común)**

## Determinación del sexo (alelos sexuales)

$X_1, X_2, X_3, \dots, X_n$

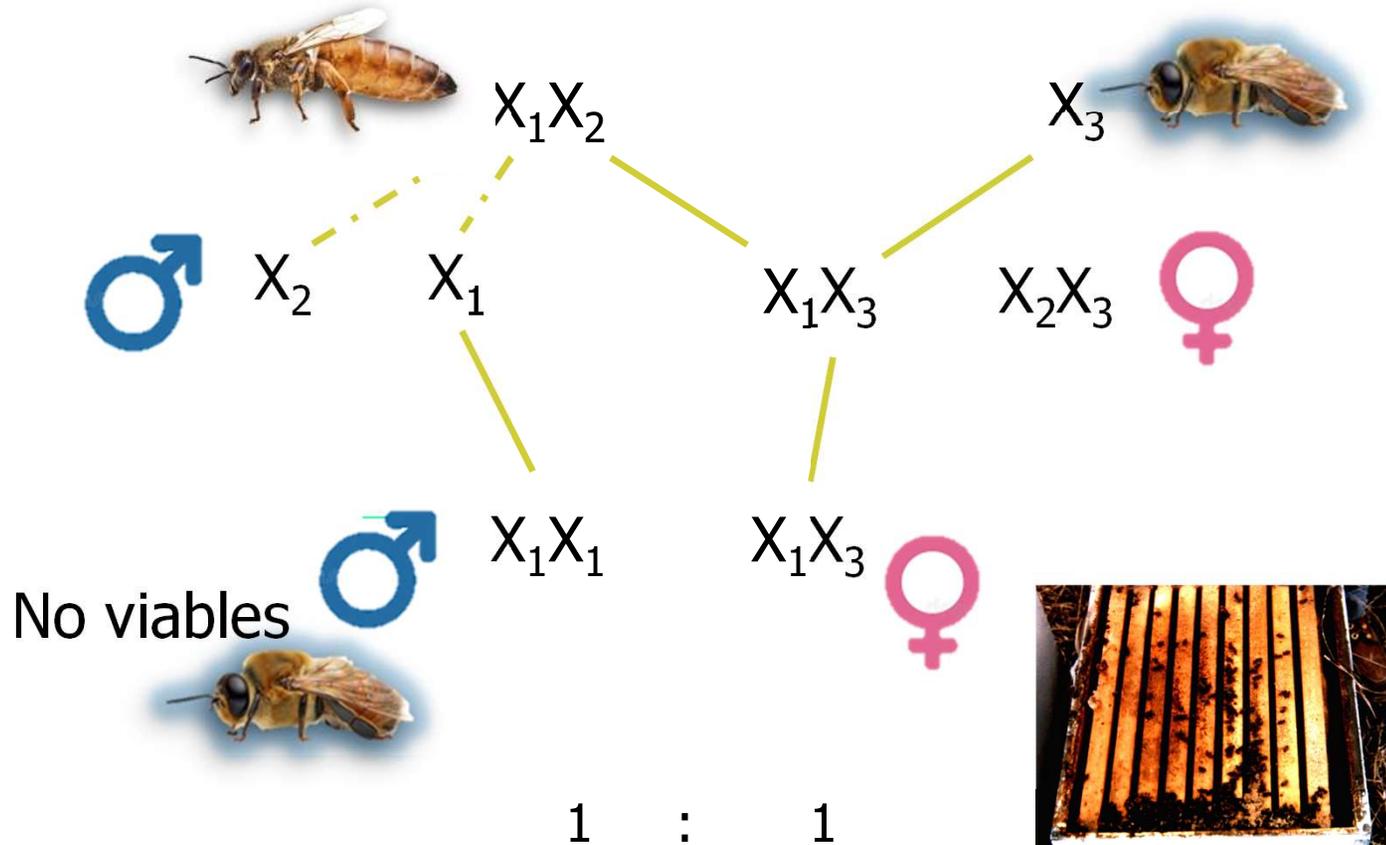
**Hembras**  $2n$   $X_1X_2$

**Machos**  $n$   $X_1$  ó  $X_2$



**$X_1X_1$  NO VIABLES**

# Determinación del sexo (alelos sexuales)



## SELECCION

elección de los individuos superiores que serán usados como padres para la próxima generación.

### IDEOTIPO

Interés comercial:

- ✓ producción de miel
- ✓ producción de polen
- ✓ producción de propoleo
- ✓ producción de jalea real
- ✓ polinización

✓ color

✓ mansedumbre

Rango geográfico: G x A

Fenotipo = Genotipo + Ambiente + G x A



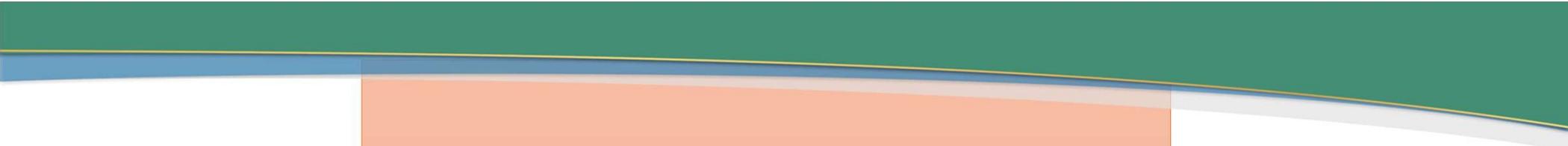
=



+



+ G x A



La superioridad de un material genético depende del objetivo del Apicultor y de la zona en que se encuentre

## Unidad de selección

aptitud  
polinización



producción

tolerancia a  
enfermedades

defensa

## Unidad de manejo

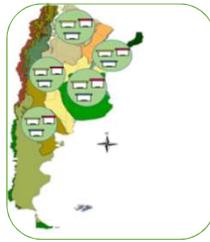
Alimentación

Manejo  
sanitario



Recambio  
reinas

Amplia base de selección

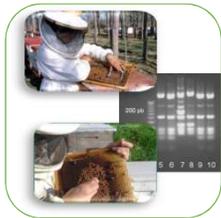


Adaptación ambientes

Estudios moleculares

Criterios de selección

Medidas objetivos



Calidad de semen

Calidad de reinas



Material seleccionado

Banco In Vivo de germoplasma



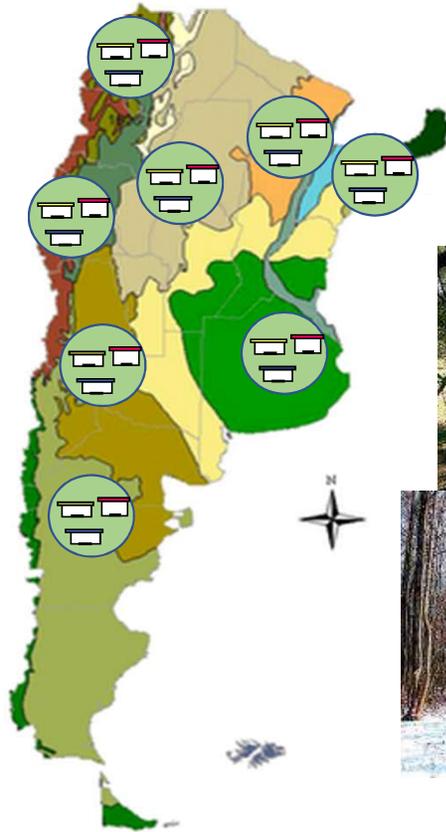
PRO API   
Convenio ACAMVC



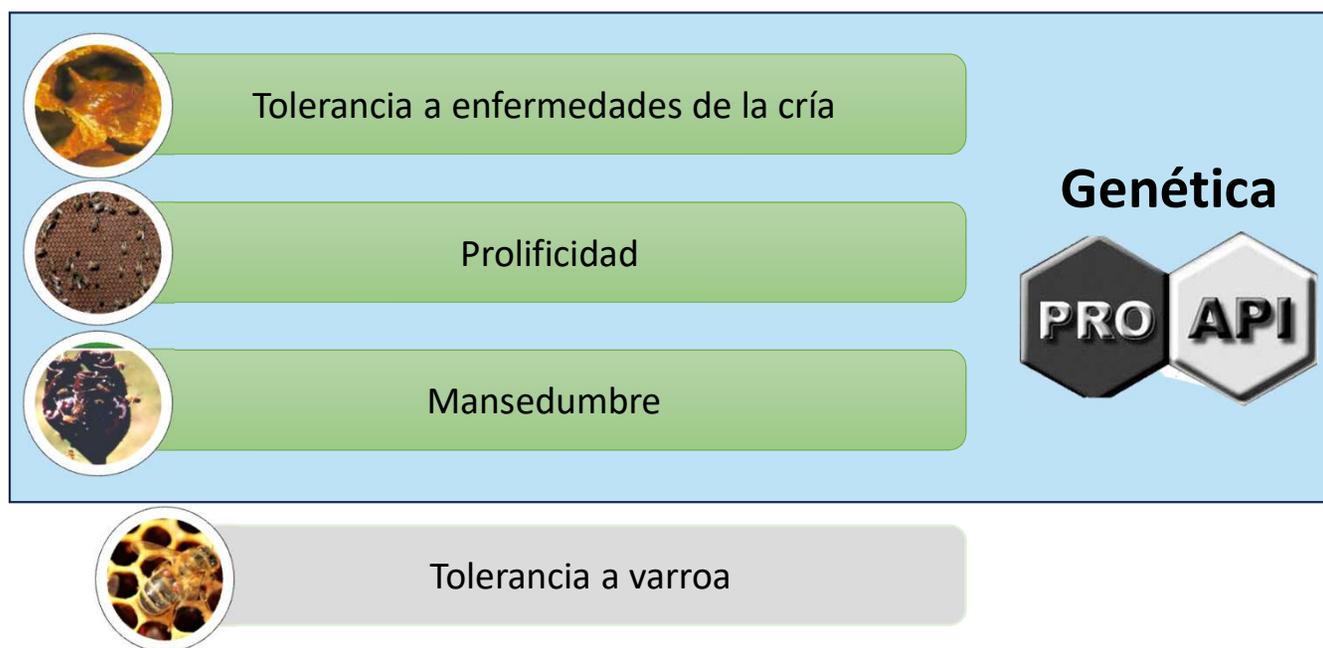
## Amplia base de selección



# Adaptaciones ambientes



## Criterios de selección



# CARACTERES CORRELACIONADOS

**RENDIMIENTO DE MIEL**

**TOLERANCIA A ENFERMEDADES  
DE LA CRÍA**

**depende de**



**Fortaleza de la colonia  
Capacidad de vuelo  
Comunicación fuentes  
consumo**



**Agente causal  
Necesidad de inoculación**



**CAPACIDAD DE POSTURA  
DE LA REINA**



**COMPORTAMIENTO  
HIGIENICO**

# MEDIDAS OBJETIVAS

Comportamiento  
higiénico



Prolificidad



Comportamiento  
o defensivo



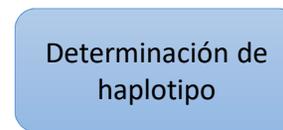
Productividad



Estudios  
moleculares



Determinación de  
haplotipo



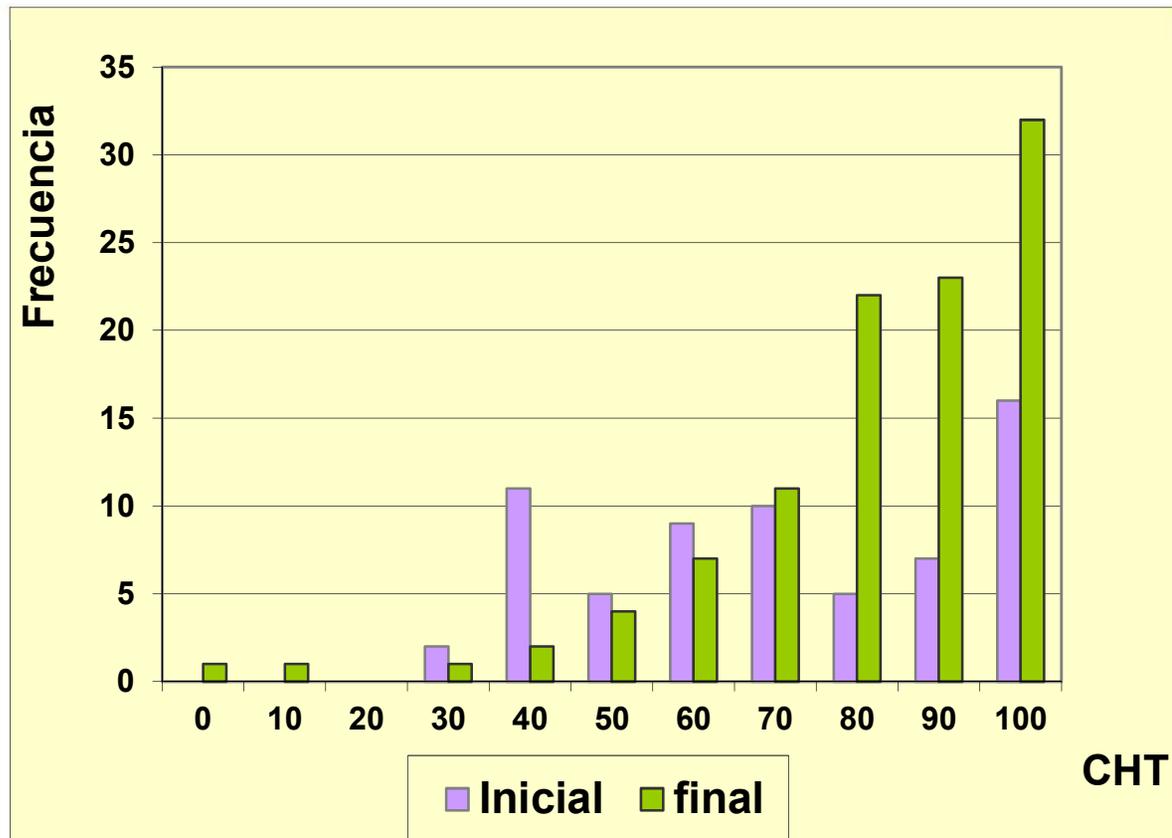
Tolerancia a varroa



## MEDIDAS OBJETIVAS



## MEDIDAS OBJETIVAS



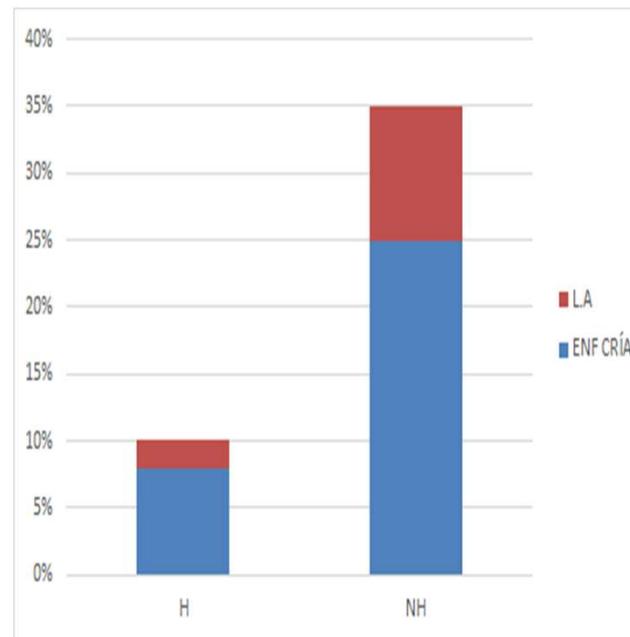
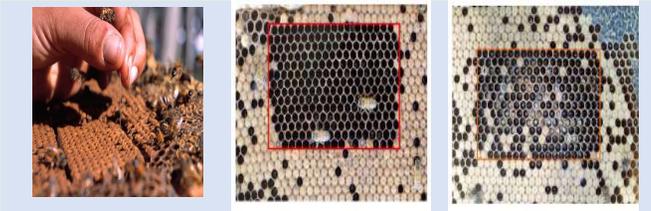
FRECUENCIA DE COMPORTAMIENTO HIGIENICO  
TOTAL EN LA POBLACION INICIAL Y FINAL

## MEDIDAS OBJETIVAS



**Colonias Higiénicas** ➔ **Menor frecuencia de enfermedades de la cría**

Importante efecto en la sanidad



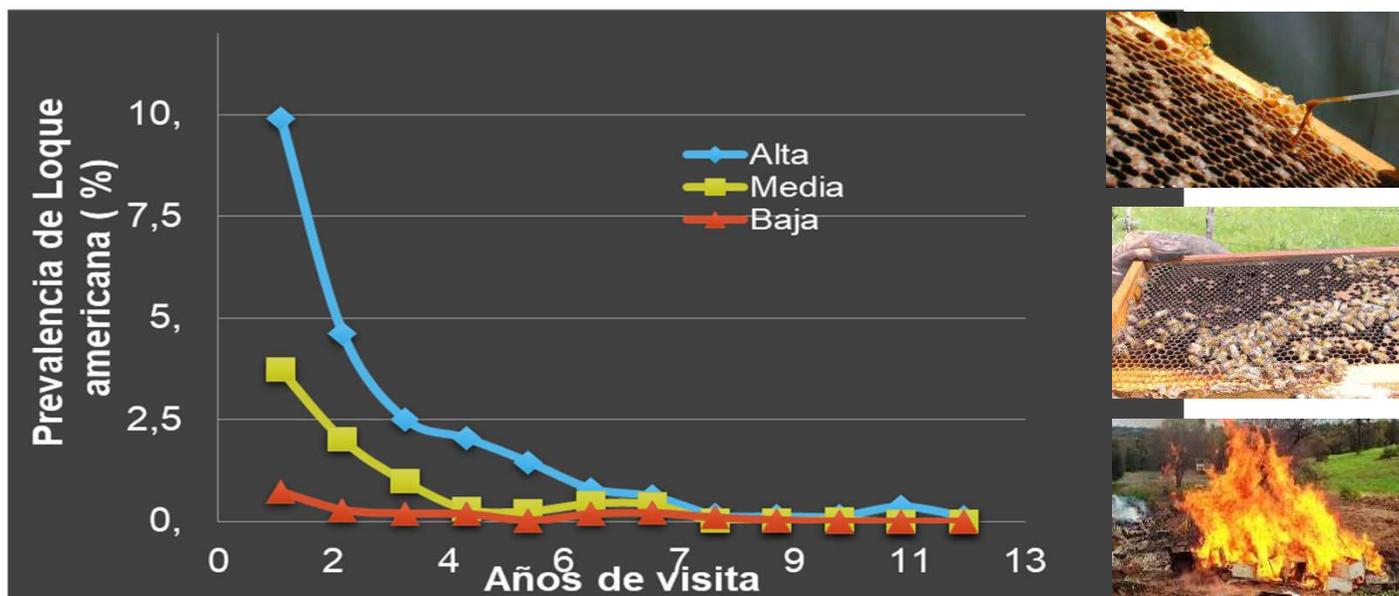
PALACIO et al. 2000. Changes in a population of *Apis mellifera* selected for its hygienic behaviour..  
Apidologie 31:471-478



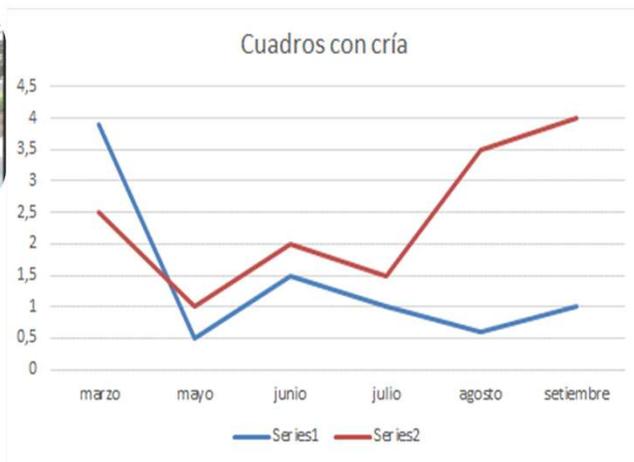


## Colonias Higiénicas ➔ Menor frecuencia de enfermedades de la cría

Importante efecto en la sanidad  
Apicultura sin uso de antibióticos  
Productos de calidad



# MEDIDAS OBJETIVAS



**Colmena Tipo I**

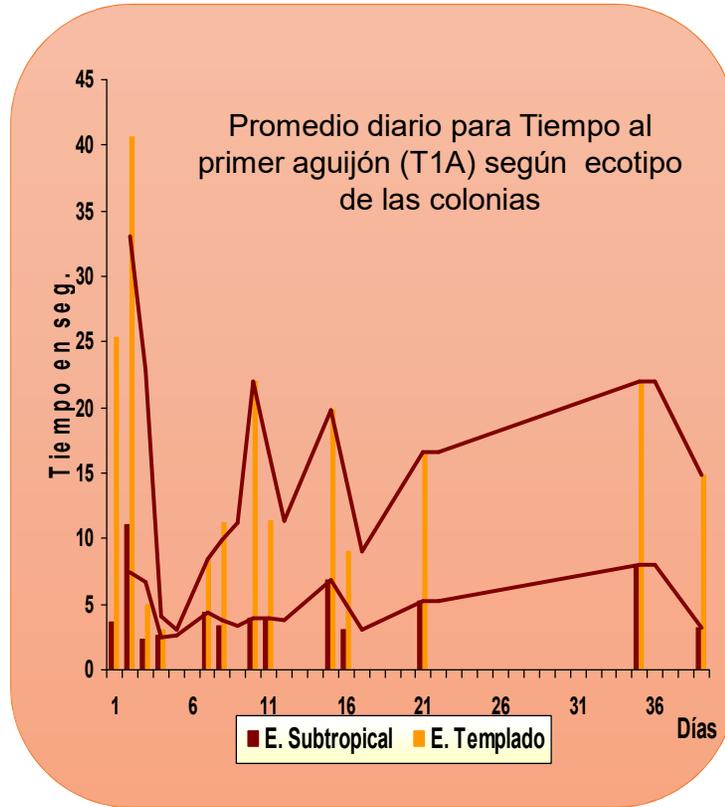
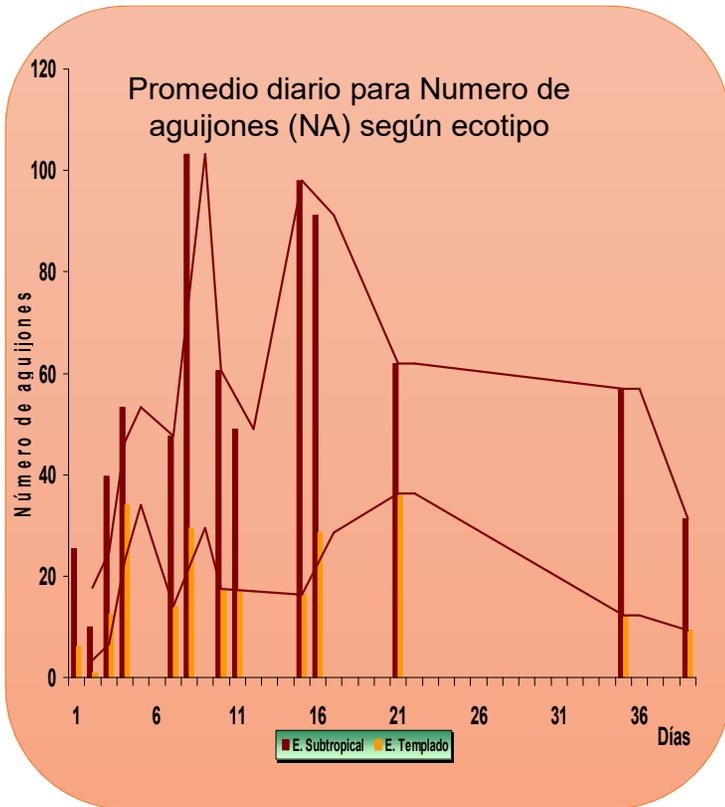


**Colmena Tipo II**



**Colmena Tipo III**

# MEDIDAS OBJETIVAS



ANDERE,C et al. (2000) Evaluation of honeybees defensive behavior in argentina. I. A field method. American Bee Journal 140 (12): 975-978

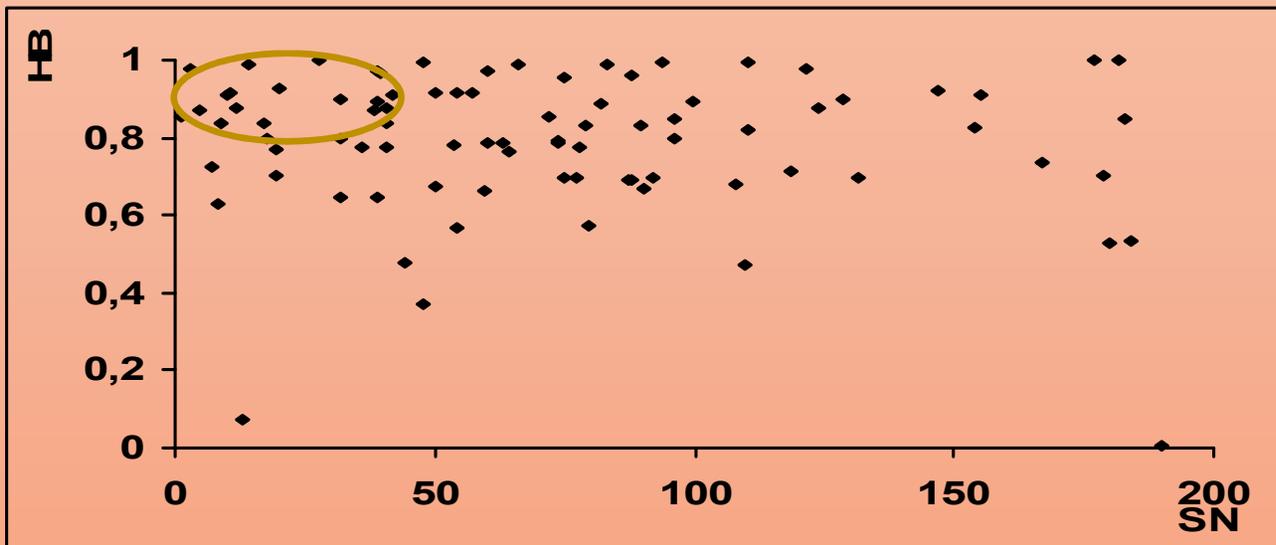


# MEDIDAS OBJETIVAS



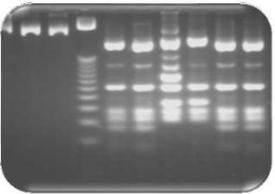
## CHT vs Número de agujones

$r^2 = 0.04078$  ( $p=0.7319$ )

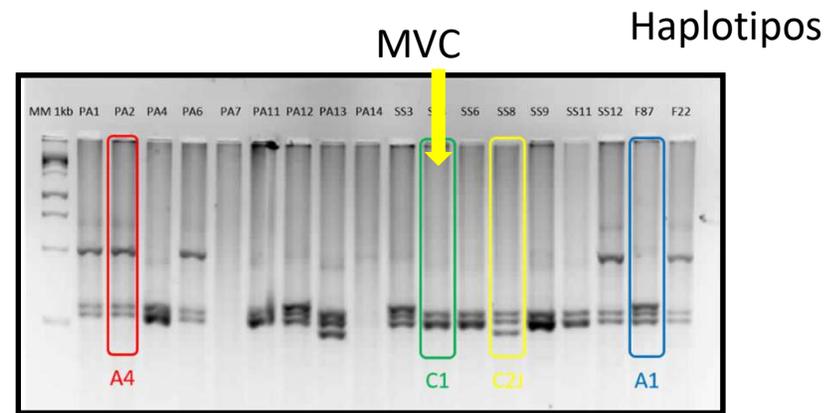
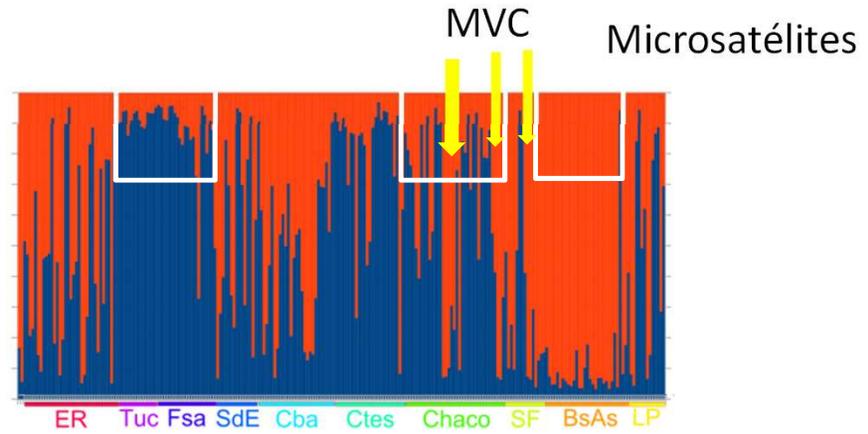
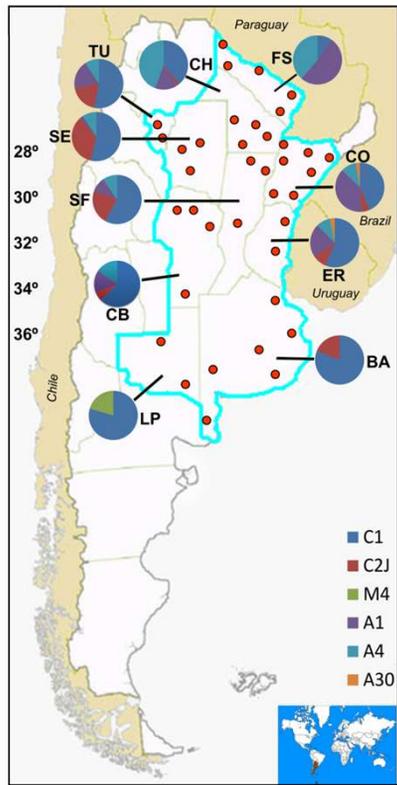


# MEDIDAS OBJETIVAS



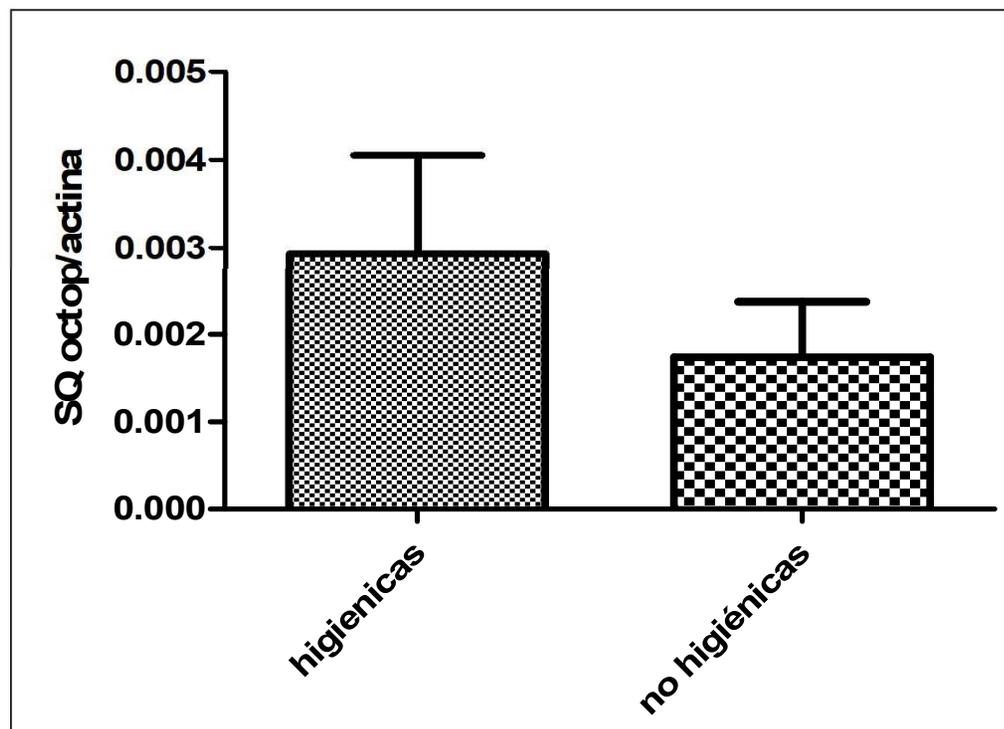


Análisis de la estructura poblacional.

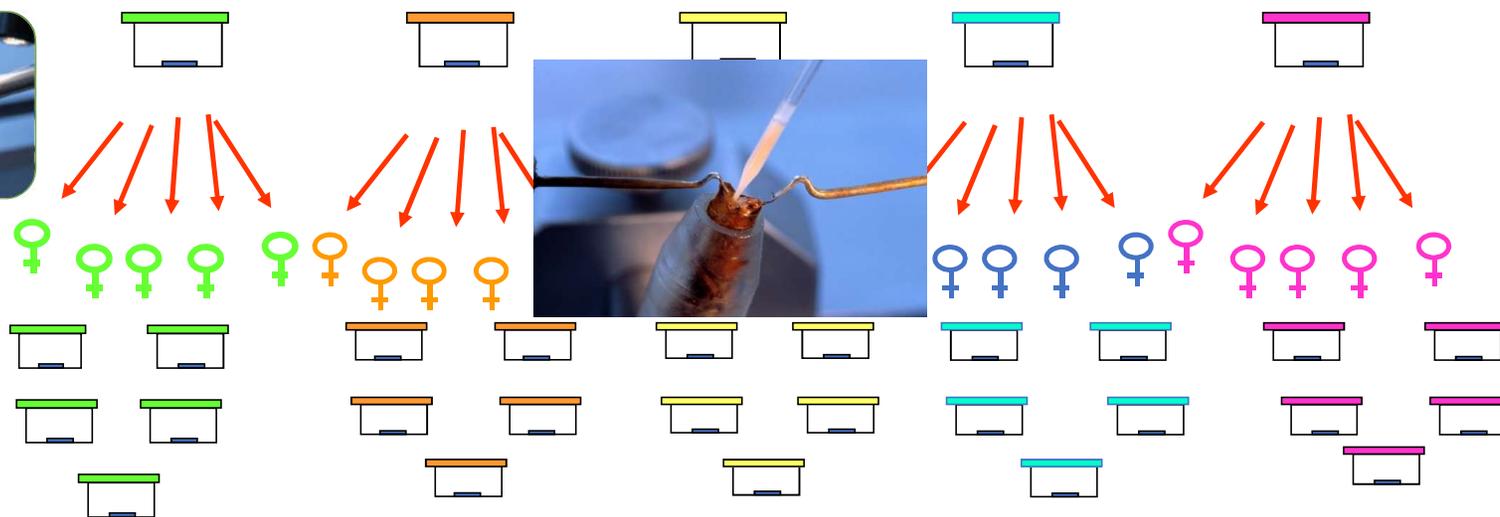


Dr. Marcelo Agra – EEA Balcarce





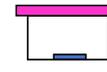
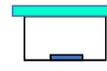
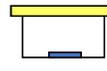
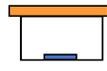
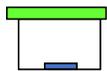
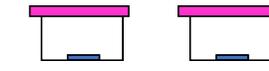
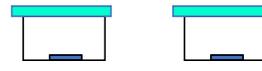
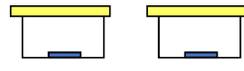
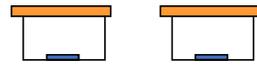
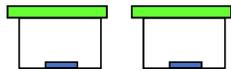
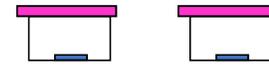
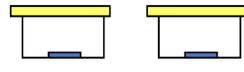
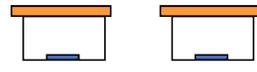
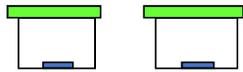
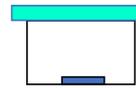
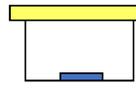
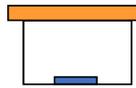
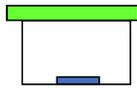
Las abejas H tienden a expresar mayores niveles del receptor de la octopamina que las abejas NH

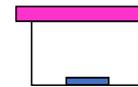
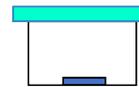
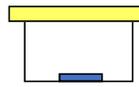
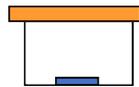
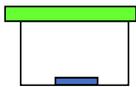
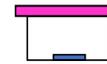
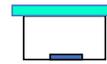
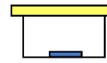
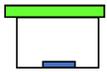
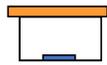
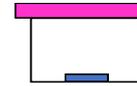
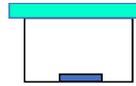
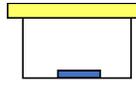
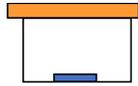
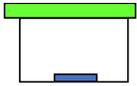


Preservación en poblaciones cerradas

Técnica de inseminación instrumental







## Criterios de selección

Tolerancia a enfermedades de la cría

Prolificidad

Mansedumbre

Tolerancia a varroa

**Genética**  
**PRO API**

# Abejas Tolerantes

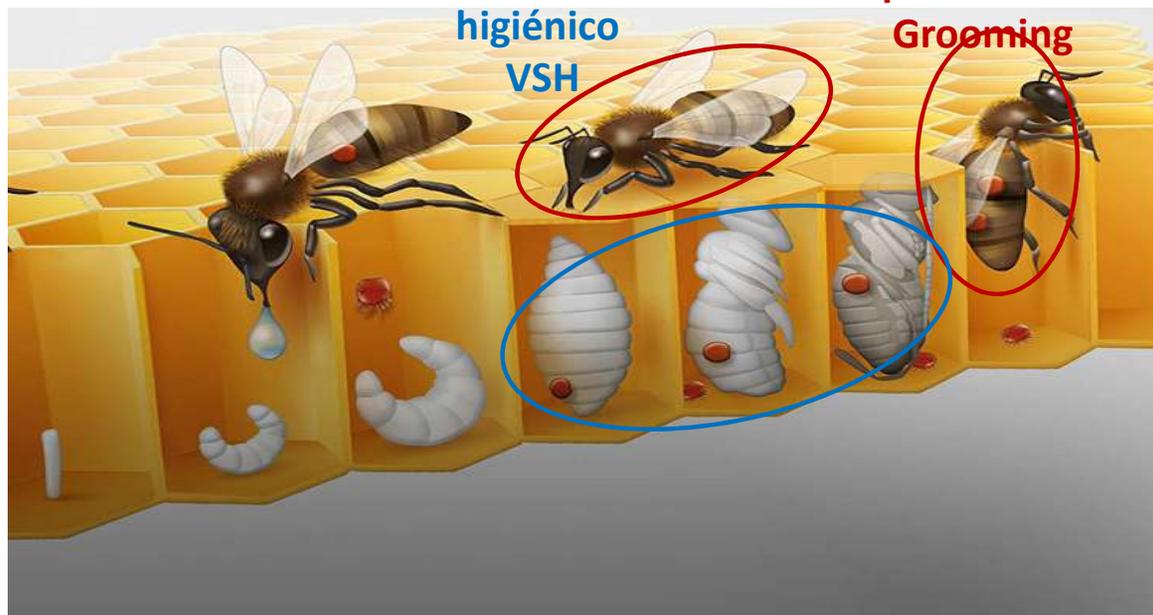


Varroosis (*Varroa destructor*)



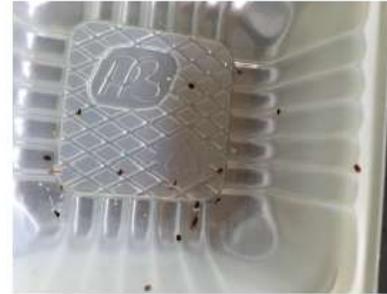
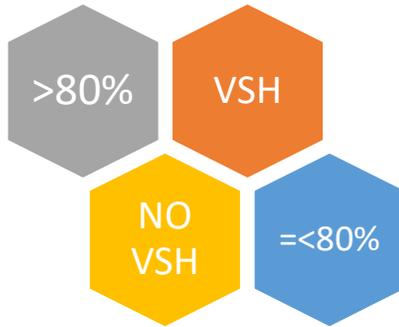
Comportamiento  
higiénico  
VSH

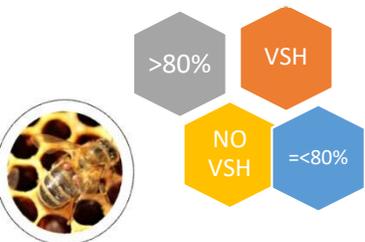
Comportamiento de  
Grooming



# VSH

## Infestación artificial de celdas + control





COLONIAS VSH



Menores niveles de varroa



Menor éxito reproductivo

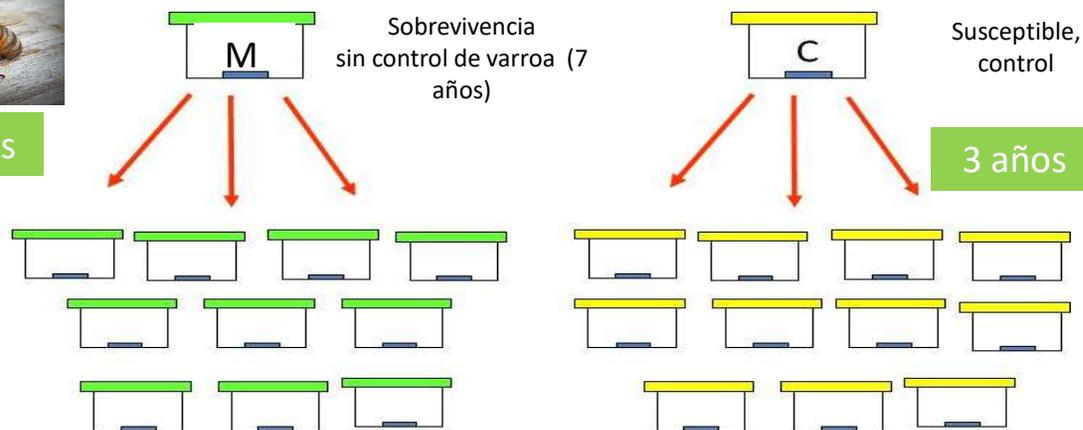
Variable respuesta	Factor	Media (%) y desviación estándar	P
HNR	VSH	72,22 ± 25,46	0,024
	NO-VSH	29,45 ± 19,31	
DNV	VSH	100	0,036
	NO-VSH	42,86 ± 14,11	
FER	VSH	100	0,013
	NO-VSH	59,75 ± 15,11	

Colonia	Media	P valor
CH	VSH	91,09 ± 8,05
	NO-VSH	71,29 ± 17,22
VF final	VSH	3,23 ± 0,69
	NO-VSH	9,20 ± 4,71

# Caracterización de poblaciones sobrevivientes a varroa



2 stocks



Parámetros evaluados





## Varroosis (*Varroa destructor*)

Temporadas	%Varroa foretica		% ácaros caídos		% Varroa dañadas	
	C	M	C	M	C	M
2015-2016	4.7 (0.5-16)	5.6 (0-19)	1.1 (0-18)	2.9 (0-44)	5.8 (0-20)	12.9 (13-50)
2017-2018	4.7 (0-25)	2.7 (0-14)	0.8 (0-8.8)	2.9 (0-50)	3.3 (0-25)	25.2 (0-100)
2018-2019	2.49 (0-11)	1.41 (0-7)	0.5 (0-6)	4.3 (0-100)	6.9 (0-23)	36.7 (0-100)

P < 0.05; P = 0.08

↓  
Población de ácaros



↓  
Medida indirecta de grooming

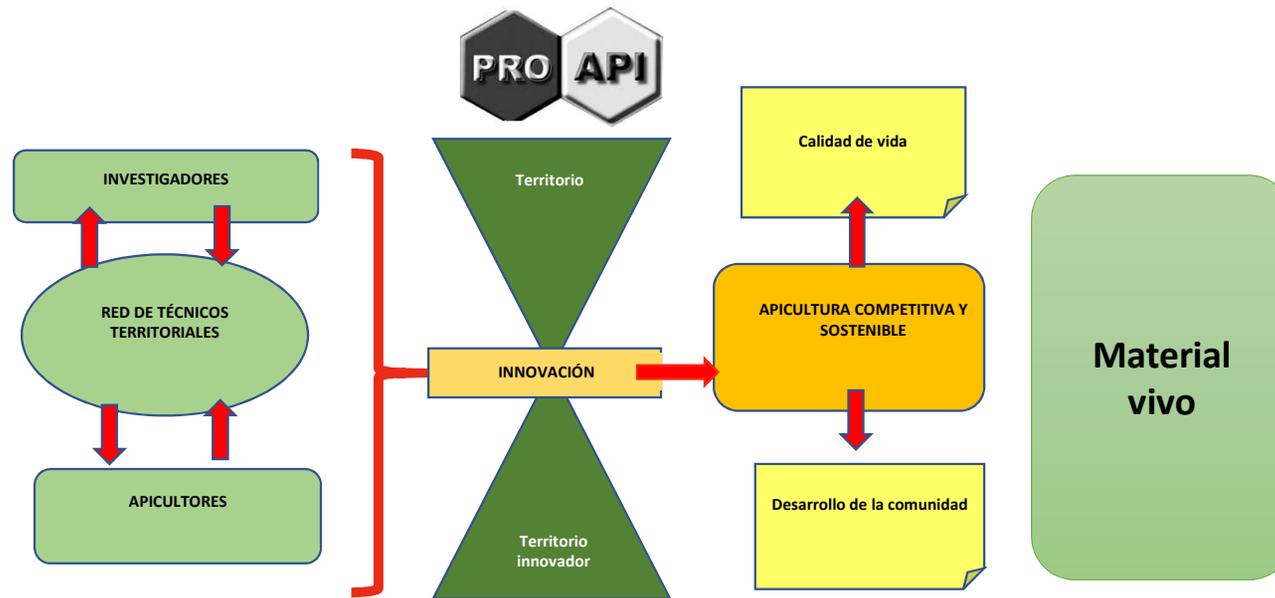


↓  
Medida directa de grooming



# Modo colectivo de Innovar

## ENFOQUE TERRITORIAL





**MATERIAL VIVO CERTIFICADO**



# Material vivo seleccionado MVC



# Asociación de cabañas apícolas productoras de material vivo certificado ACAMVC



2001

**5 empresas**  
**5 provincias**

2024

**13 empresas**  
**10 provincias**





No uso de antibióticos

Inspección de todas las colonias

Recambio de reinas anual

Sin síntomas de LA

Categoría de las colonias



## ACAMVC- Auditorias



Evolución de las colonias  
Registros  
Criadero (iniciadora, continuadora, celdas)  
Muestras de varroa, nosema y virus.



## Asesoramiento Técnico



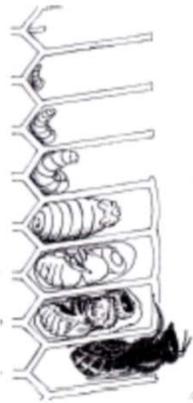
## Aseguramiento de la calidad



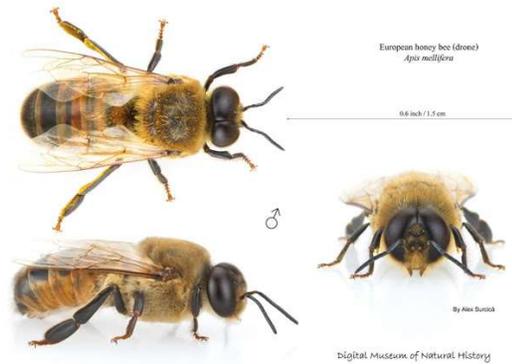


# Inseminación Instrumental de abejas reinas

# Cría de zánganos



24 días

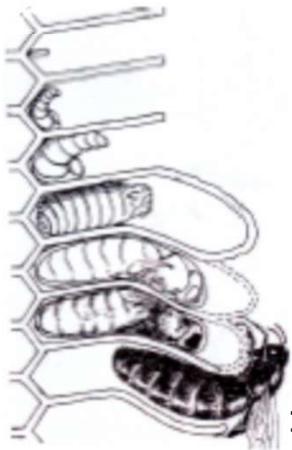


Digital Museum of Natural History

Extracción de semen  
24 días + 12 días



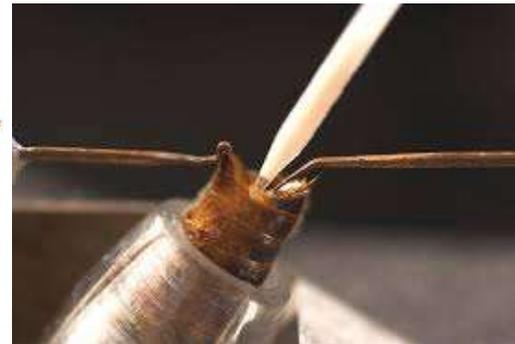
# Cría de reinas



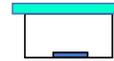
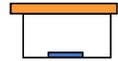
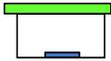
16 días



Inseminación instrumental  
16 días + 7 días



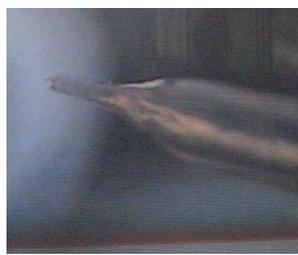
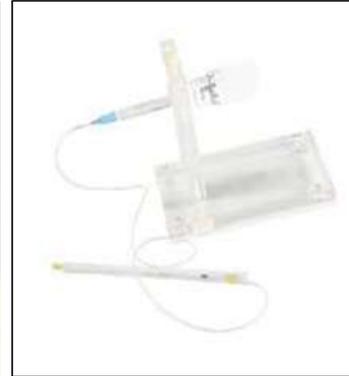
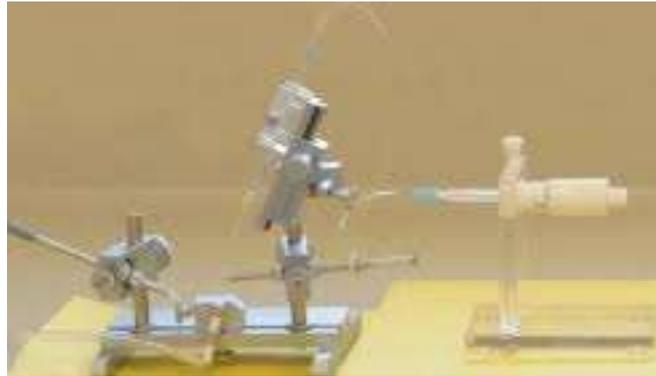
# Inseminación instrumental



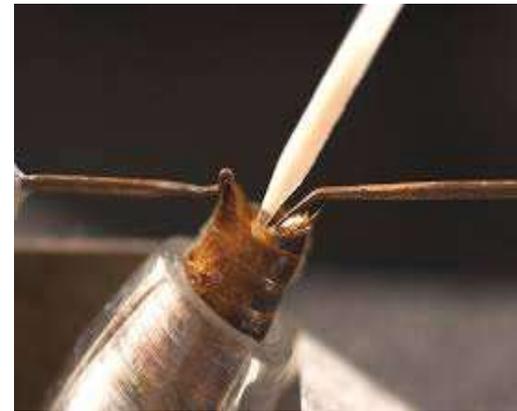
# Instrumental



# Instrumental



# Inseminación instrumental



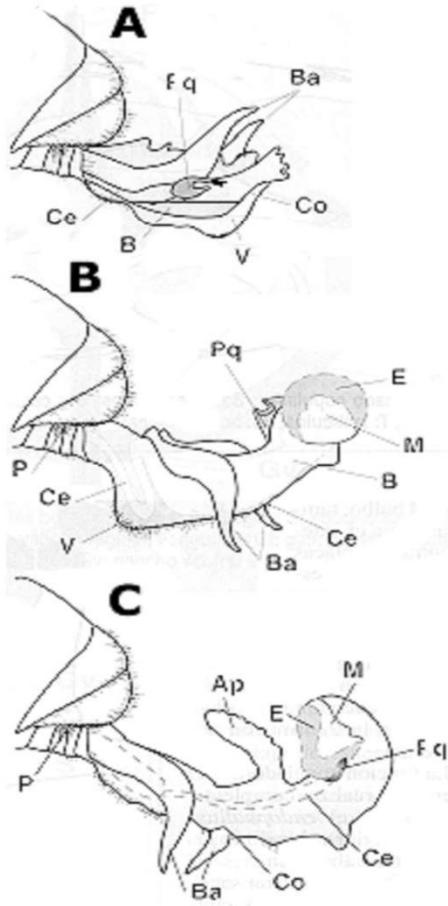
# Captura de zánganos



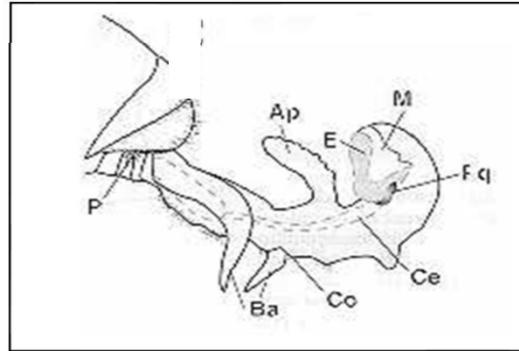
# Colecta de semen



# Colecta de semen



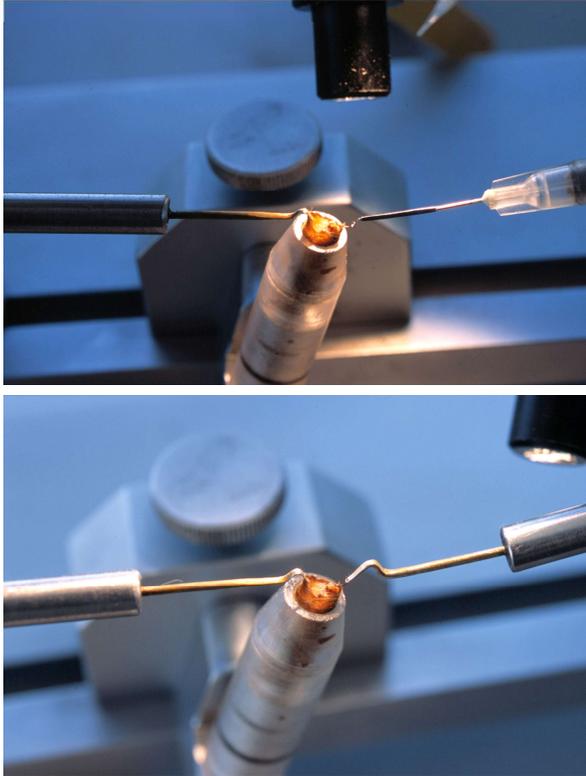
# Colecta de semen



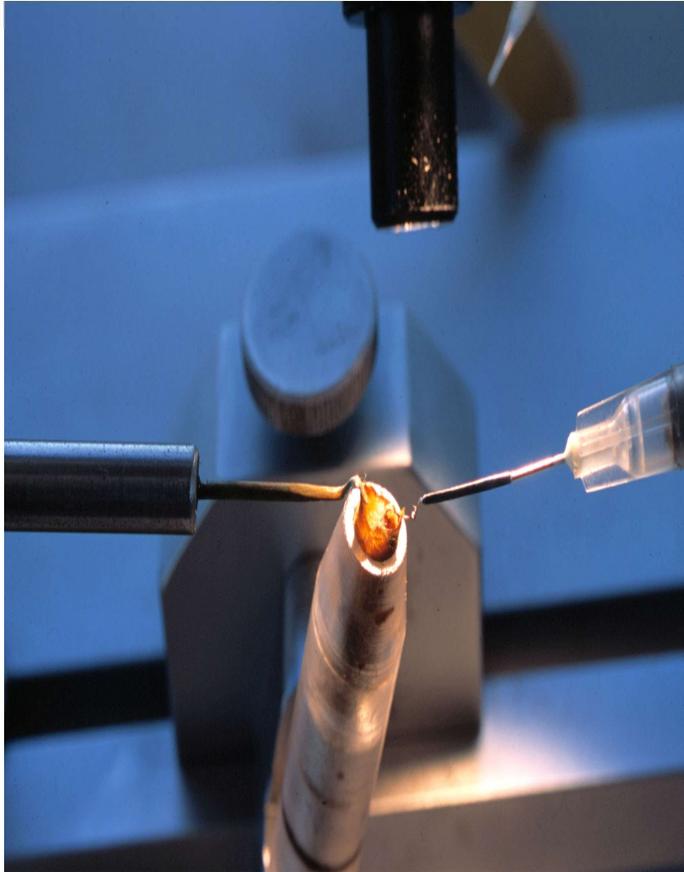
# Reinas vírgenes



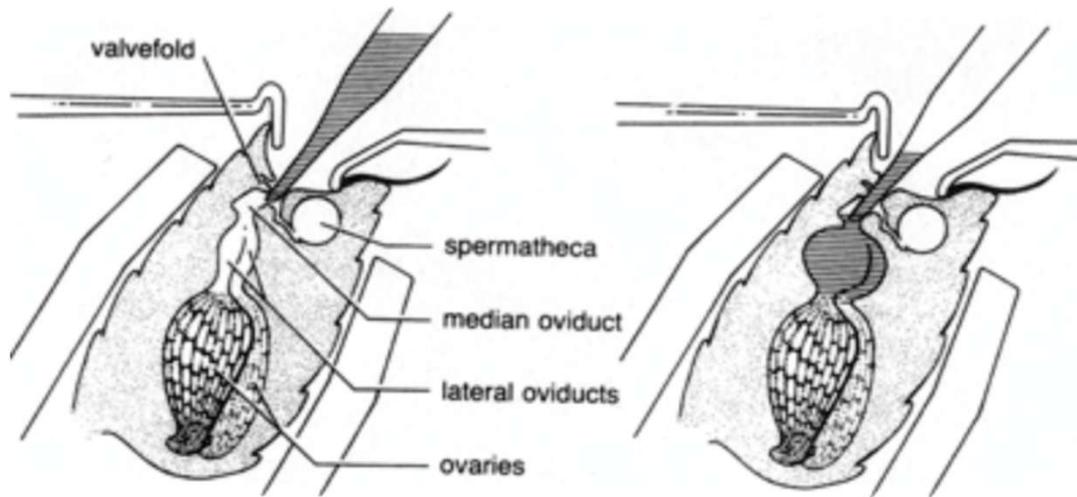
# Inseminacion instrumental



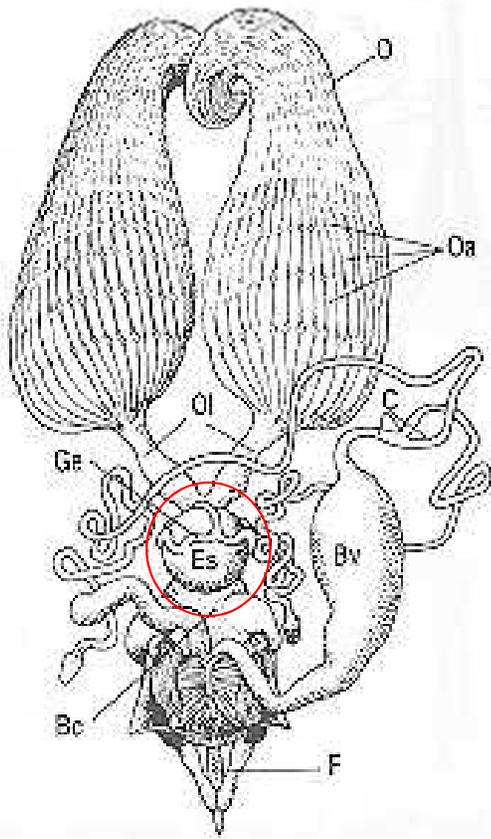
# Inseminacion instrumental



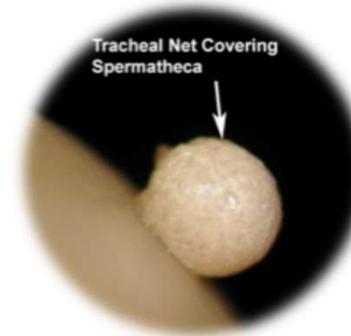
# Inseminacion instrumental



# Inseminación instrumental



Espermateca de reina fecundada



Espermateca de reina virgen



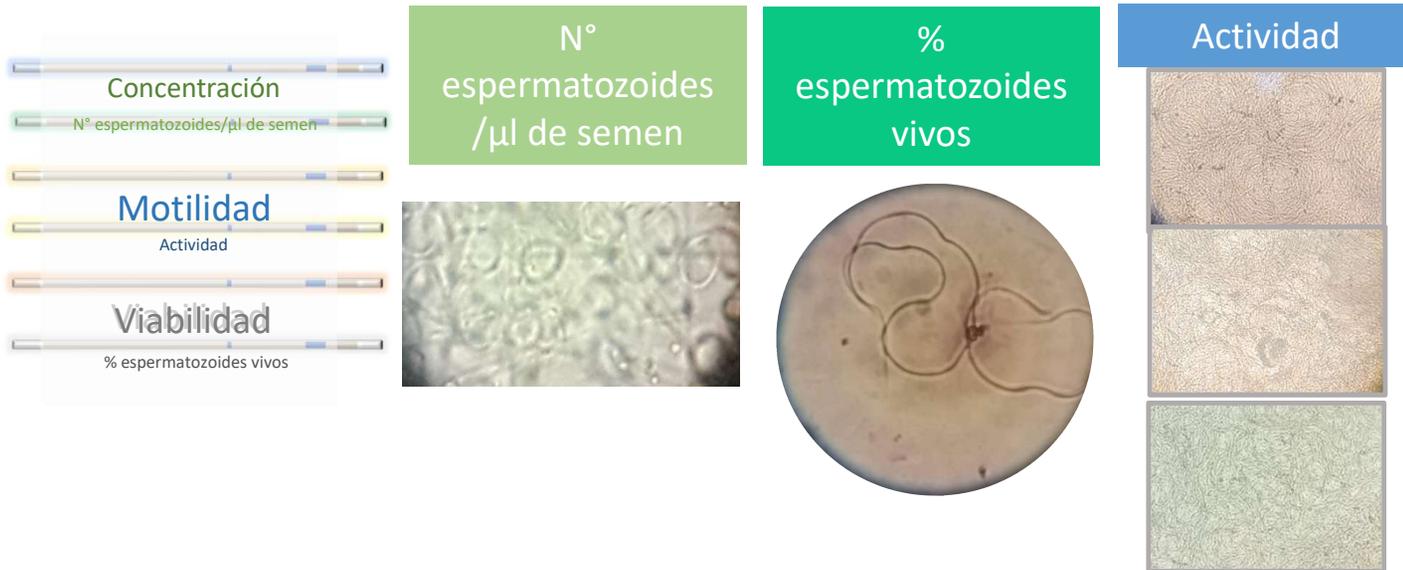
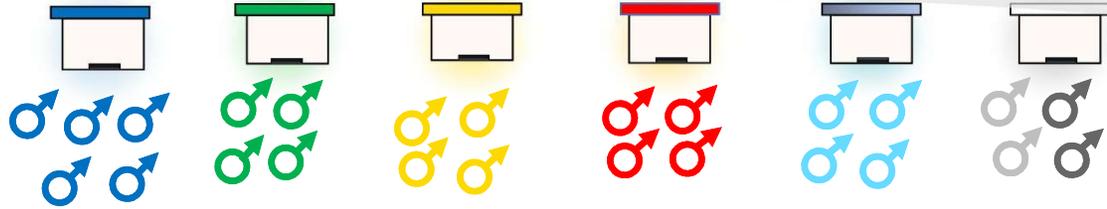
# Introduccion y control de postura



# Inseminacion instrumental



# Calidad seminal



# Calidad seminal



Concentración

N° espermatozoides/ $\mu$ l de semen

Motilidad

Actividad

Viabilidad

% espermatozoides vivos

## Calidad Seminal

Relación con parámetros nutricionales

Proteínas en Fluido seminal

Proteínas en Hemolinfa

**Correlación**

Relation between seminal fluid proteins and semen quality in Apis mellifera.

