OP-050 [Bee Biology]
Effects of various fall feeding sugar sources on survival, health, and performance of honey bee colonies (Apis mellifera L.)

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In Canada, beekeepers supplement their colonies with sugar in the fall to ensure survival during winter, when floral resources are absent. Sucrose syrup is the predominant choice due to its high availability, chemical stability, and ease of use. However, upcoming revisions to Canada's organic standards will prohibit the use of conventional sucrose syrup, necessitating a shift toward honey or organic sucrose syrup as overwintering resources. The implications of this transition on colony survival, development, productivity, and pathogen prevalence remain insufficiently characterized, particularly regarding economic viability. This study evaluated honey bee colonies fed with conventional sucrose syrup, organic sucrose syrup, summer honey, or fall honey. Key parameters assessed included winter survival, colony development, honey production, and pathogen prevalence (Varroa destructor, Nosema spp., and six viruses). Additionally, the economic costs of alternative feeding strategies were analyzed. Results indicate that organic sucrose syrup, summer honey, and fall honey are viable alternatives to conventional sucrose syrup for overwintering. However, precise colony weight management following fall feeding is critical to prevent starvation. In most cases, a minimum of nine honey frames per colony housed in a Langstroth single-brood chamber or four frames supplemented with 12 liters of organic sucrose syrup supported successful overwintering, although adjustments may be required depending on colony size and winter severity. No statistically significant differences were observed in brood and bee population development, honey production, or pathogen prevalence across feeding treatments. However, the cost of overwintering with nine frames of honey was $272 per colony, representing an 830% increase compared to conventional sucrose syrup. These findings suggest that while organic beekeepers can effectively overwinter colonies using alternative carbohydrate sources, the financial and logistical constraints associated with honey-based feeding warrant careful consideration. To mitigate economic risk and optimize colony survival, preliminary trials on a subset of colonies are recommended prior to full-scale implementation.

Effects of various fall feeding sugar sources on survival, health, and performance of honey bee colonies (*Apis mellifera* L.)

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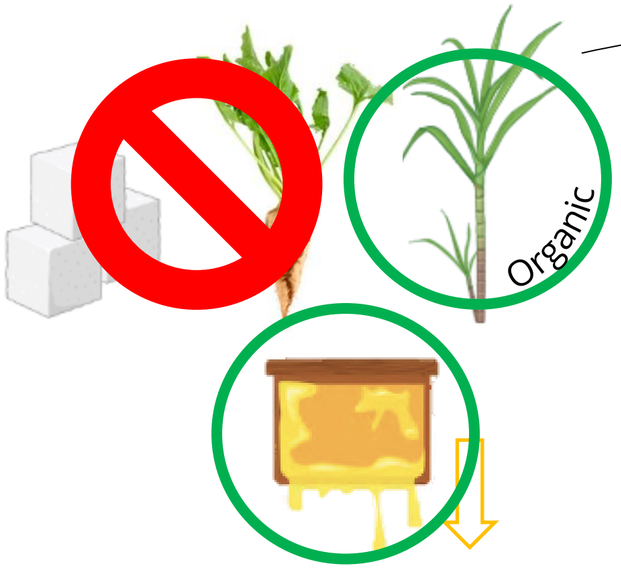
LES APICULTEURS ET APICULTRICES DU QUÉBEC

PROGRAMME INNOV' ACTION AGROALIMENTAIRE

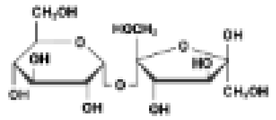
Introduction

CRAAQ 2020, Severson et Érickson 1984

Introduction



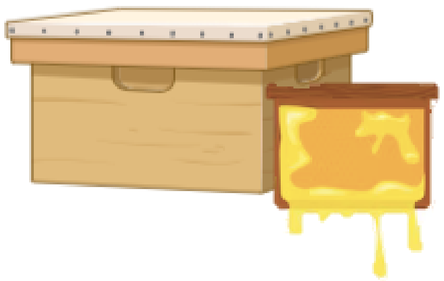
Sucrose



Minimum of 6 months without floral resources

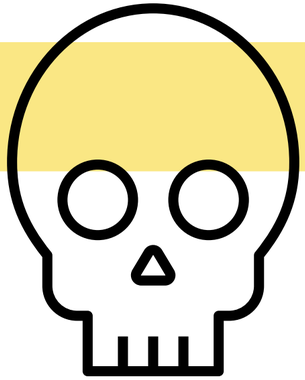
- No data in the literature to determine whether it is safe to feed bees with organic syrup or honey under our winter conditions
- Several data indicating potential risks

CRAAQ 2020, Severson et Érickson 1984

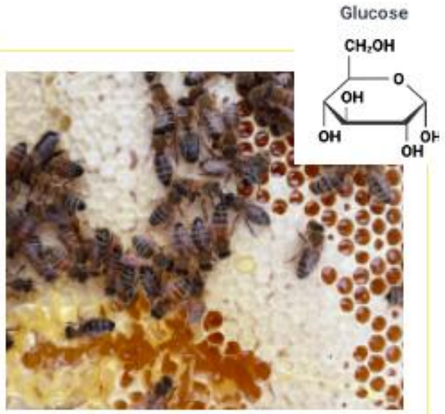


Risks associated with honey feeding

Problematic



Dysentery



Crystallization of honey

Starvation

Alfonsus 1935, Fingler 1980, Gooderham 1926, Gruzka 1979, Moeller 1978, Sladen 1920

Problematic

Fear associated with organic sugar

Minerals in molasses

Extraction

Organic

Conventional

Molasses

Refinement

Molasses

The Sugar Association 2024, Rambler 1932

Problematic

Fear associated with organic sugar

als in molasses

AMERICAN BEE JOURNAL

Vol. LXXII—No. 3 Hamilton, Illinois, March, 1932 Monthly, $1.00 a Year

Colonies Will Grow Rapidly on a Mixture of Milk, Sugar, and Water

By Rambler II
Washington

IN 1914 and 1915, with the help of another beekeeper, I tried many experiments with bees. One was the feeding of a number of unusual things.

We fed different strengths of glucose, and mixtures of glucose and sugar. We tried molasses. Then we used common sugar and different acids. Later we fed great quantities of sweetened fruit juices, with amusing results. Imagine currant jelly

Think as you wish. The idea seems foolish, but we have heard of it before. In September, 1930, J. W. Winson reported the experiments of James Frazer, of the Dominion Experiment Station, Agassiz, British Columbia, indicating that milk-fed bees do well on the "bottle."

feeders. It was as thick as some New England honey that I have sampled, probably just under twelve pounds to the standard gallon.

I then put the empty combs back and fed clear, heavy sugar syrup to which a very little light honey had been added before boiling. The bees are alive and strong February 12 and they had lost remarkably few workers during the past winter. I have always seen that nuclei built

olasses

The Sugar Association 2024, Rambler 1932

Project objectives

01/
Sugar sources

02/
Impacts on colonies

03/
Feasibility in enterprise

04/
Costs

Variables

Bee population

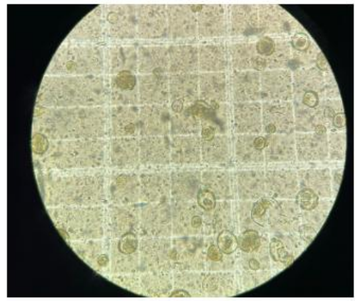
Brood population

Phase 1

Honey production

Weight

Varroa



Phase 2

Nosema

Phase 2

Virus

Mortality

Phase 1

2022-2023
CRSAD: 50 colonies
Groups:

- Conventional syrup 2 :1
- Organic syrup 2 :1
- Mix of organic syrup (12L) and fall honey (4 frames)
- Fall honey (8 frames of honey + 2 frames of pollen)
- Summer honey (8 frames of honey + 2 frames of pollen)

Wintered outside with one brood chamber

©Laurence Plamondon

Results phase 1

Table 2. Number of colonies wintered in the fall, number of colonies surviving in the spring, and winter mortality percentage for 2022-2023 in each experimental group.

Experimental groups	Number of wintered colonies	Number of surviving colonies in spring	Winter mortality (%)
Fall honey	9	3	67
Fall honey + Organic syrup	10	10	0
Summer honey	9	5	44
Conventional syrup	9	9	0
Organic syrup	9	9	0

All deceased colonies died of starvation

8 frames of honey + 2 frames of pollen is not enough

Results phase 1

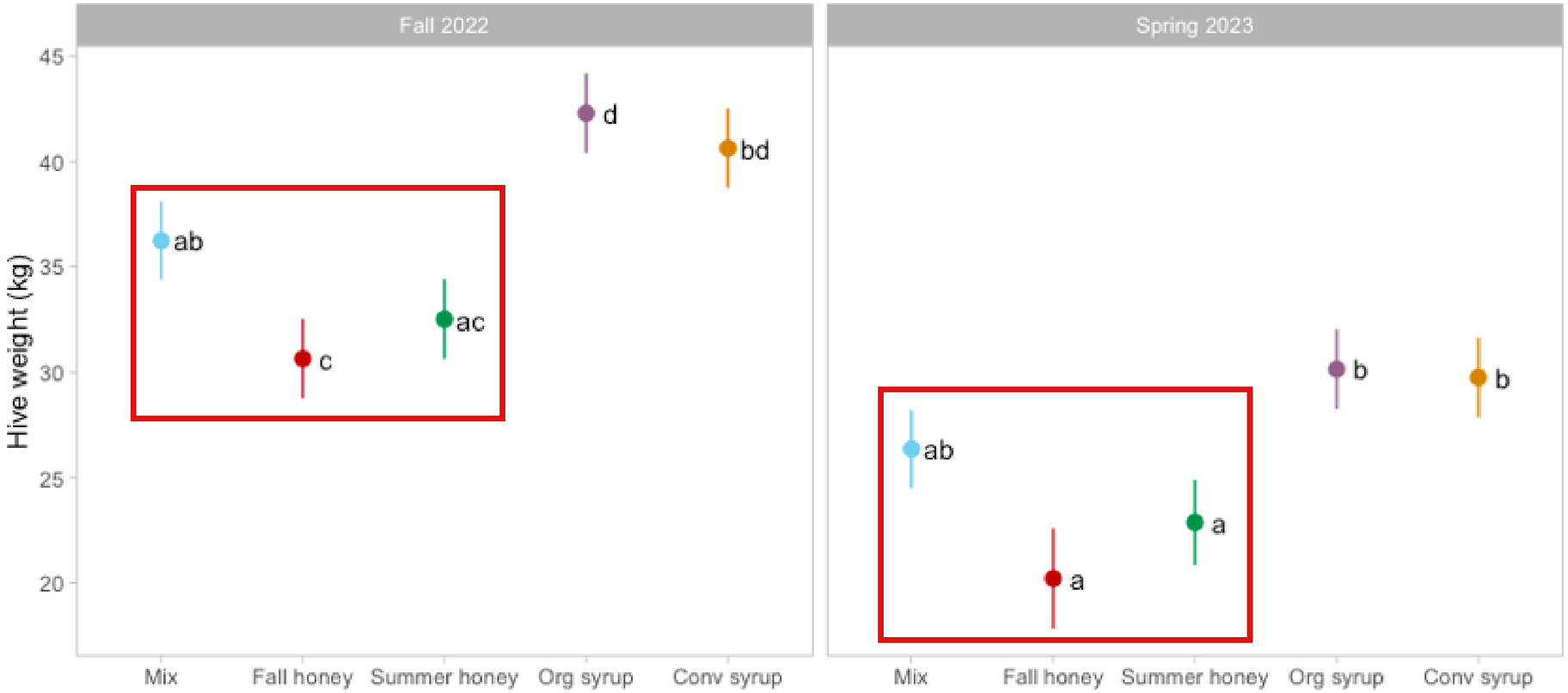


Figure 3. Hive weight (kg) in fall and spring, based on experimental groups (mean ± SE). Different letters indicate statistically significant differences between groups ($p < 0.05$).

Results phase 1

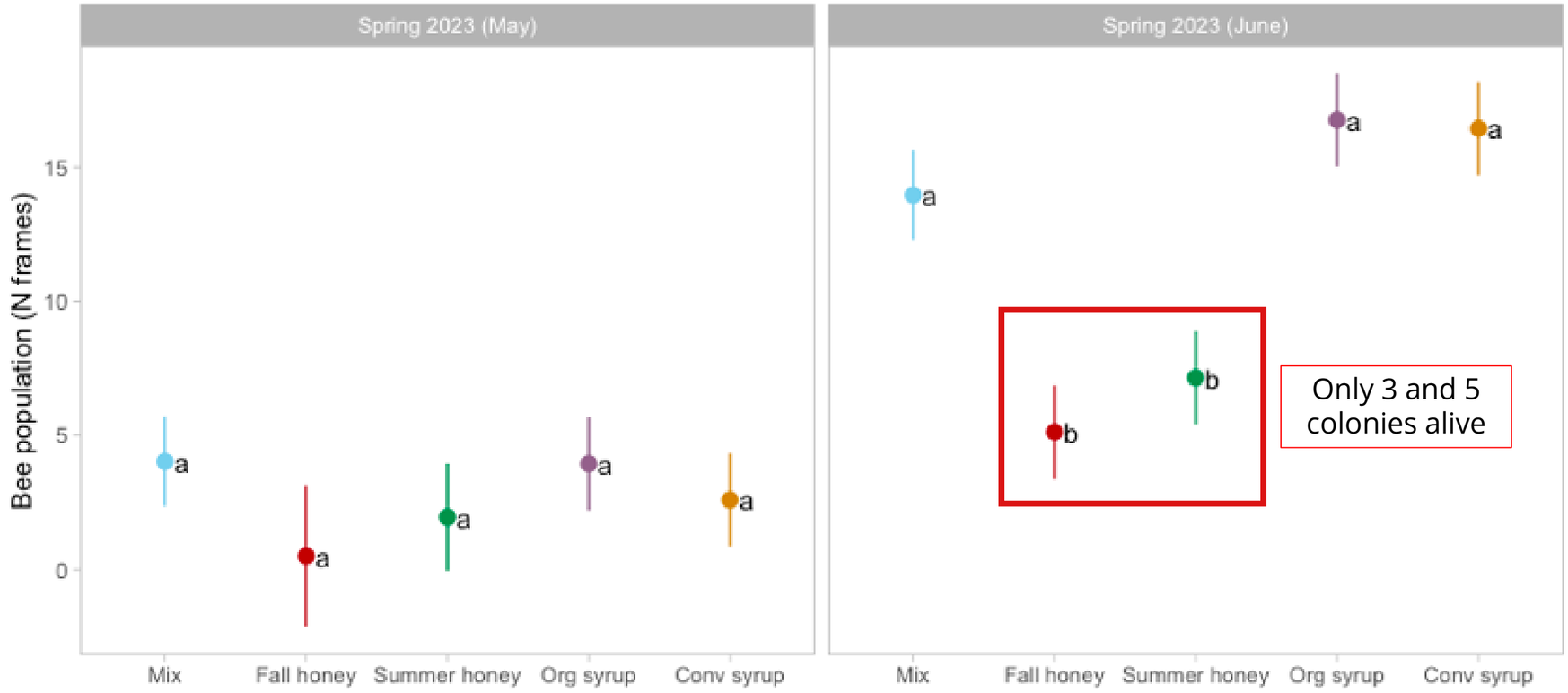


Figure 4. Bee population (number of frames covered with bees) in May and June, based on experimental groups (mean ± SE). Different letters indicate statistically significant differences between groups ($p < 0.05$).

NO SIGNIFICANT IMPACT ON BROOD

Results phase 1

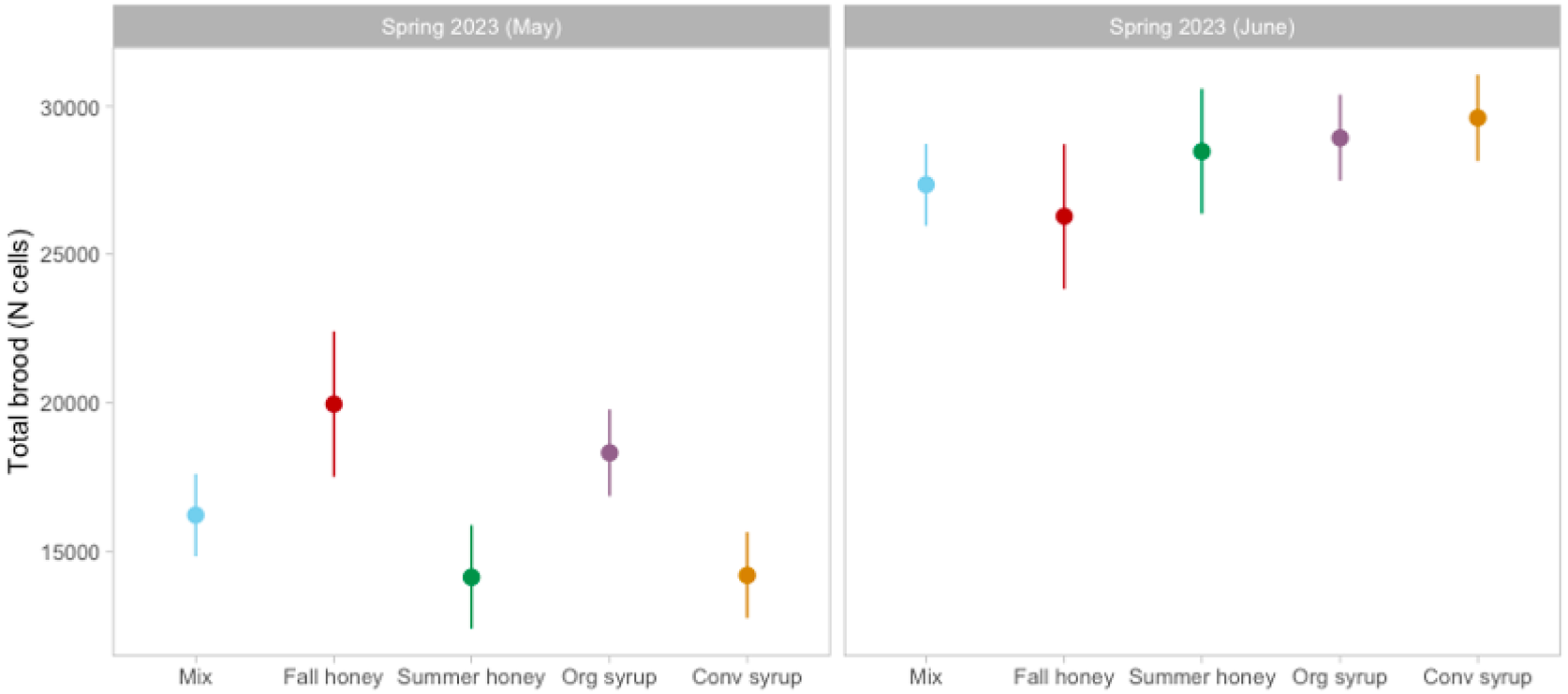


Figure 5. Total brood population (number of cells of eggs, larvae, and pupae) in May and June, based on experimental groups (mean ± SE).

NO SIGNIFICANT IMPACT ON HONEY PRODUCTION

Results phase 1

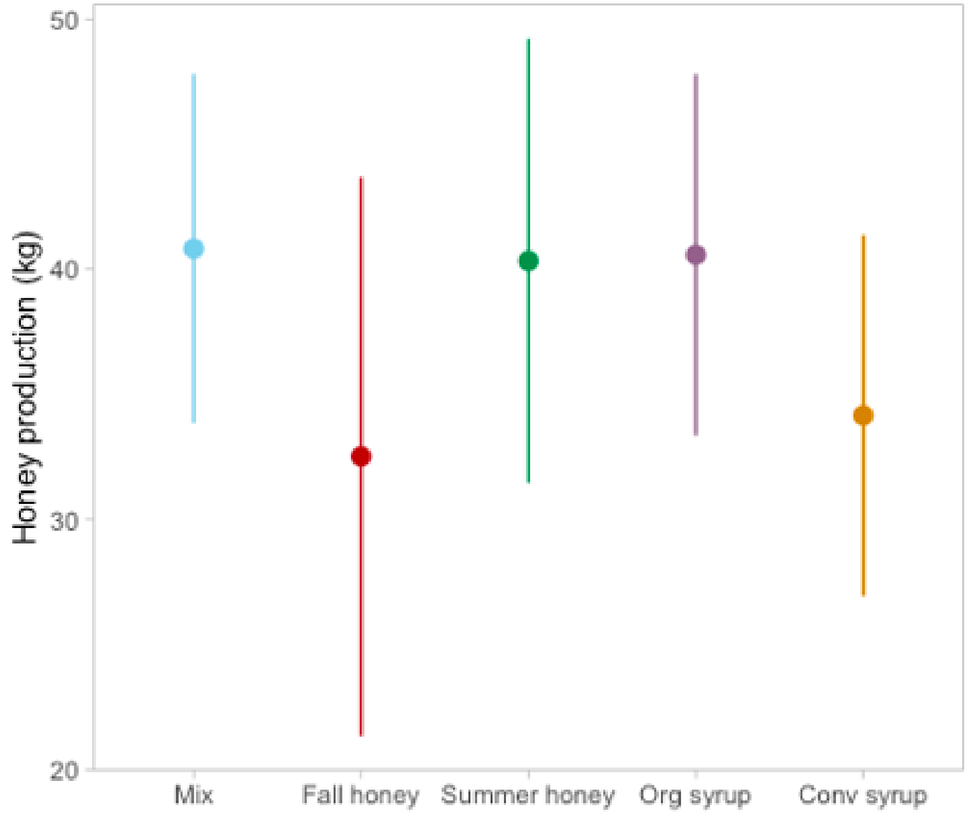


Figure 6. Honey production (kg) from May to August, based on experimental groups (mean ± SE).

Phase 2

2023-2024
Two organic beekeepers : 60 colonies
Groups:

- Conventional syrup 2 :1
- Organic syrup 2 :1
- Summer honey (9 frames of honey)

Wintered outside with one brood chamber

+1 frame
Following the results of phase 1

Results phase 2

Table 2. Number of colonies wintered in the fall, number of colonies surviving in the spring, and winter mortality percentage for 2022-2023 in each experimental group.

Experimental groups	**Number of wintered colonies**	**Number of surviving colonies in spring**	**Winter mortality (%)**
Honey	18	15	16.67
Conventional syrup	20	20	0
Organic syrup	20	20	0

1 died of unknown causes and 2 died of starvation

Results phase 2

Figure 8. Colony weight (kg) in fall and spring, based on experimental groups (mean ± SE). Different letters indicate statistically significant differences between groups ($p < 0.05$).

NO SIGNIFICANT IMPACT ON BEE AND BROOD POPULATION

Results phase 2

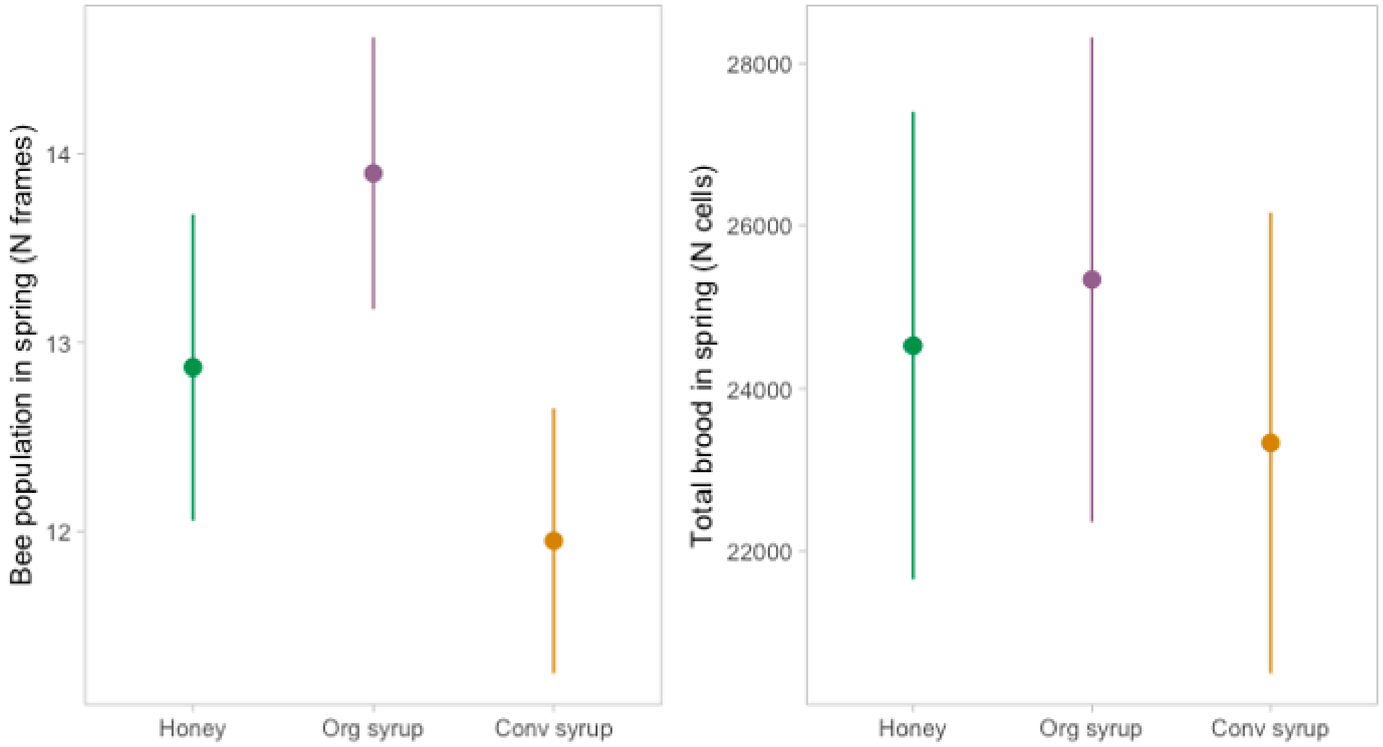


Figure 9. Bee population (number of frames covered with bees) on the left graph and total brood (number of cells with eggs, larvae, and pupae) on the right graph in spring, based on experimental groups (mean ± SE).

NO SIGNIFICANT IMPACT ON VIRUSES

Results phase 2

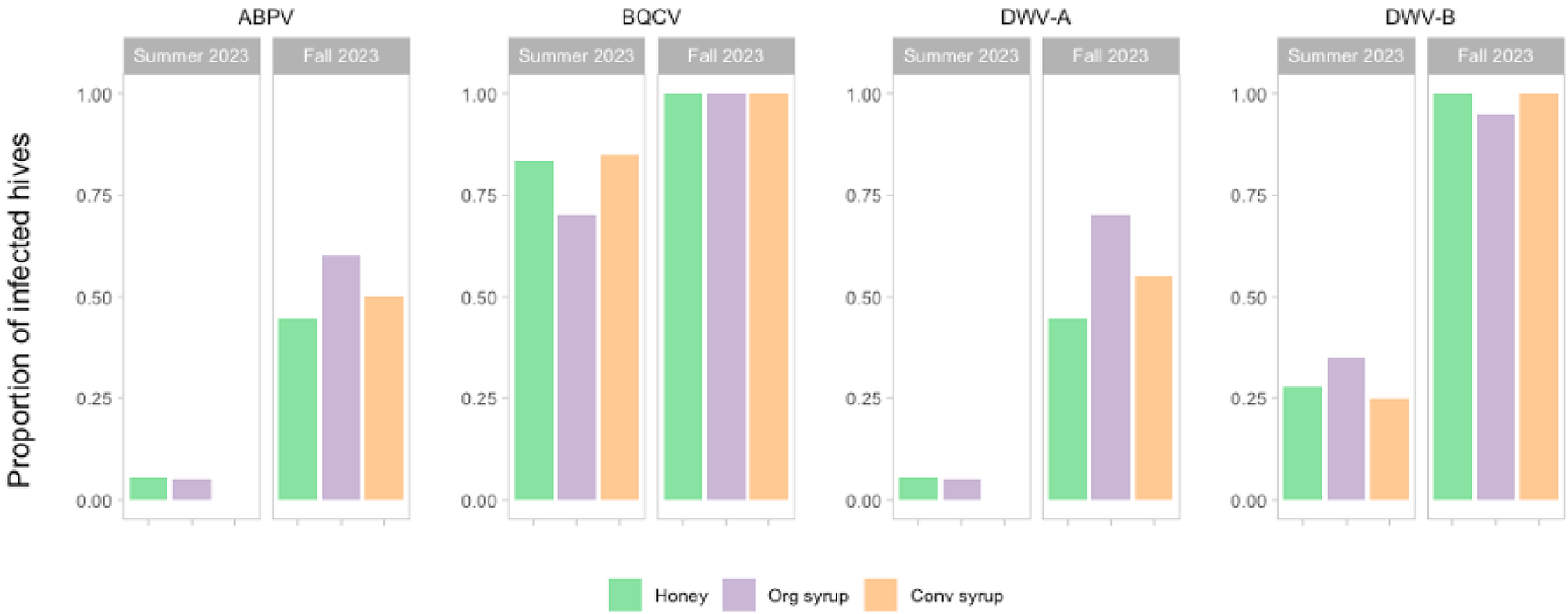


Figure 10. Proportion of hives infected by different viruses in summer and fall, based on experimental groups.

NO SIGNIFICANT IMPACT ON THE PRESENCE OF NOSEMA SPORES

Results phase 2

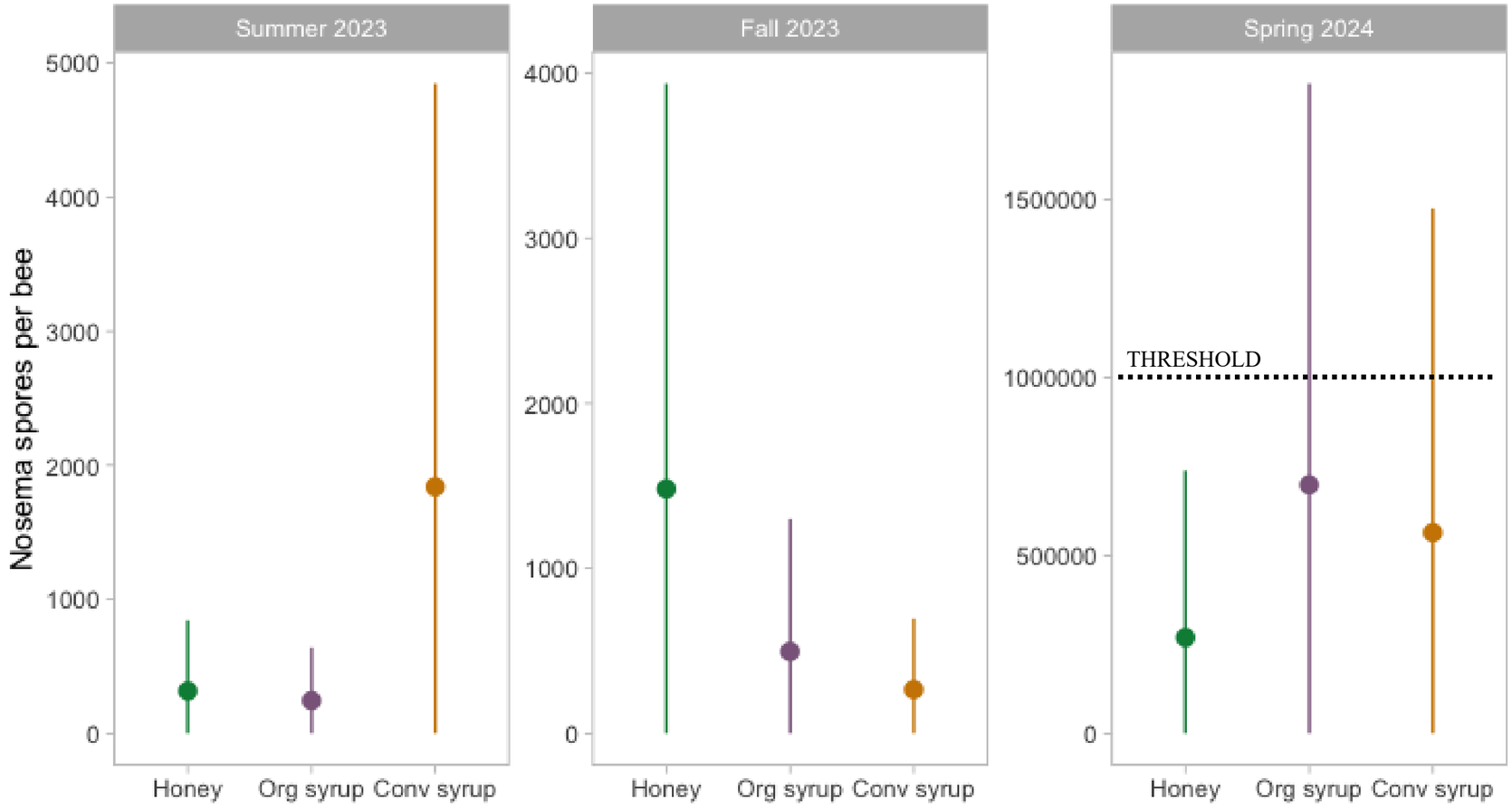


Figure 11. Number of *Nosema* spp. spores per bee in summer, fall and in spring, based on experimental groups (mean ± SE).

Bailey et Ball 1991

Conclusion

Possible to overwinter with organic sugar

- Study conducted with cane sugar containing <1% minerals

Possible to overwinter with honey

- Colony weight in fall
- Risk of mortality
- Honey variability
- Climate variability

No significant long-term effects on performance and pathogens

Between 62% and 104% of the average production per hive in Quebec between 2018 and 2022

Honey feeding is more complex and expensive

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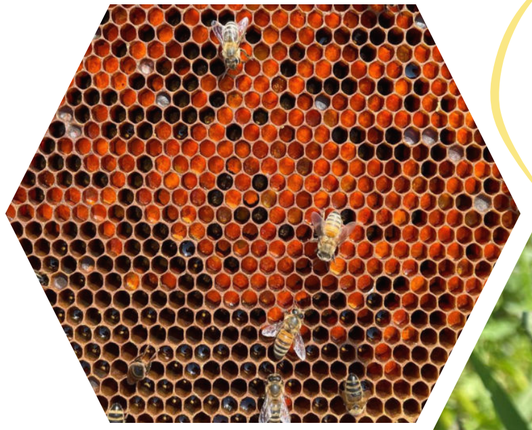

Thank you

CRSAD team, Laval University students,
Marilène Paillard and Marie-Lou Morin

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Centre de recherche en sciences animales de Deschambault

LES APICULTEURS ET APICULTRICES DU QUÉBEC

PROGRAMME INNOV' ACTION AGROALIMENTAIRE

Honey pollens analyses

Phase 1
summer honey

Phase 1
fall honey

Phase 2
summer honey
beekeeper 1

Phase 2
summer honey
beekeeper 2

Sugar profile analyses

No éch. / Description	Résultat	Unité	Spécifications	Analysé le
Nature: Aliment Prélevé le: 2024-08-01 Par: L. Plamondon Reçu le: 2024-09-17 Temp. réception: T.P.				
6639451 / 1. Miel Apiculteur 2				
Sucrose	<0.1	%		2024-09-26
Maltose	<0.1	%		2024-09-26
Lactose	<0.1	%		2024-09-26
Glucose	32.0	%		2024-09-26
Fructose	39.8	%		2024-09-26
6639454 / 2. Miel Apiculteur 1				
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Maltose	<0.1	%		2024-09-26
Lactose	<0.1	%		2024-09-26
Glucose	34.4	%		2024-09-26
Fructose	40.4	%		2024-09-26
6639458 / 3. Sirop conv Apiculteur 2				
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Maltose	<0.1	%		2024-09-26
Lactose	<0.1	%		2024-09-26
Glucose	<0.1	%		2024-09-26
Fructose	<0.1	%		2024-09-26
6639460 / 4. Sirop bio Apiculteur 2				
Sucrose	69.3	%		2024-09-26
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Lactose	<0.1	%		2024-09-26
Glucose	<0.1	%		2024-09-26
Fructose	<0.1	%		2024-09-26
6639461 / 5. Sirop conv. Apiculteur 1				
Sucrose	69.3	%		2024-09-26
Maltose	<0.1	%		2024-09-26
Lactose	<0.1	%		2024-09-26
Glucose	<0.1	%		2024-09-26
Fructose	<0.1	%		2024-09-26
6639462 / 6. Sirop bio Apiculteur 1				
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Maltose	<0.1	%		2024-09-26
Lactose	<0.1	%		2024-09-26
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