The Importance of Apiculture

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Meadow Ridge Enterprises

Outline

- Definition of apiculture
- Importance of honey bees and apiculture practices
- Honey bee health issues
- The Saskatraz project

Apiculture

- Apiculture is the management and study of domesticated honey bees (Apis Mellifera).
  - A critically important profession for secure and sustain the world's food supply.

Importance of Honey bees and Apicultural Practices

- Responsible for 1/3 of the world's food supply by pollination of more than 90-100 species of flowering plants (Greenleaf and Kremer, 2006, PNAS, 103: 13890)
- Worldwide economic value to food production of 50-100 billion USD annually with little or no "carbon footprint" (Dr. Phippes, Apitrack website)
- Indicators of the health of their surrounding ecosystem. Essential for the preservation and sustainability of wild species of flowering plants.
- Used for prospecting and detecting land mines.

Apicultural Practices

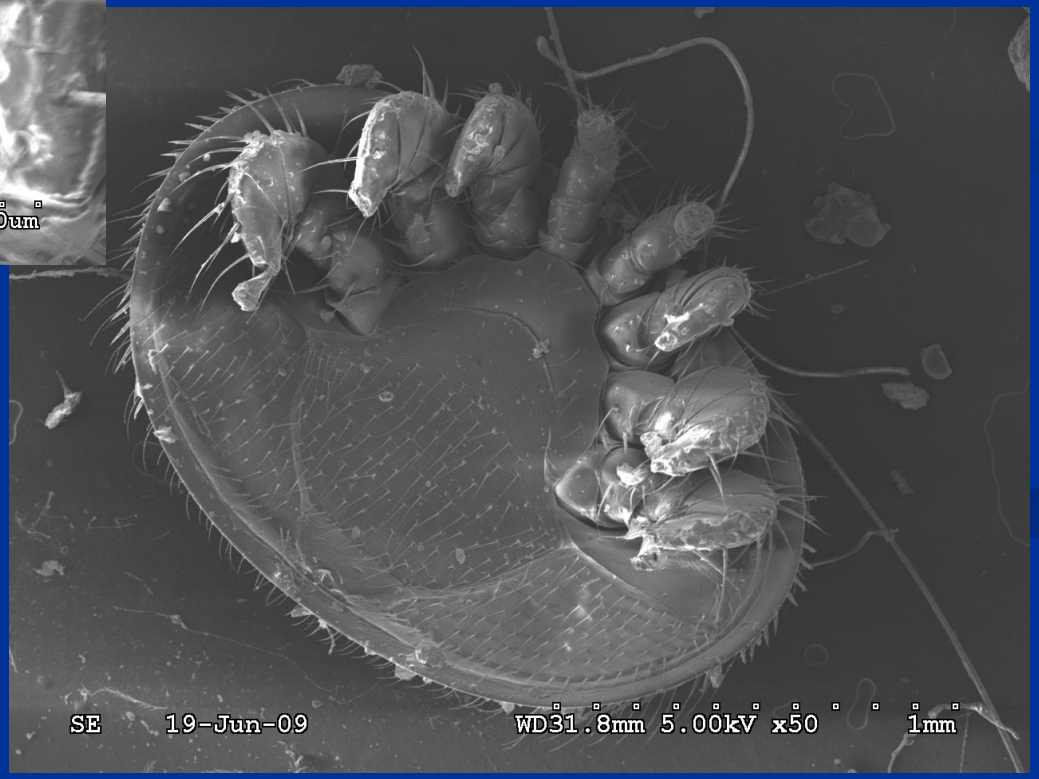
- Involved with collection of valuable hive products.
- Honey
  - most "green" sweetener; more evidence of health benefits accumulating (Dr. Ron Fessenden, www.foodnavigator-usa.com) diabetes, weight loss, cognitive function, wound healing, chemotherapy induced neutropenia, cough suppression, antioxidant source.
- Wax
  - Long chain aliphatic alcohol (30-32 C)
  - Cloned gene involved in bee wax synthesis from SAT-28. Prapanan Teerawanichpan, Albert J. Robertson, Xiao Qui, 2010, Insect Biochemistry and Molecular Biology 40; 641-649.
- Pollen, propolis, royal jelly, bee venom (apitherapy)

Honey Bee Health Issues

- In the media since 2007, Colony Collapse Disorder (CCD). Increased and continued decline in honey bee populations throughout the world is of serious concern.
- Possible Causes:
  - Parasitic mites (Varroa Destructor)
    - Apis cerana → Apis mellifera
    - Pathogens (viruses and microsporidia) associated with the mites
  - Synthetic chemical miticide treatments
    - Residues, mite resistance, decreased natural immunity and suppression of the development of natural resistance to mites
  - Lack of genetic diversity in the managed bee population.
  - Compounded by poor apicultural practices and agricultural pesticide uses (nicotinoids)

Varroa Mites in Pupae

Scanning Electron Micrographs of Varroa Mite



The Saskatraz Project
SBA Honey Bee Breeding Program

- Established in 2004 in collaboration with Saskatchewan and Manitoba queen breeders.
- Involved assembling a large diverse gene pool at an isolated apiary called Saskatraz.
- Aimed at using natural selection (no synthetic chemical miticides) to select for honey bee genotypes with tolerance to parasitic mites.

The Saskatraz Project

Objective: To develop productive, gentle honeybees with tolerance to mites and brood diseases

By: Albert J. Robertson
SBA Honeybee Breeding Program

Summer 2004-05

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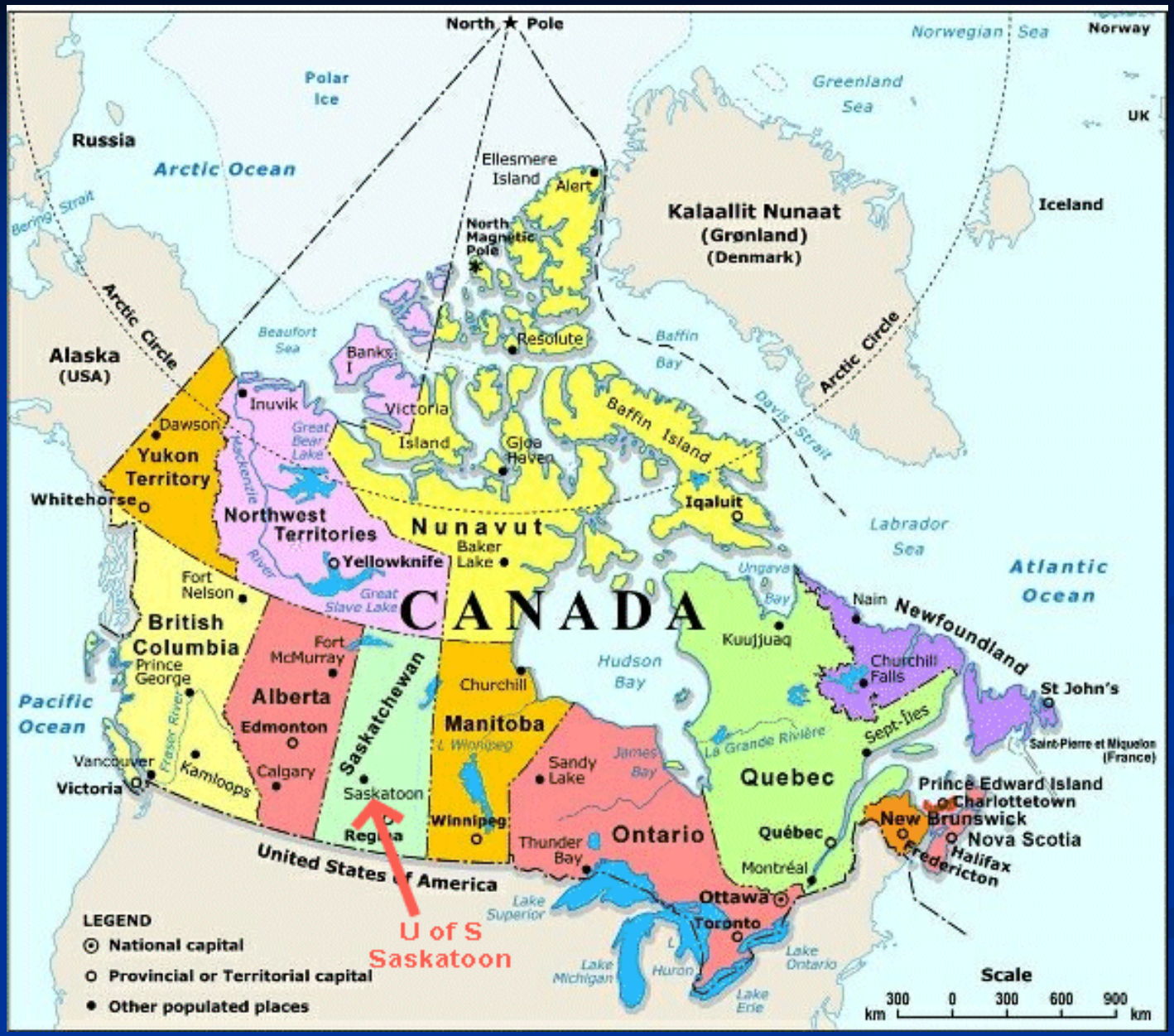
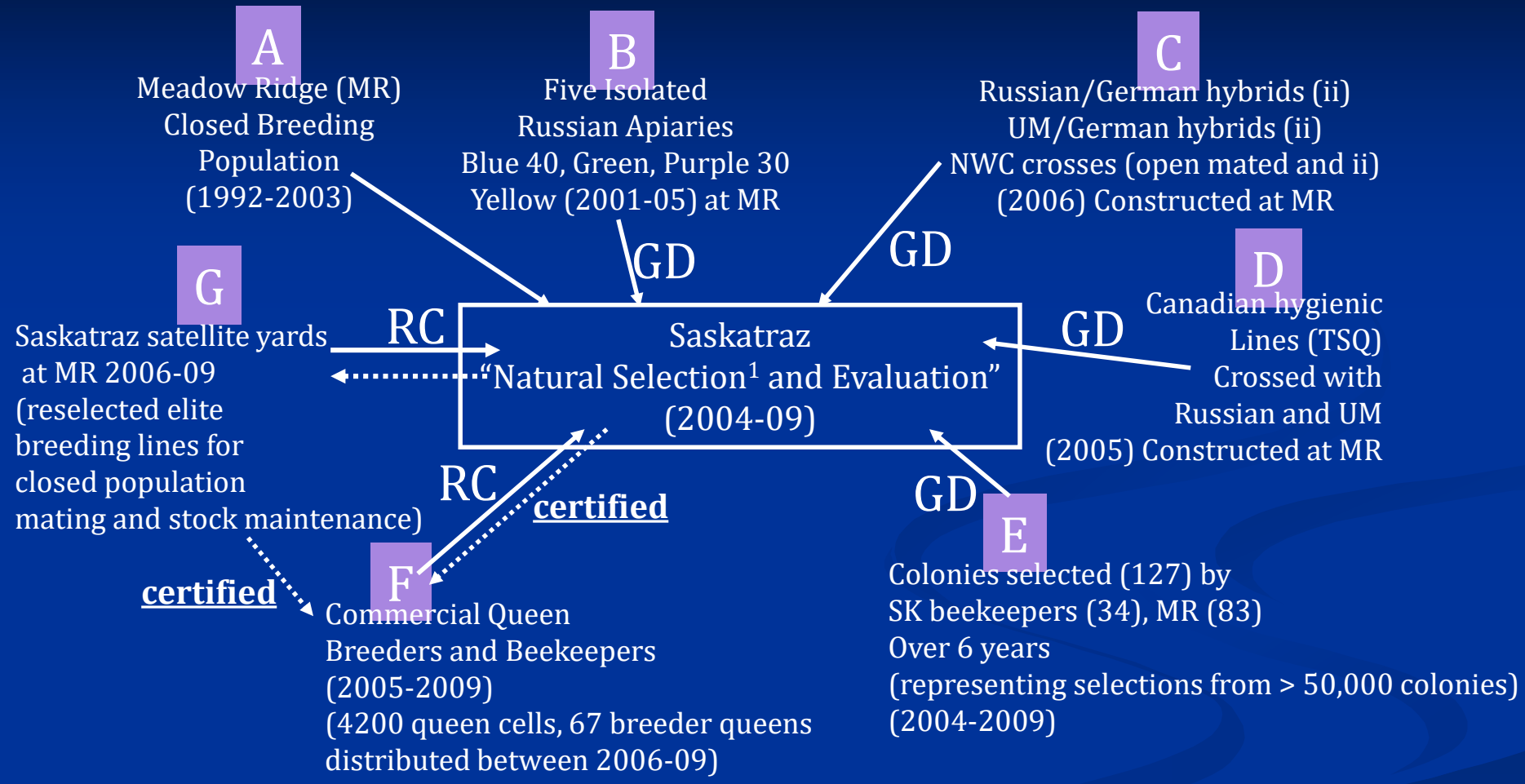


Saskatraz Breeding Program Logistics



Letters A to G represent isolated apiaries and the year of establishment at Meadow Ridge. Solid arrows indicate genetically diverse gene (GD) flow into Saskatraz, dashed arrows gene flow out of Saskatraz. (ii) denotes instrumental insemination. RC denotes recurrent selection. [1]Denotes no chemical miticides.

Saskatraz natural selection yard site fall 2006 – fenced.
Selection for this Saskatraz yard site is a death sentence.

Primary Selection Criteria:

1. Honey Production
2. Wintering Ability
3. Mite Resistance and Suppression
4. Resistance to Brood Diseases (chalk brood, foul brood and virus susceptibility)

Breeding methods used to select and enrich for important traits (natural selection, back crossing, recurrent selection and progeny analyses).

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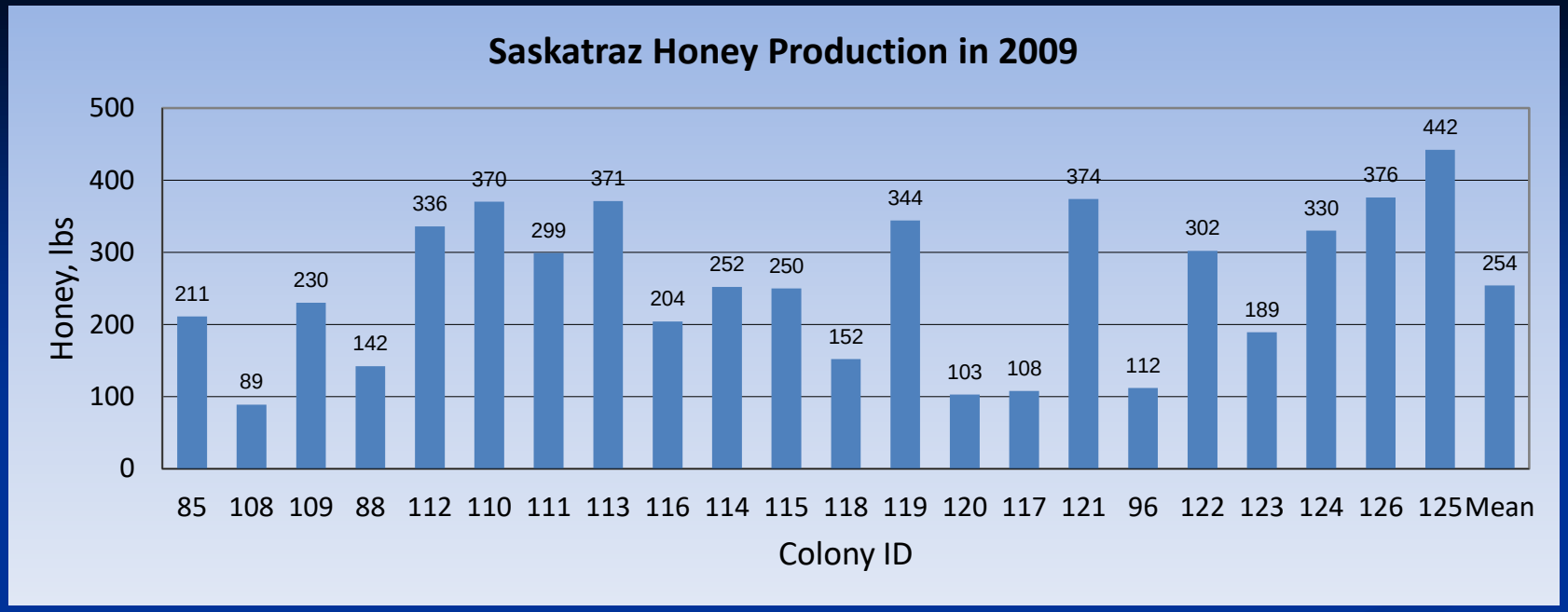

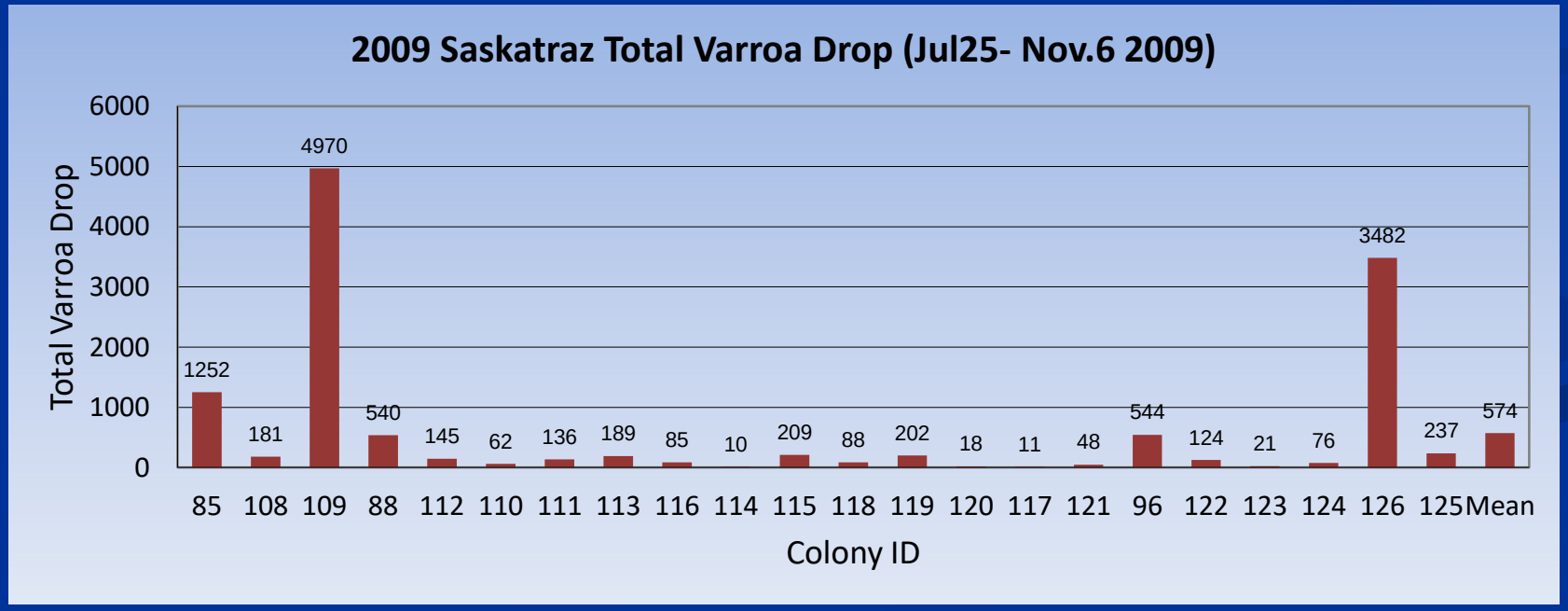

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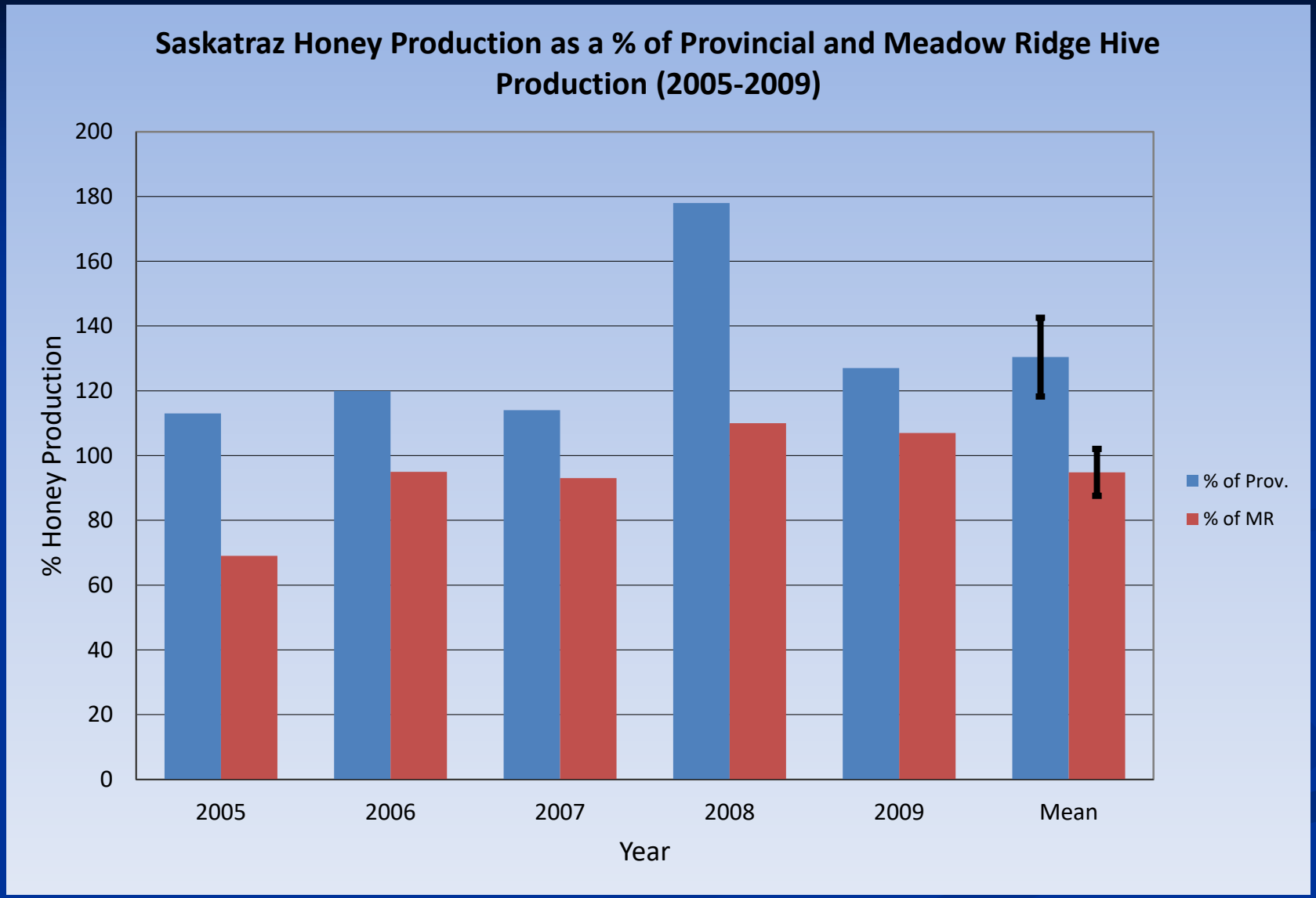

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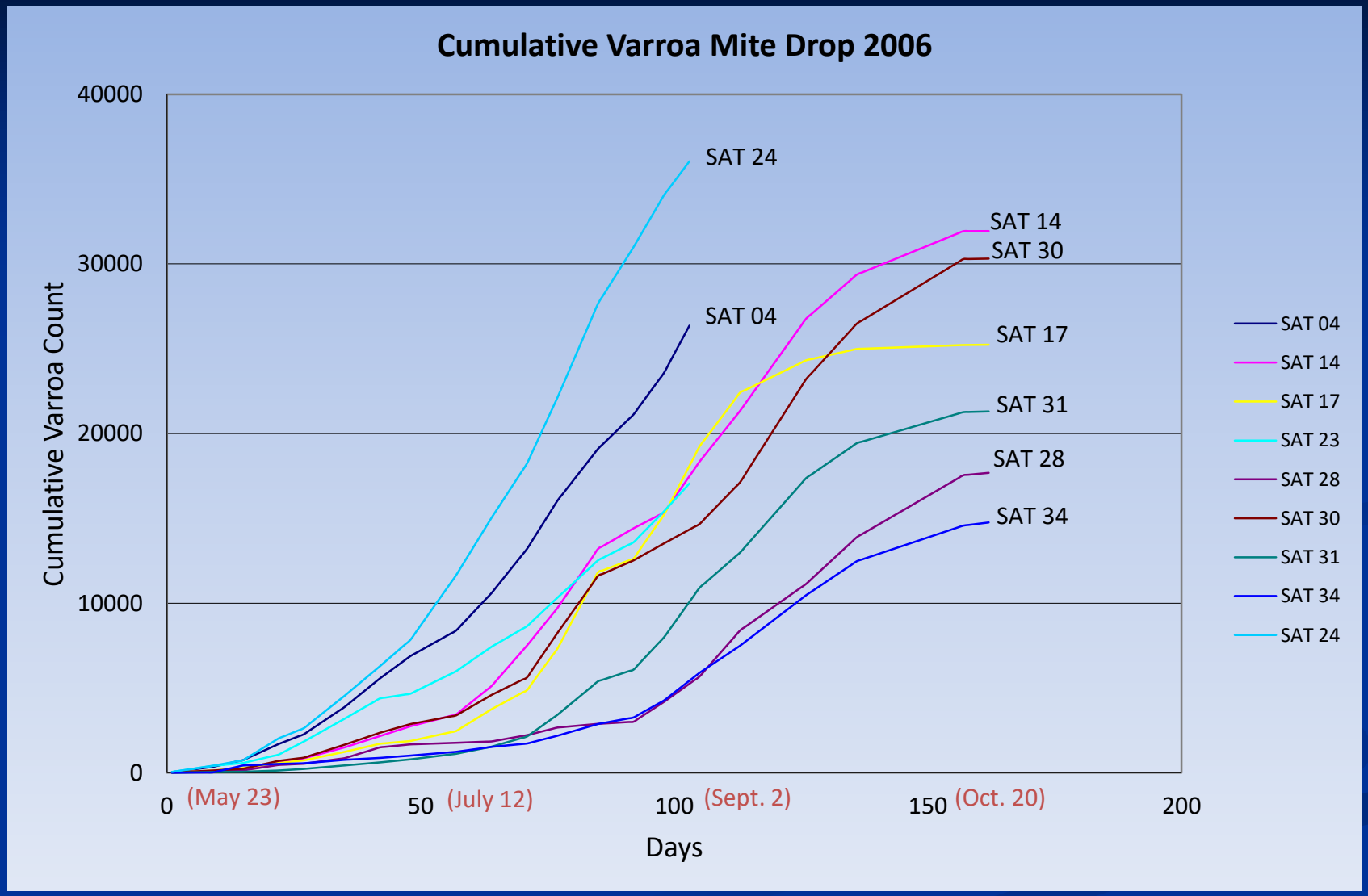


September 2006

These bees look good, but they are dying.

Varroa (ND 2005-2006) Were Sampled From All Saskatraz Colonies To Monitor Virus Infection Status of the Varroa Population and Host Colony.

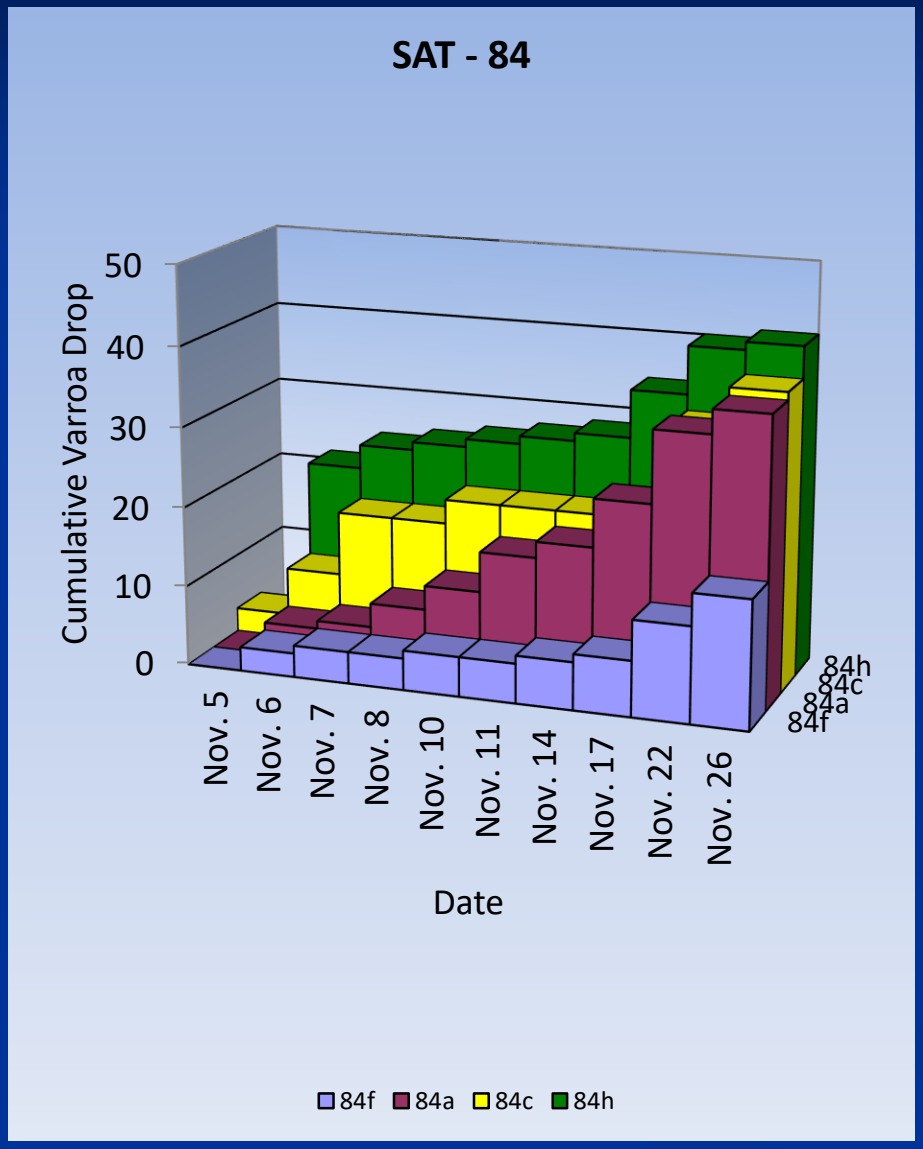
Pandemic

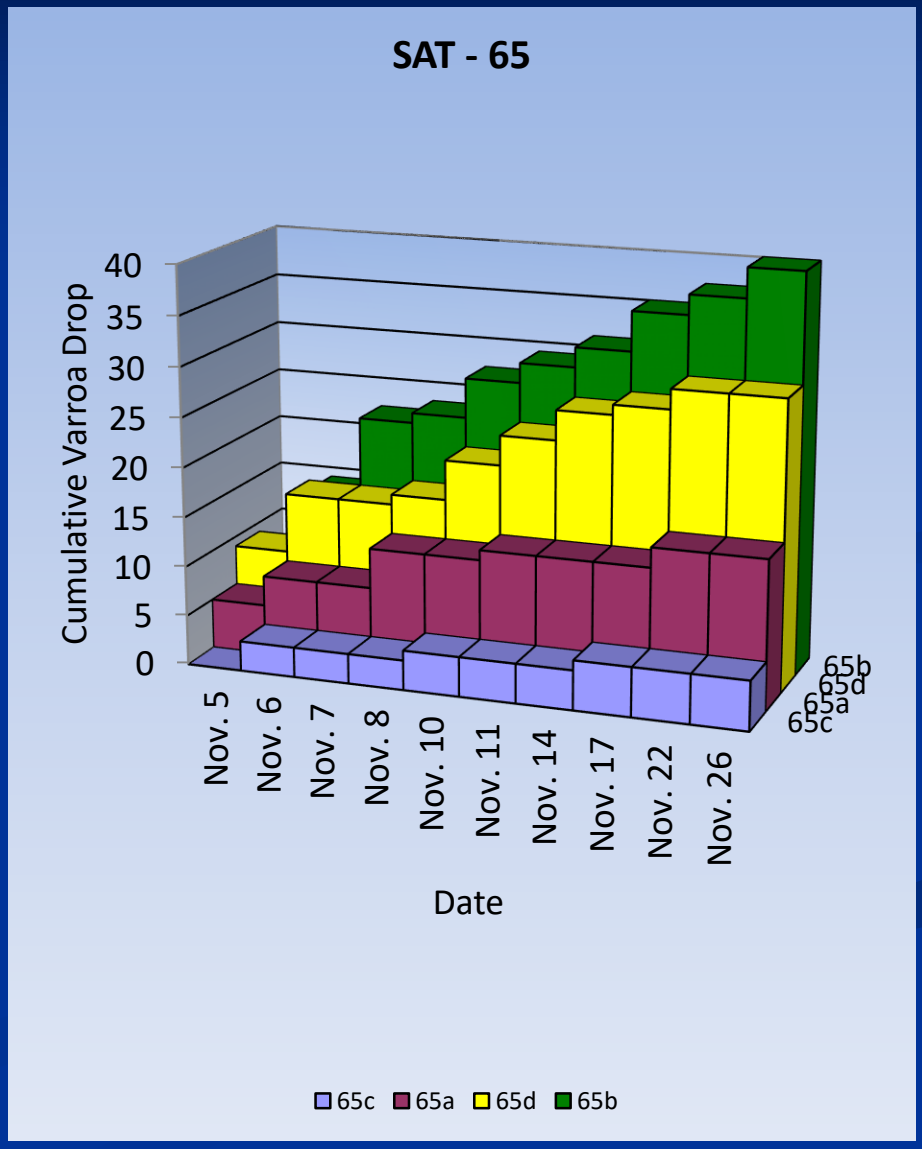
Colony (2004)	Virus	May 2005	June 2005	July 2005	Aug. 2005	Sept. 2005	Oct. 2005	May 2006	June 2006	July 2006	Aug. 2006	Sept. 2006	Oct. 2006
SAT 01	DWV	–	–	+	+	+	–	+	+	+	–	+	Dead
	IAPV	–	–	–	–	–	–	+	–	+	+	+	
	KBV	–	– – –	3 – –	–	– – 1.2	–	– – 7	– – 1	+ 9	– + 31	+	
SAT 24	DWV	+	–	+	+	+	+	–	–	+	Dead	Dead	Dead
	IAPV	–		–	–	–	–	–	–	+			
	KBV	–	– – –	1 – –	–	– – 1.3	–	3 – –	1 – 17	7 – 3	2 33		
SAT 28	DWV	+		–	+	–	+	+	+	–	+	–	+
	IAPV	–		–	–	–	–	+	–	–	+	+	+
	KBV	–		– – –	–	– – –	–	– – –	–	–	1 + 12	9 + 46	+
SAT 30	DWV	–	+	+	+	+	–	–	–	–	+	–	–
	IAPV	–	–	–	–	–	–	–	+	–	+	+	+
	KBV	–	– – –	– – –	–	– – 0.9	–	2 – –	– – 3	– – 10	3 + 26	4 + 95	+
SAT 34	DWV			+	+	+	–	–	+	–	–	+	–
	IAPV			+	–	+	–	–	+	–	+	+	+
	KBV			– – –	–	– – 0.75	–	– – –	+	– – 5	– + 11	– + 26	+
Saskatraz Apiary	%T		0.33	0.64		1.5		0.5	0.3	0.72	0.9	0.75	
	%V		–	0.06		1.6		1	3.3	3.9	15	32	

Progeny Analyses of Selected Breeders and Non-Selected Colonies

- Grooming Assays
- Hygienic Behaviour (VSH phenotypes)
- Morphometric Analyses
- Molecular Marker Analyses
- Selecting for variability in virus susceptibility

Grooming Assay





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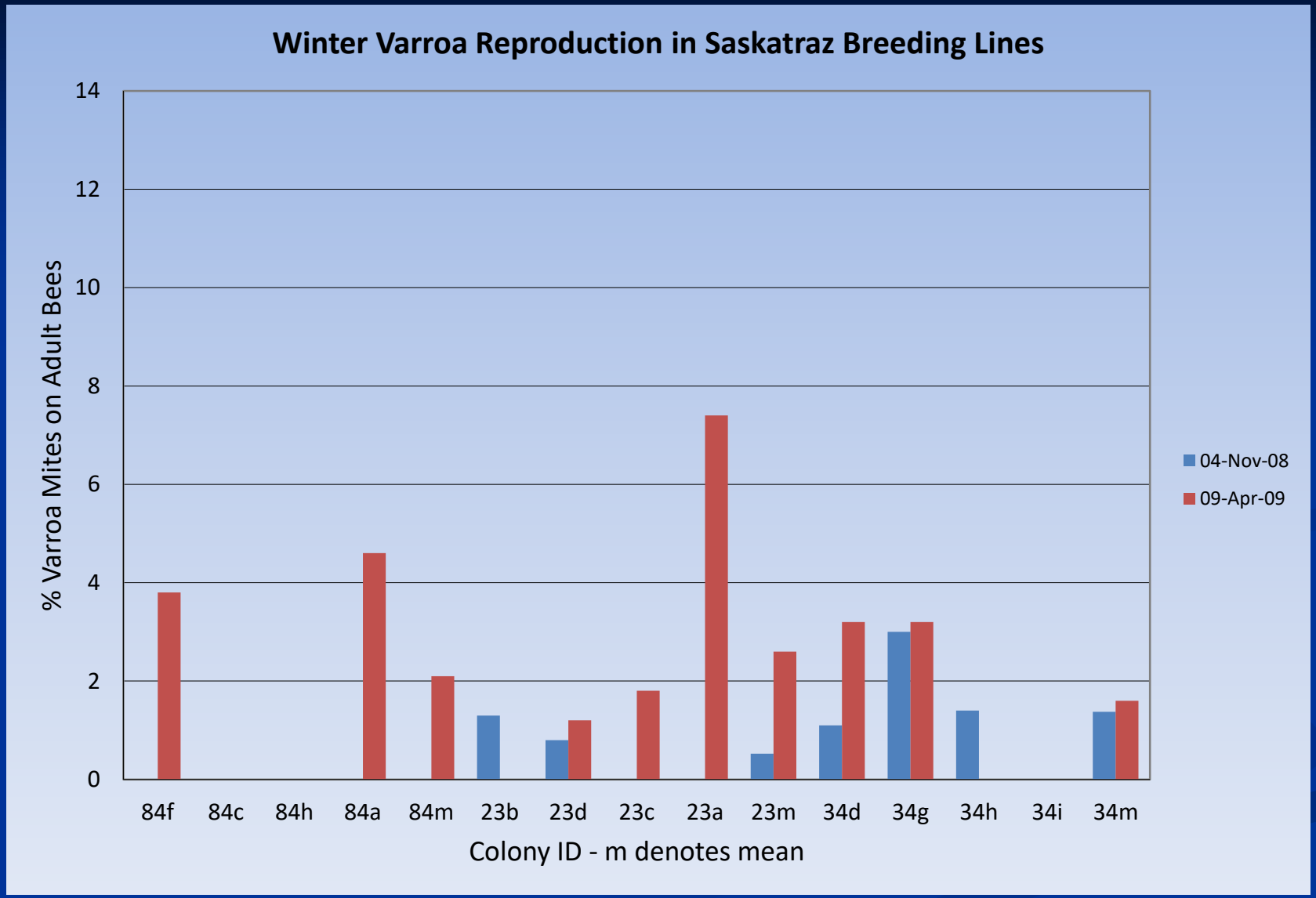
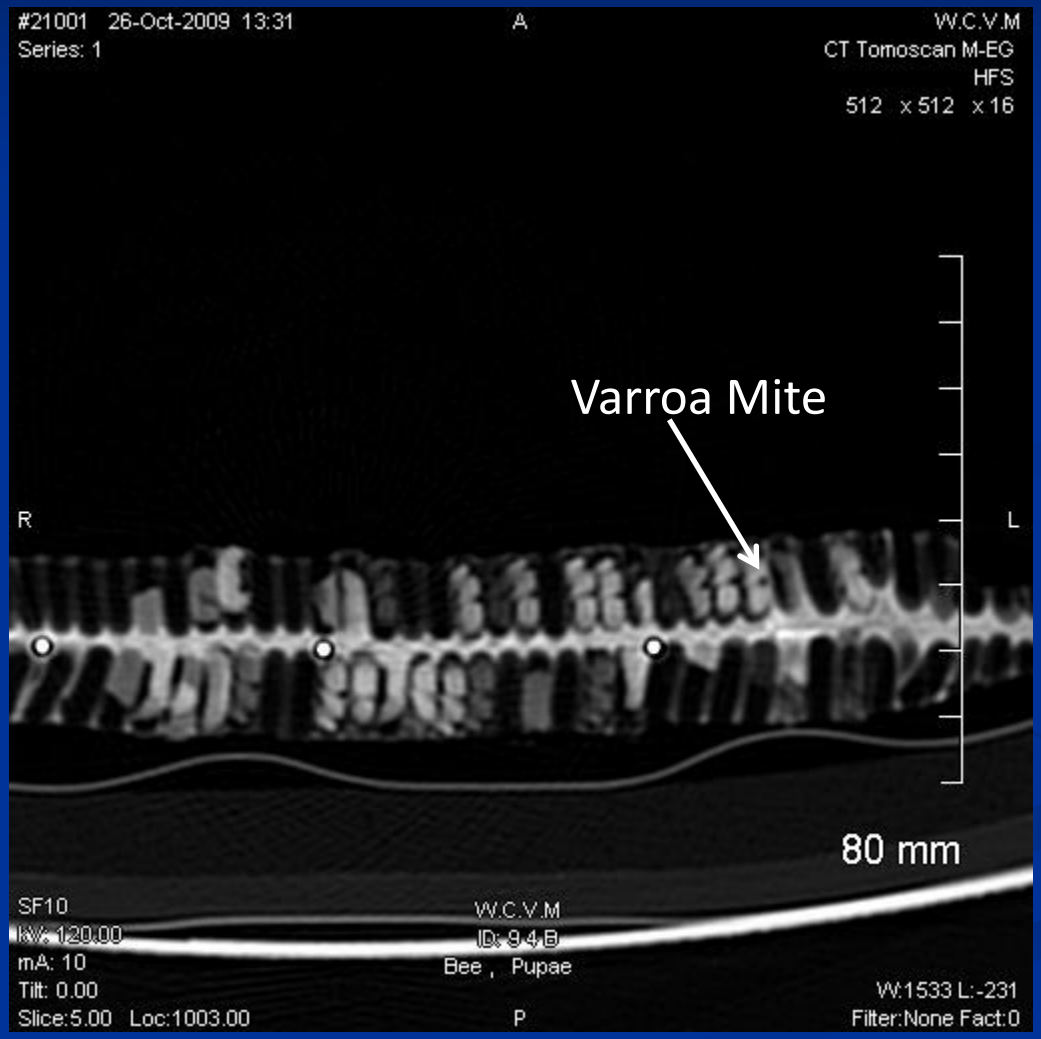
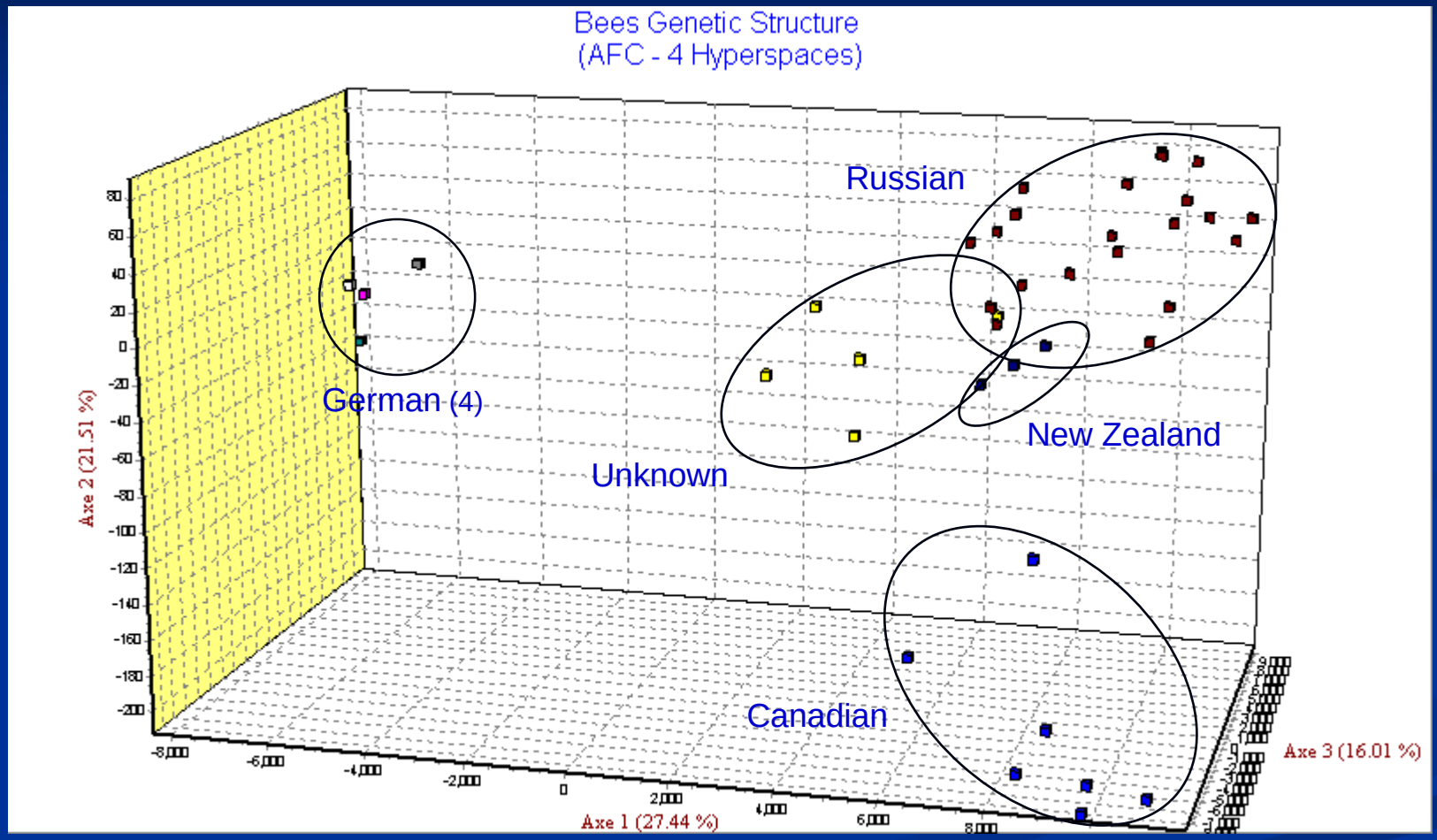


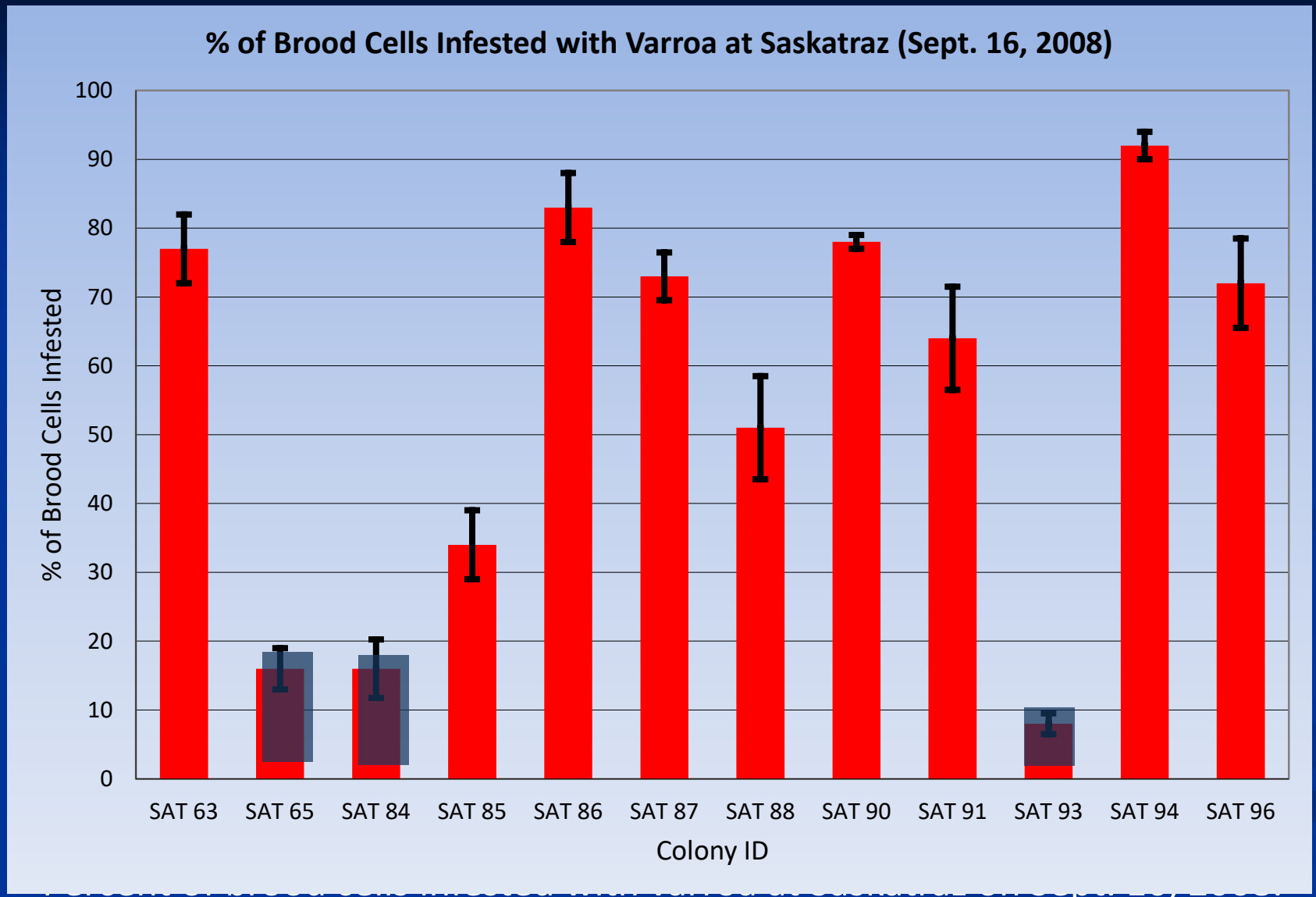
Hygienic Behaviour Analyses





A three dimensional plot showing the grouping of 5 different honeybee populations using 20 informative microsatellite markers.

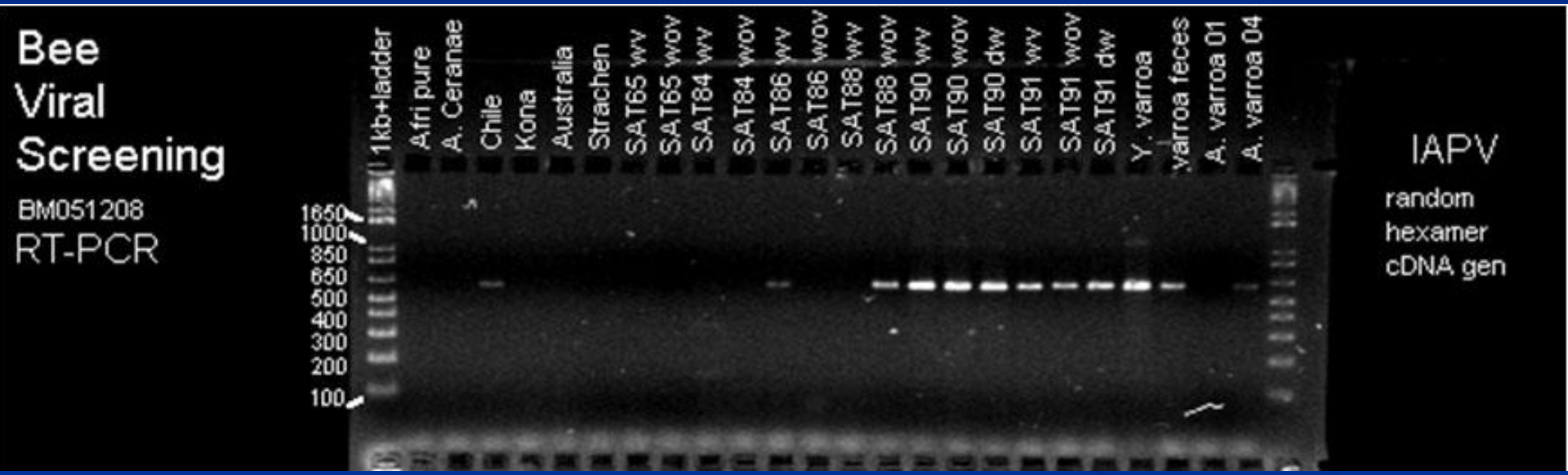
Selecting for Variability in Virus Susceptibility of Saskatraz Breeding Lines



(Red bars indicate colonies showing virus infections)

Values plotted are mean, error bars are SE.

Screening of Pre-Emergent Pupae From Varroa Tolerant and Sensitive Saskatraz Breeding Lines for IAPV using RT-PCR



Summary

- Natural Selection coupled with effective breeding procedures show promise in improving the productivity, health and sustainability of the domesticated honey bee.
- Positive selection pressure without the use of synthetic chemical miticides, should allow natural genetic processes to improve tolerance to mites and other pathogens (viruses, bacteria, fungi).
- Apiculture practices should focus more on genetics, breeding and biotechnology to help obtain sustainability of honey bee populations.

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