Movento®, Citrus and Honey Bees

Results of a successful cooperative study

Dick Rogers, Geoff Williams, Chung Lam,
David Fischer, and David Hackenberg *

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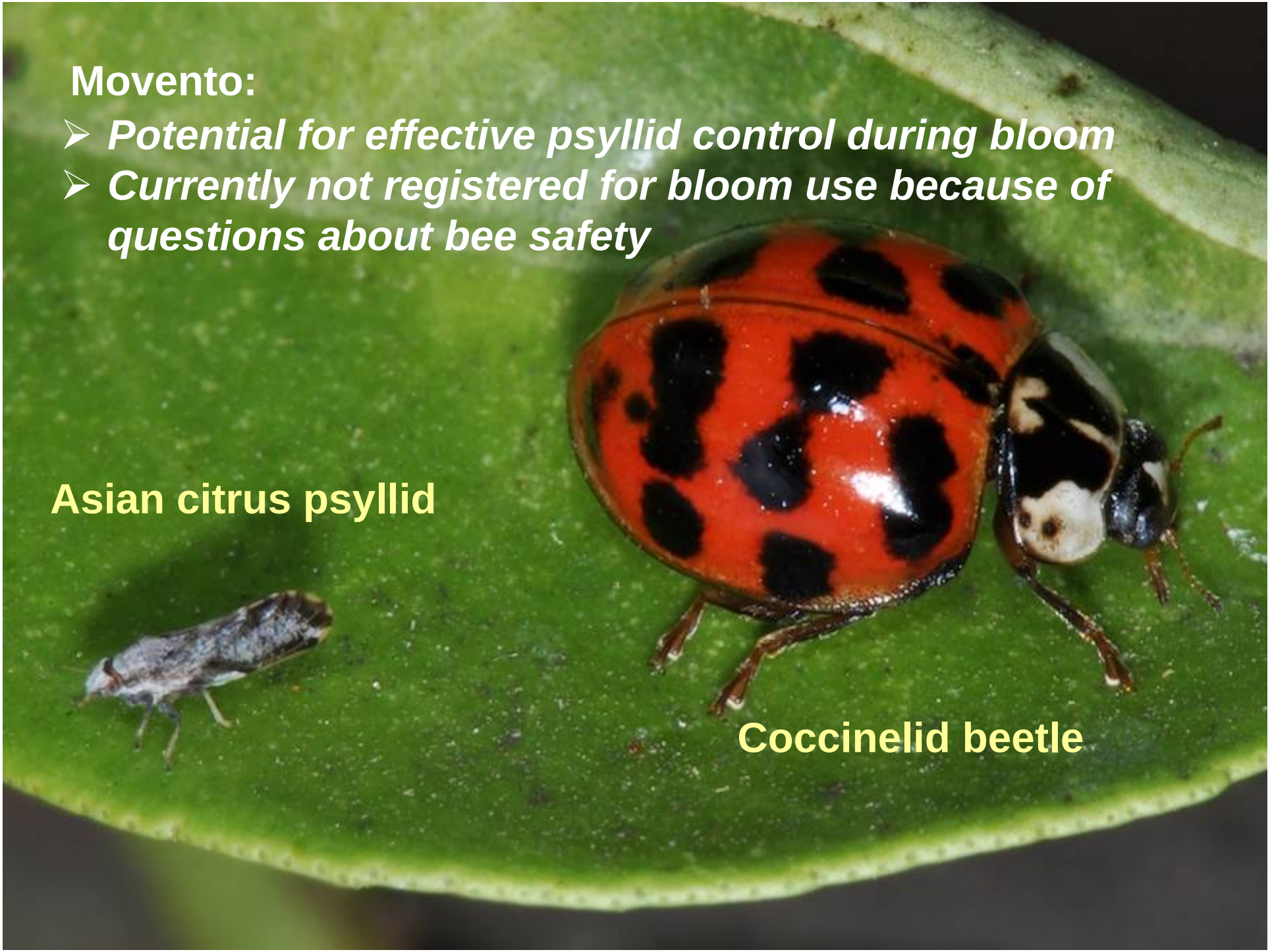
Movento:
Potential for effective psyllid control during bloom
Currently not registered for bloom use because of questions about bee safety
Asian citrus psyllid
Coccinelid beetle

Introduction

Questions

1. **What levels of Movento (spirotetramat) are present in pollen and nectar brought back to hives when bees are placed in citrus groves that are sprayed during bloom?**
2. **Is brood development or colony viability adversely affected by application of Movento to citrus during bloom?**

Materials & Methods

Endpoints

- Brood cohort success
- Colony strength (bees, brood, honey, pollen, queen)
- Colony health (pests, diseases)
- Intra-hive mortality (dead bees in traps)
- Hive weight change
- Residues (spirotetramat in citrus blossoms, bee-collected nectar and pollen)
- Long-term survival of colonies

Materials & Methods

Study Location

Control

~14 km separation

Movento

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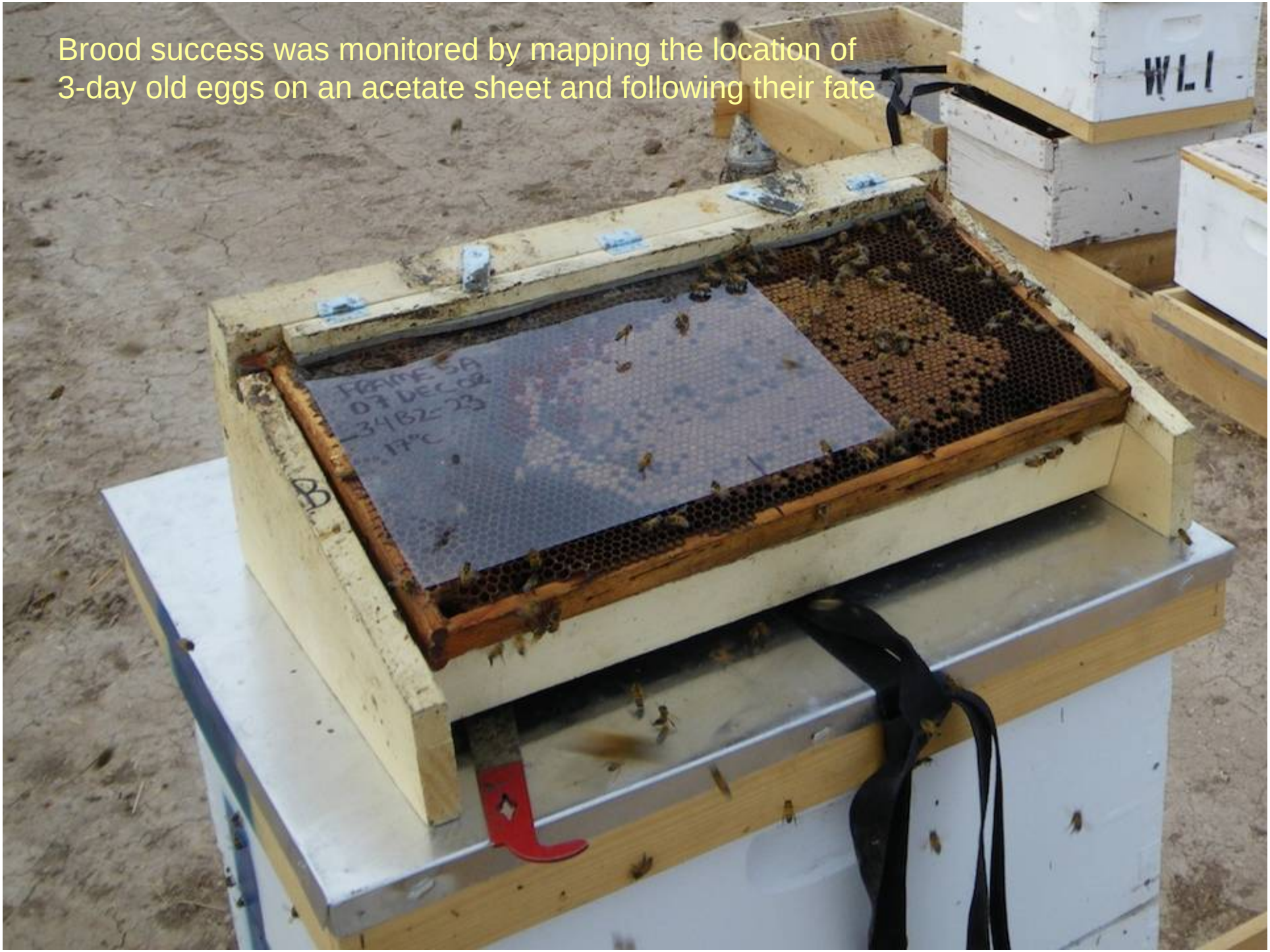
Materials & Methods

Application

Applied 26 March 2009 at maximum label rate for citrus:
10 fluid ounces/Acre (0.16 lb ai/A; 730 ml product/ha; 175 g ai/ha).


Citrus foliage and blooms were thoroughly covered by the spraying operation while bees were foraging

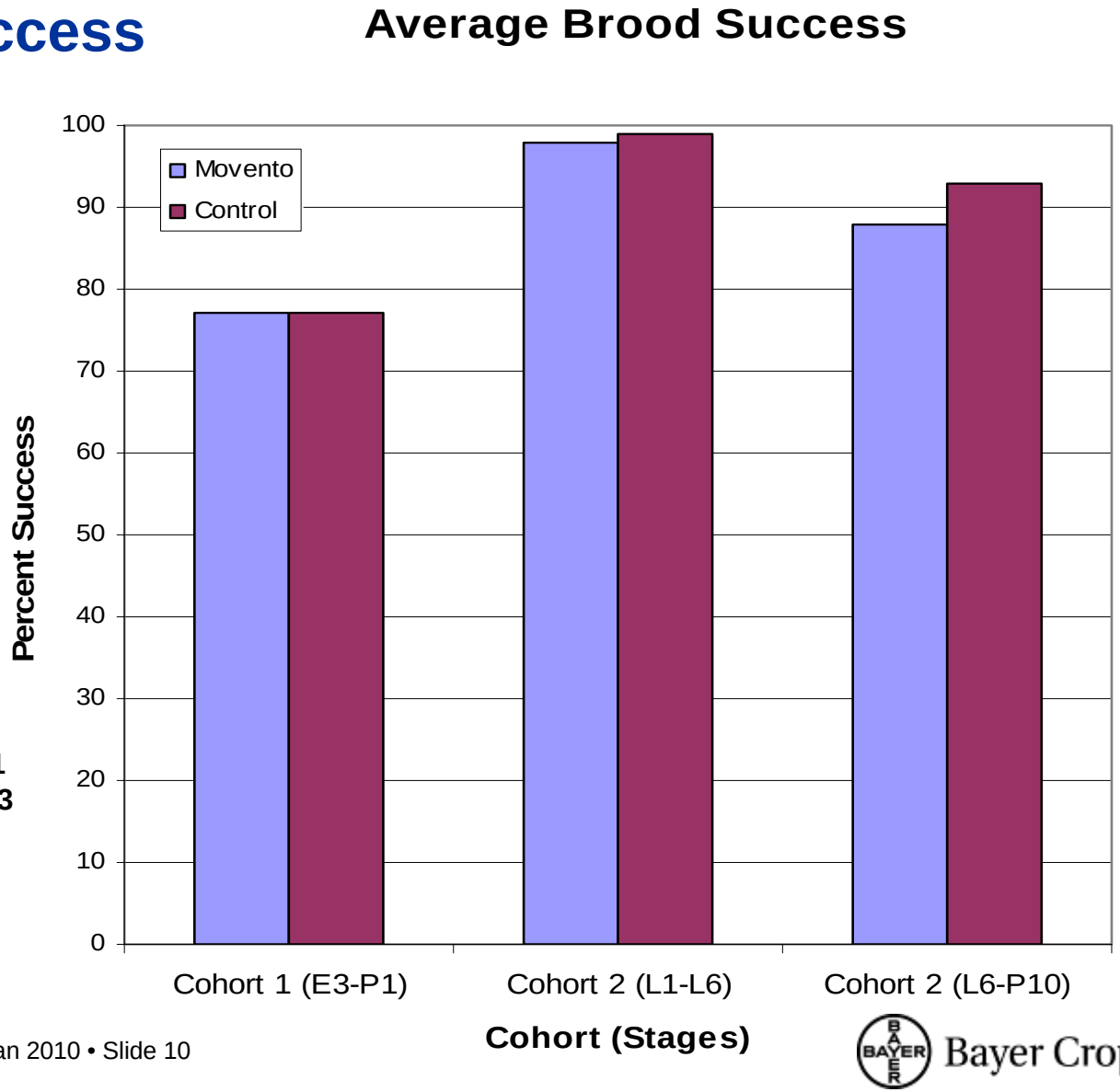

Brood success was monitored by mapping the location of
3-day old eggs on an acetate sheet and following their fate
WLI


Monitoring of brood development in cells mapped on an acetate sheet

Results & Discussion

Brood Success (in citrus)

Most susceptible stages are young larvae at time of application, but no effect



- **Cohort 1 mapped -1**
- **Cohort 2 mapped +3**
- **No Sig. Diff.**

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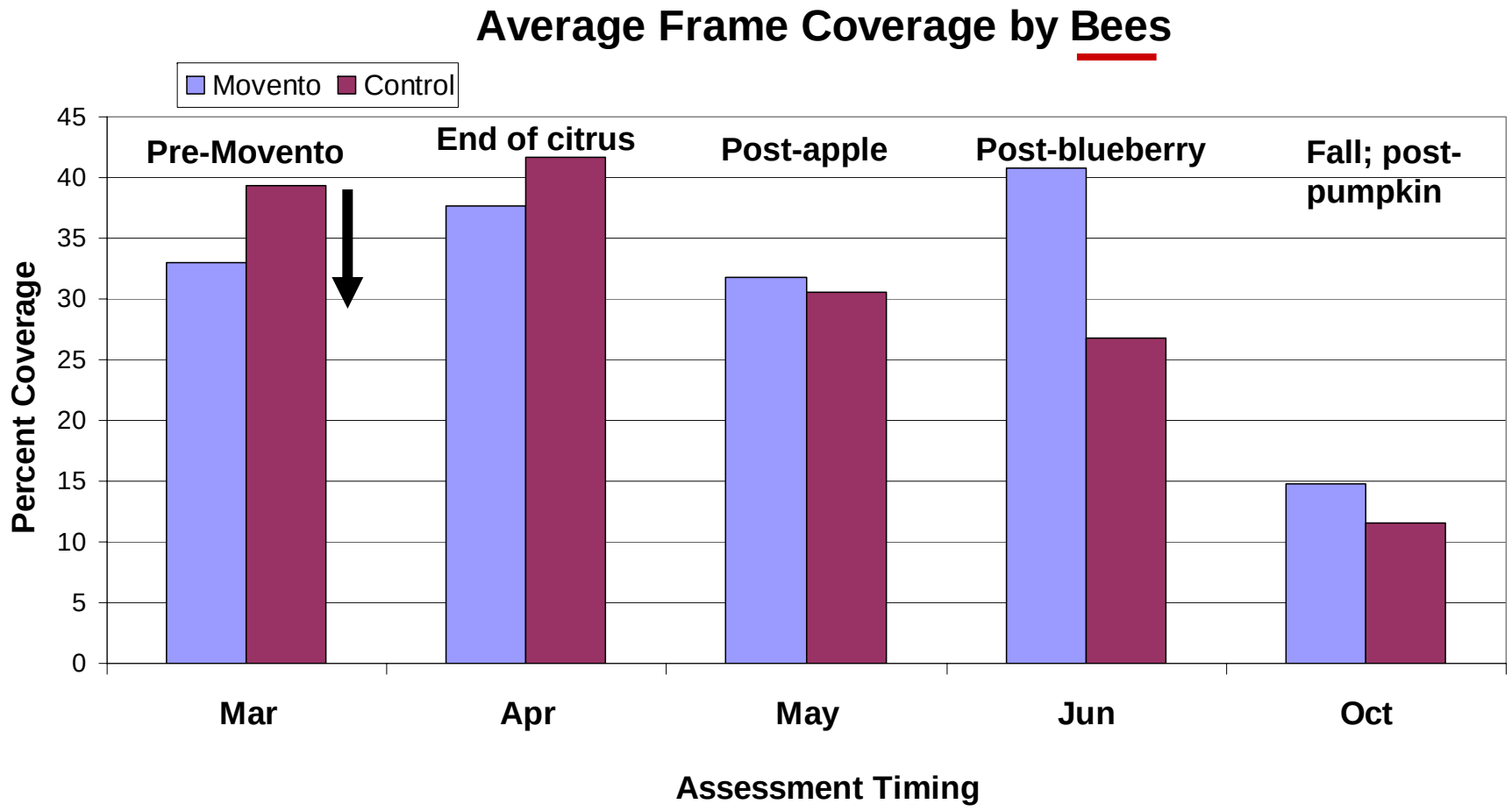
Results & Discussion

Colony Strength



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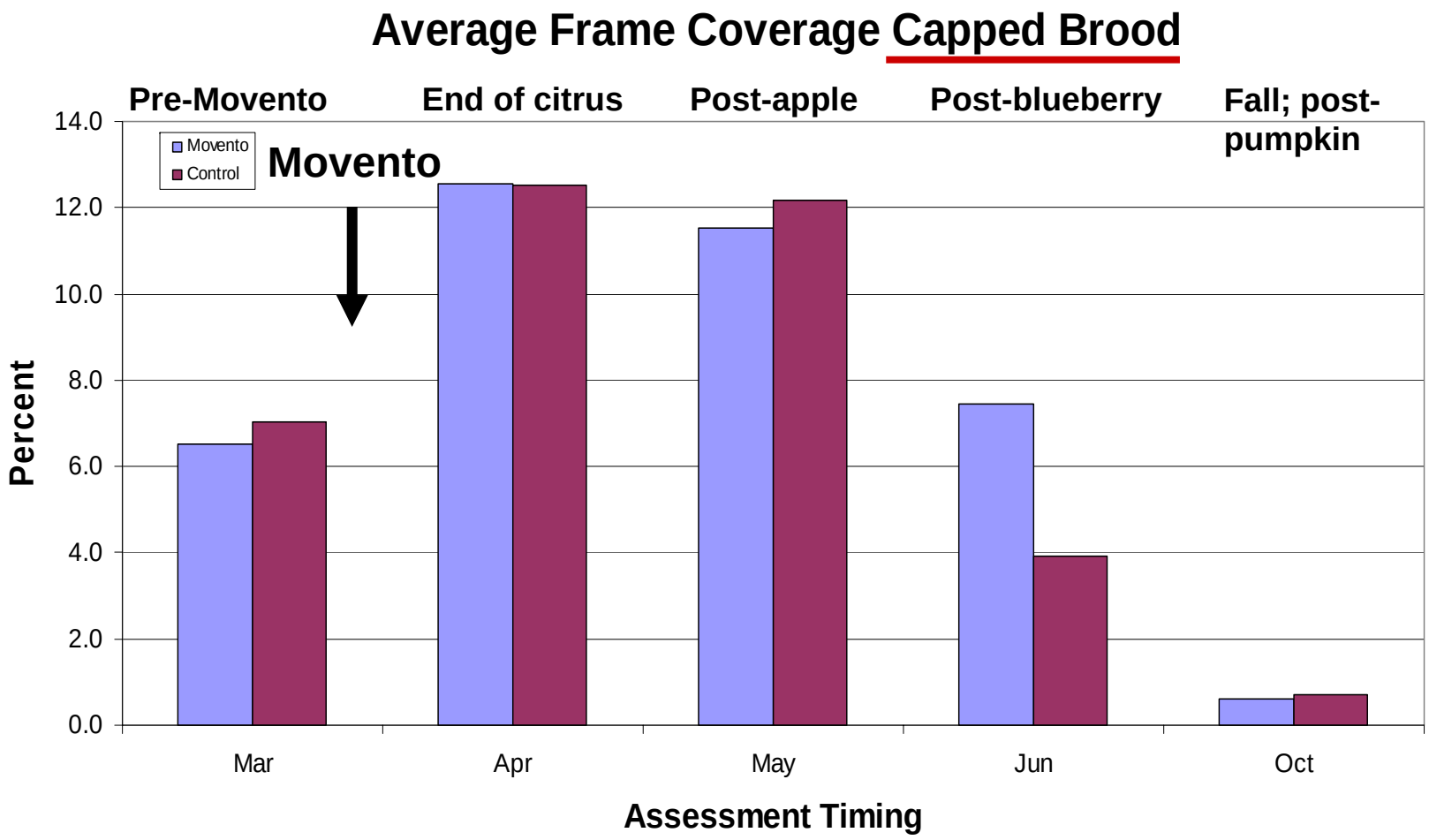
Results & Discussion

Colony Strength



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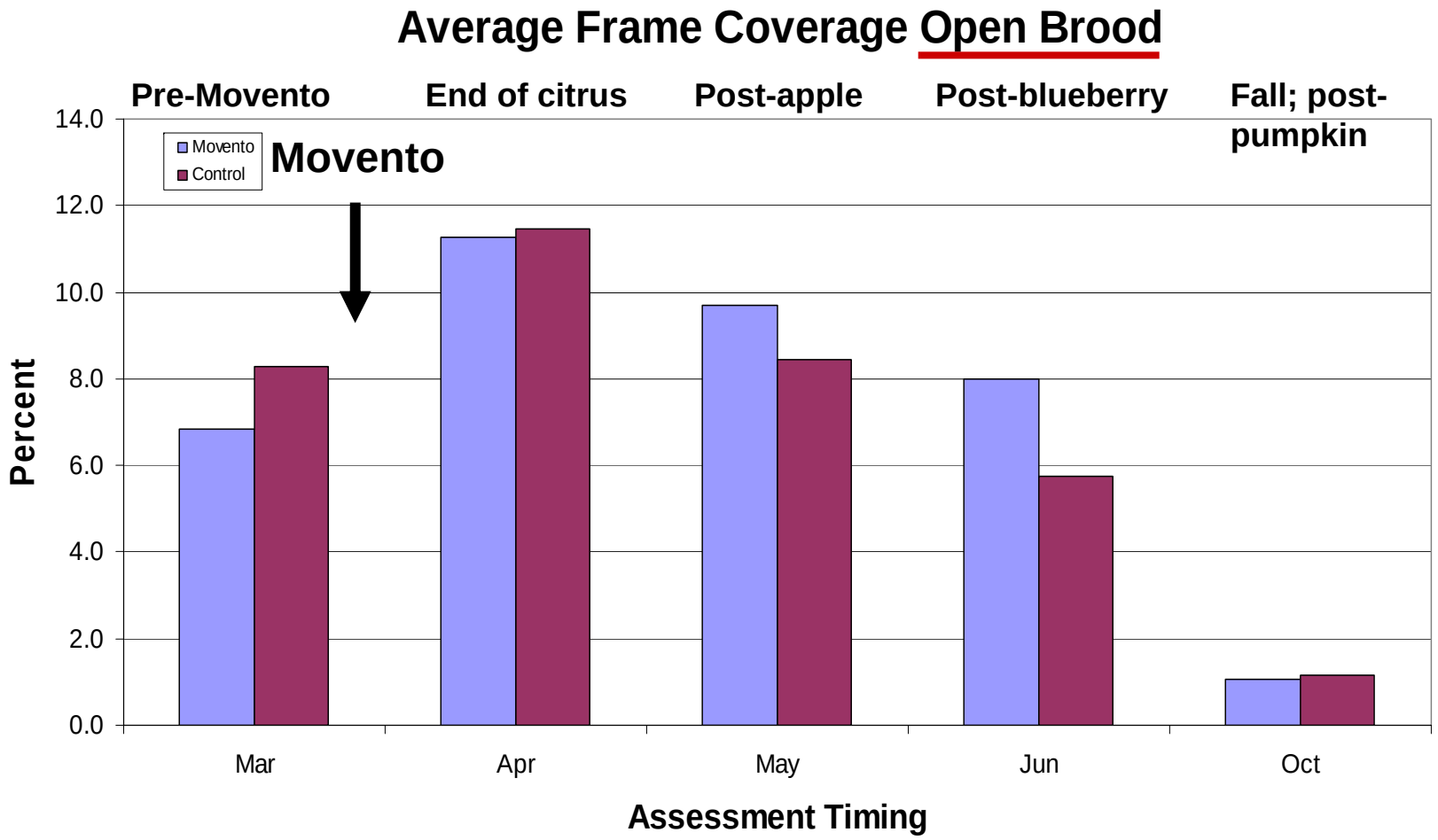
Results & Discussion

Colony Strength



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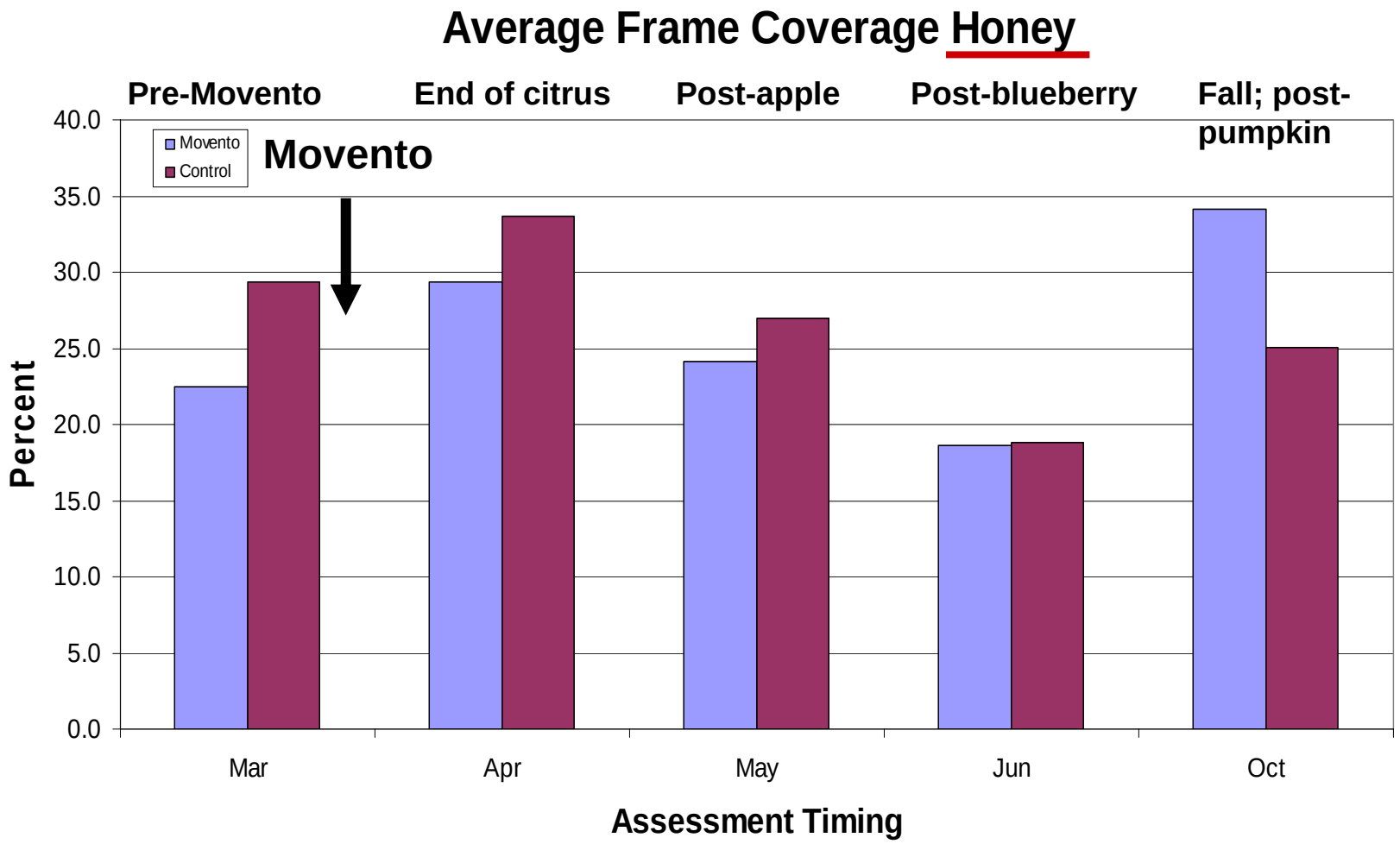
Results & Discussion

Colony Strength



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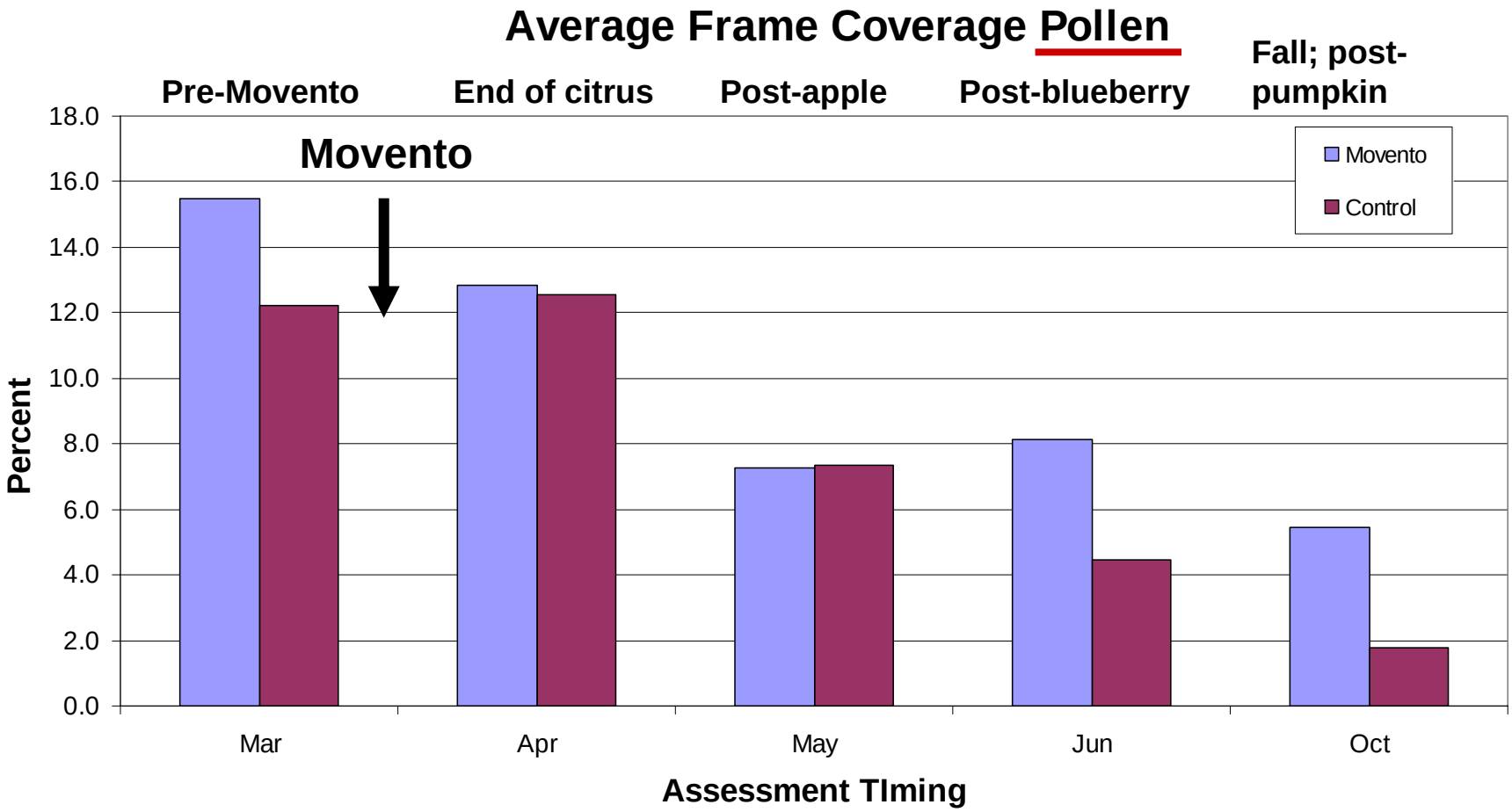
Results & Discussion

Colony Strength



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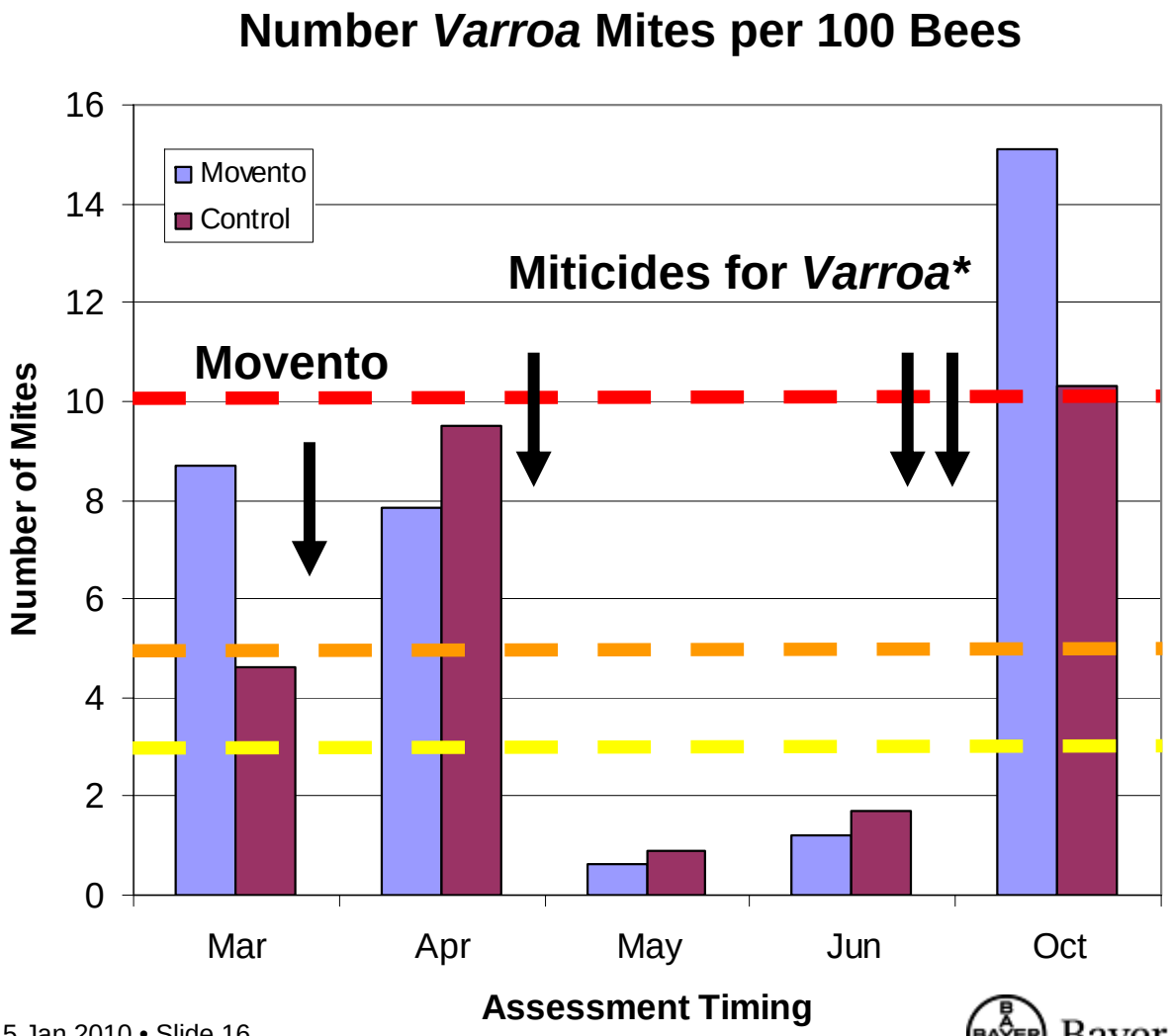
Results & Discussion

** 25 Apr, 30 Jul, 2 Oct*

Colony Health



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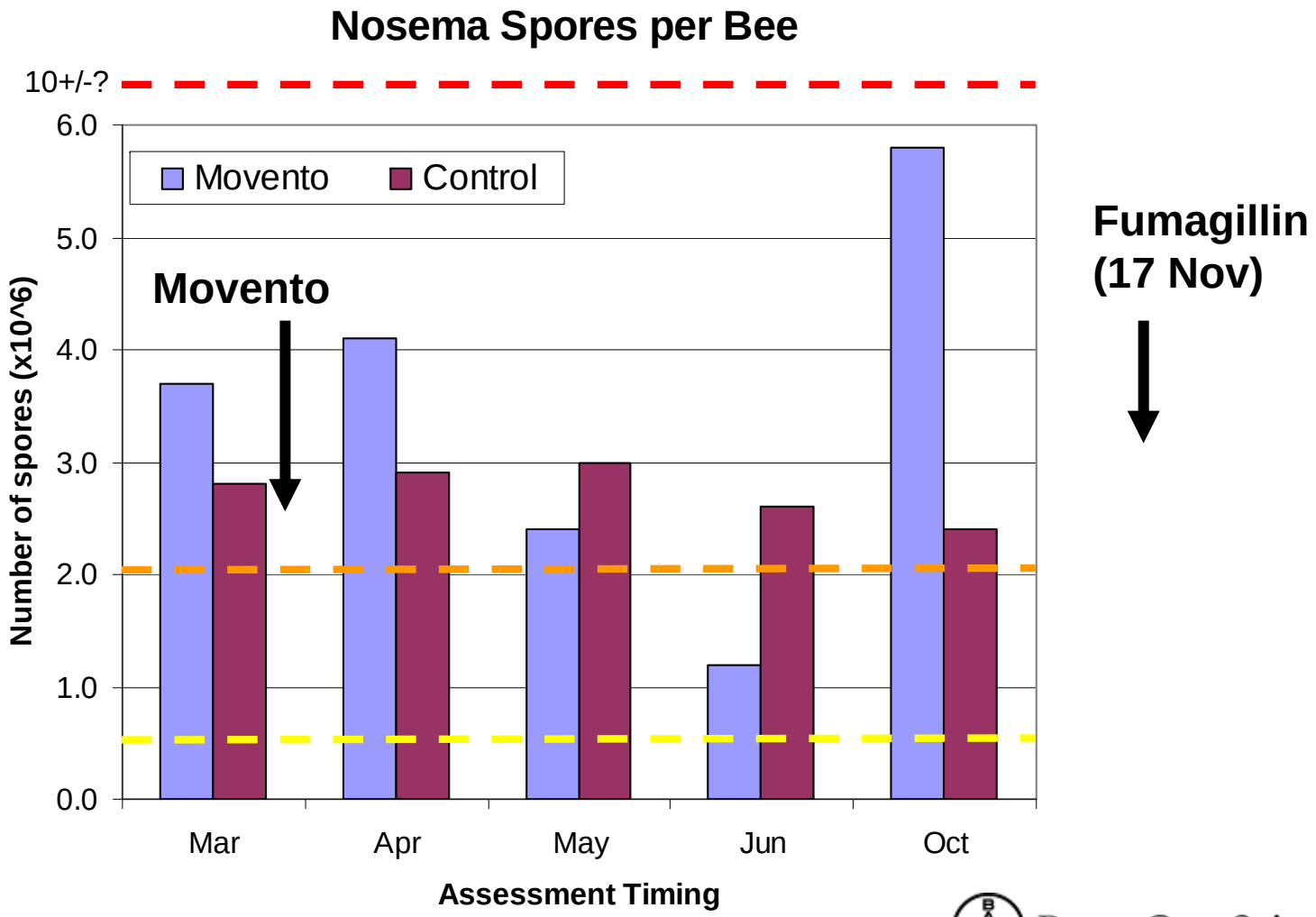
Results & Discussion

Colony Health



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Drop zone dead bee (DZDB) traps were used to monitor bee mortality and obtain samples of dead bees

Results & Discussion

Intra-hive Mortality

Average dead bees per day

	Movento (26 Mar to 3 Apr)	Control (26 Mar to 3 Apr)	Movento (15 Apr)	Control (15 Apr)
Adult normal-wing worker	20	26	46	78
Pupal normal-wing worker	0	0	0	0
Adult normal-wing drone	1	1	1	3
Pupal normal-wing drone	0	0	0	0
Adult normal-wing queen	0	0	0	0
Pupal normal-wing queen	0	0	0	0
Adult deformed-wing worker	0	0	1	1
Pupal deformed-wing worker	2	3	17	21
Adult deformed-wing drone	0	0	0	1
Pupal deformed-wing drone	0	0	3	6
Adult deformed-wing queen	0	0	0	0
Pupal deformed-wing queen	0	0	0	0

DW portion of bee mortality = 9% *10%* *31%* *26%*

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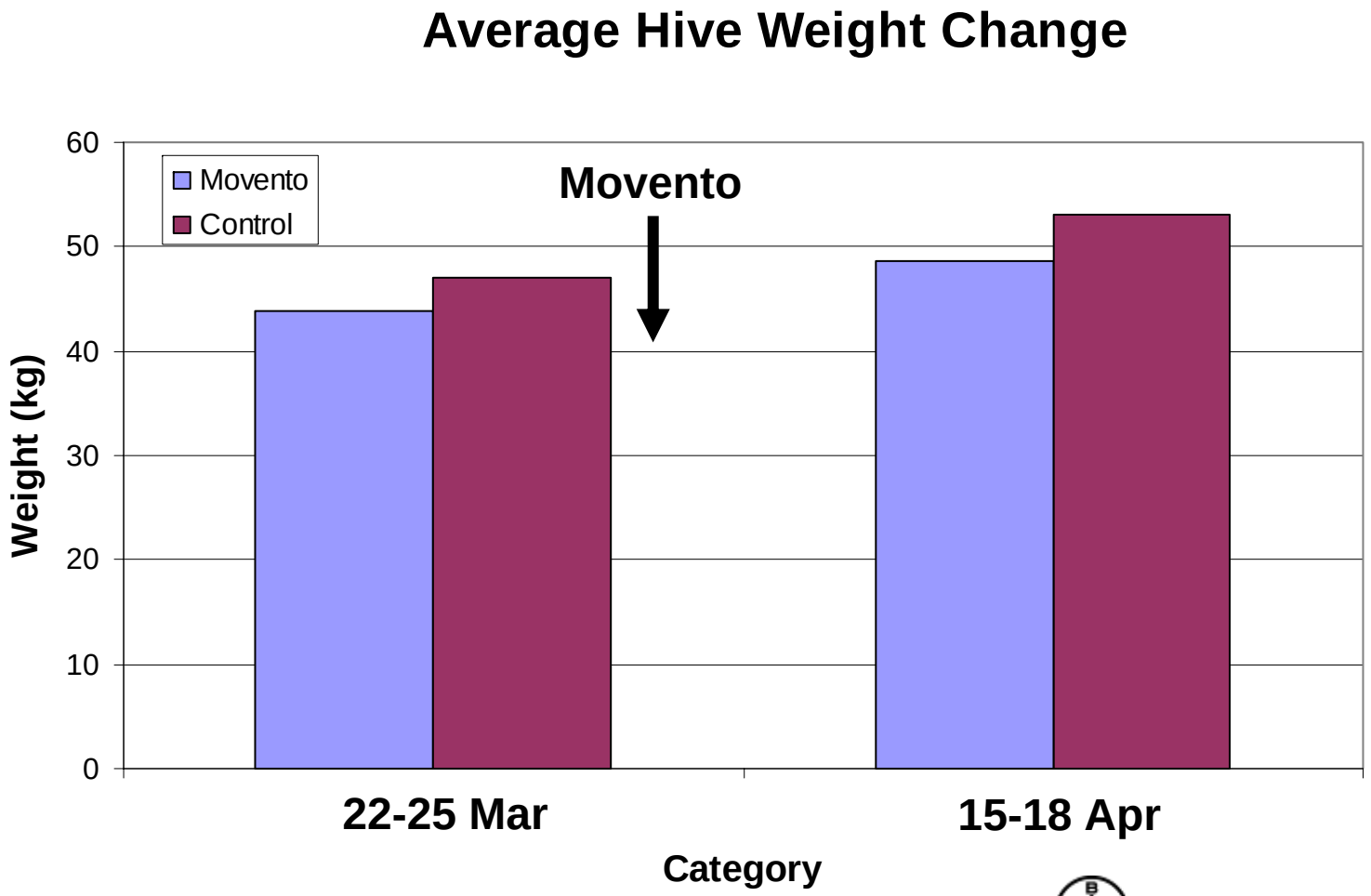
Deformed-wing condition is a major contributor to intra-hive mortality
Adult deformed-wing worker (ADWW)

Results & Discussion

Hive Weight Change (in citrus)



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Shaking comb to collect nectar


Nectar drains through hole into collection vial


Nectar sample

Results & Discussion

Average Spirotetramat Residues (parent + enol) (ppm)

	Sampling in relation to spray day					
	-1	+1	+3	+7	+14	Range post application
Blossoms						
Movento	<0.01	3.54	n/a	0.36	n/a	0.36 - 3.54
Control	<0.01	<0.01	n/a	<0.01	n/a	<0.01
Nectar						
Movento	<0.01	0.03	0.02	0.02	n/a	<0.01 - 0.04
Control	<0.01	<0.01	n/a	<0.01	n/a	<0.01
Pollen						
Movento	<0.01	0.17	0.17	0.1	<0.01	<0.01 - 0.32
Control	0.02	<0.01	<0.01	n/a	<0.01	<0.01 - 0.09*

Notes: ***LOQ = 0.01 ppm***

**** Detection of spirotetramat residues in one control pollen sample may represent contamination (source unknown). It is unlikely the sample contained any spirotetramat residues.***

Results & Discussion

Average Spirotetramat Residues (parent + enol) (ppm)

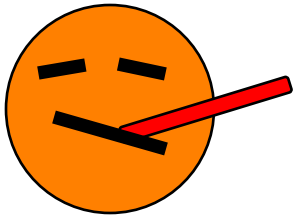
	Capped Honey	Stored Pollen
April (end of citrus)		
Movento	**0.02 (0.01-0.04)**	**0.11 (<0.01-0.56)**
Control	**<0.01**	**<0.01**
October		
Movento	**<0.01**	**<0.01**
Control	**<0.01**	**<0.01**

Materials & Methods

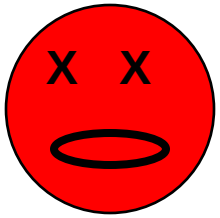
Survival Categories

= Excellent! No problem

= Not feeling so well



= Very sick



= Dead or dying

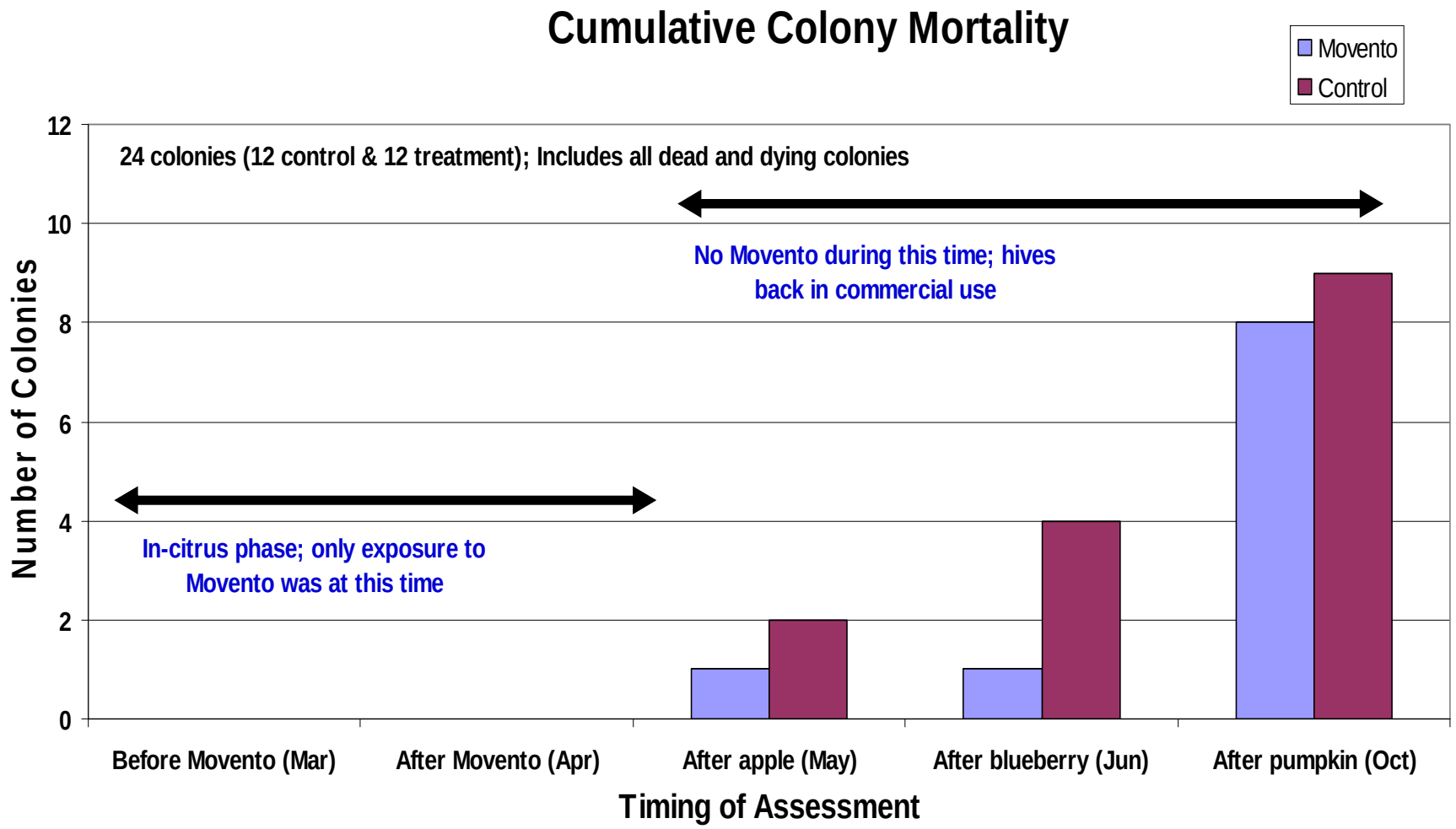
Materials & Methods

Provisional Thresholds

Disorder	Green	Yellow	Orange	Red	Units
Bees	>30	20 to 30	10 to 20	<10	Mean % frame coverage
Honey	5 to 40	3 to 5	1 to 3	<1	Mean % frame coverage
Pollen	3 to 10	1 to 3	0.5 to 1	<0.5	Mean % frame coverage
Capped*	Both capped and uncapped must be present				Mean % frame coverage
Open*	>10	5 to 10	3 to 5	<3	Mean % frame coverage
Queen	P	P w/no eggs	A w/eggs	A w/no eggs	Present or Absent
Eggs	P	A	n/a	n/a	Present or Absent
AFB	0	1 to 5	5 to 10	>10	Average number affected cells/frame
EFB	0	1 to 10	10 to 20	>20	Average number affected cells/frame
VM	<3	3 to 5	5 to 10	>10	Number of mites/100 bees
HBTM	0	1 to 10	10 to 35	>35	% infected bees
Nosema spp.	0	>0 to 2	2 to 10	>10	Number spores (x10^6)/bee
DW	A	P	Adults & pupae	>25% intra-hive mortality	Present or Absent (on frames and in DZDB trap)
CPV	A	P	TBD	TBD	Present or Absent
K-W	A	P	TBD	TBD	Present or Absent
SHB	A	P	TBD	TBD	Present or Absent
Snotty Brood	A	P	TBD	TBD	Present or Absent
CB	0	1 to 25	25 to 100	>100	Average number affected cells/frame
SBV	0	1 to 25	25 to 100	>100	Average number affected cells/frame
DZDB trap mortality	TBD	TBD	TBD	TBD	Mean number normal-wing workers/day
*	Combined coverages, plus both must be present, or a new queen is confirmed; use next best category for late season assessment results.				

Results & Discussion

Colony Survival



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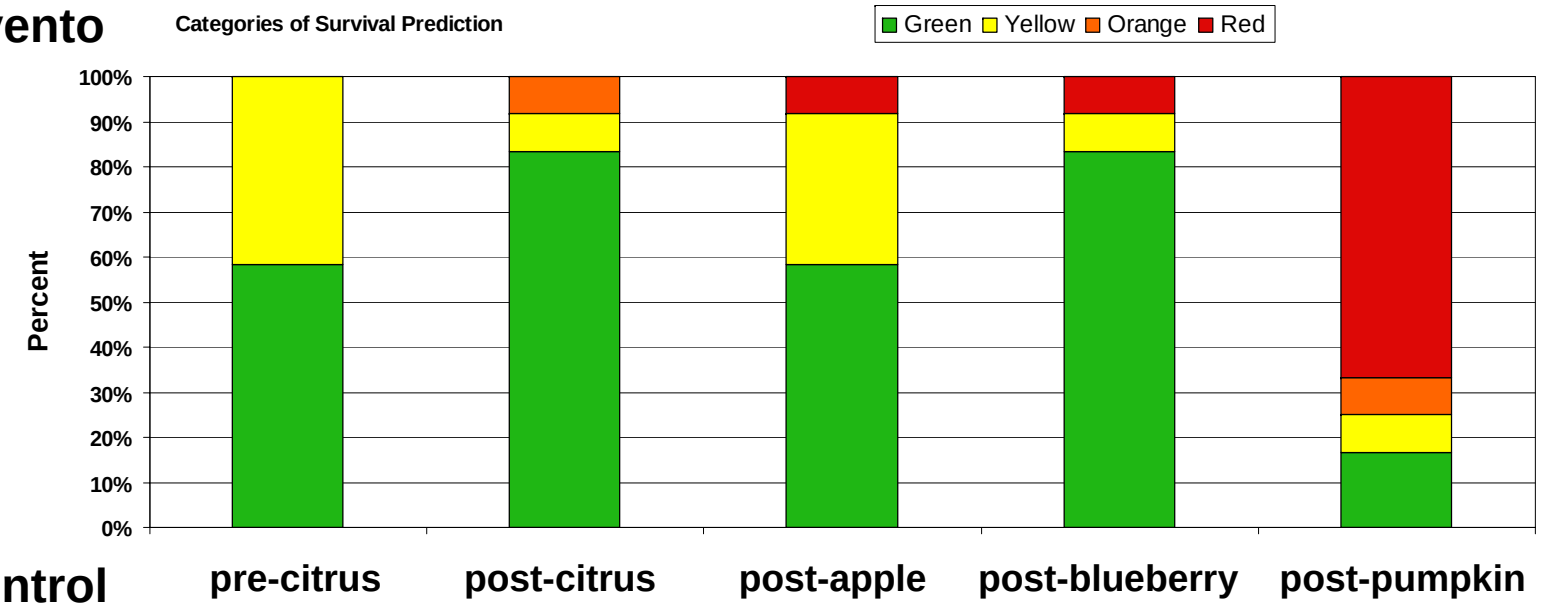
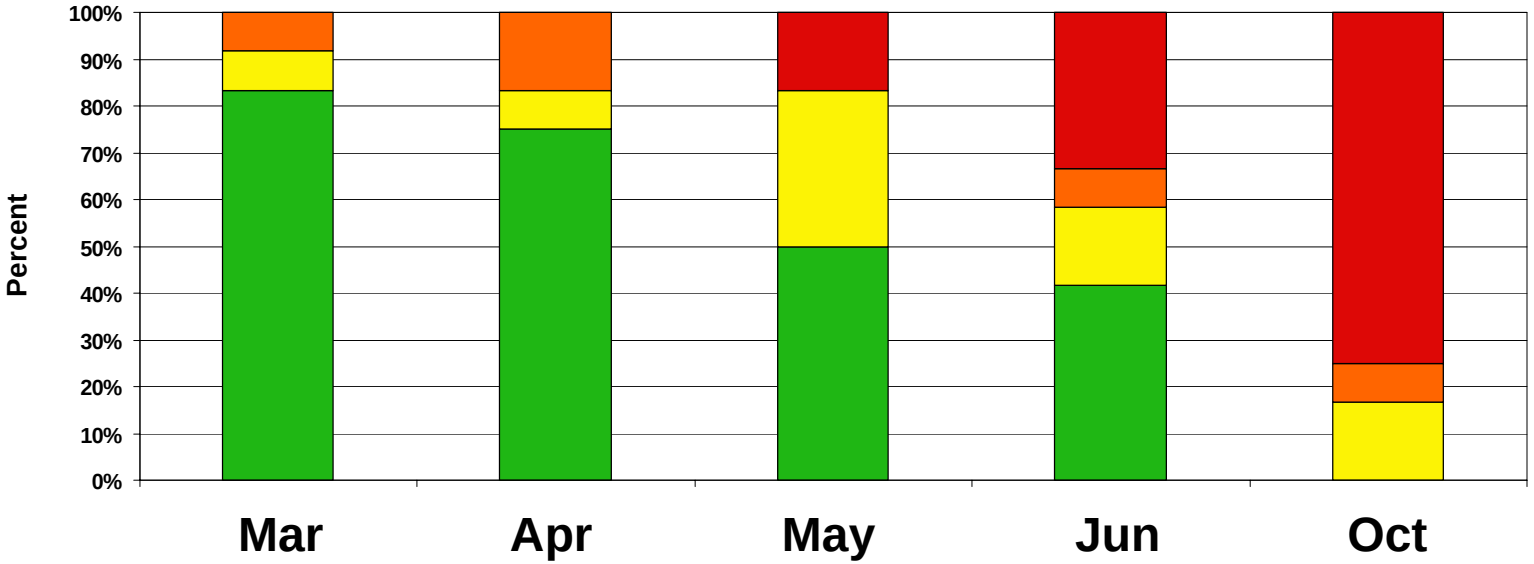
Colony Survival Prediction - Treatment Group

Movento



Control



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Conclusions

Q1: What levels of Movento (spirotetramat) are present in pollen and nectar brought back to hives when bees are placed in citrus groves that are sprayed during bloom?

Maximum residues of spirotetramat parent + enol in citrus:

- Blossoms = 3.54 ppm
- Bee-collected nectar = 0.04 ppm
- Bee-collected pollen = 0.32 ppm

All residue levels below 144 ppm where effects have been documented, and below 10-20 ppm where no effects observed in other studies.

Conclusions

Q2: Is brood development or colony viability adversely affected by application of Movento to citrus during bloom?

There were no indications that Movento had any negative impacts on brood success or colony health or survival.

Appears to be a high margin of safety.

Acknowledgements

1. Bees: D. Mendes
2. Hives: D. Mendes & D. Hackenberg
3. Moving hives, workshop, & storage: D. Hackenberg
4. Citrus groves & spraying: T. McCarthy
5. Traps and other gear: WLI (Rogers)
6. Protocol: WLI (Rogers), NHBAB & members, USEPA, USDA, BCS
7. EUP: Florida Department of Ag, USEPA
8. Hive management & relocation recordkeeping: D. Hackenberg
9. Research team: Dick Rogers, Geoff Williams
10. Residue analyses: C. Lam, R. Simonds
11. Bee sample analyses: M. Holt, L. Charbonneau, Amirault Bee Lab, G. Williams, others


Thanks to all who contributed
to the success of this study!

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