

# 22<sup>e</sup> édition des Journées Horticoles de Saint-Rémi

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*Compte rendu du 3<sup>e</sup> congrès international sur la fraise:*

## **Tendances, recherches, innovations, découvertes**

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Professeur

@prof\_yves

Institut de nutrition et des aliments fonctionnels



**3<sup>RD</sup> INTERNATIONAL  
STRAWBERRY CONGRESS**





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**Strawberries on demand**  
the consumer rules the future

**6-8 September 2017**  
Antwerp-Belgium

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STRAWBERRIES

# Strawberries on demand

*The strawberries world:  
a review of key data*

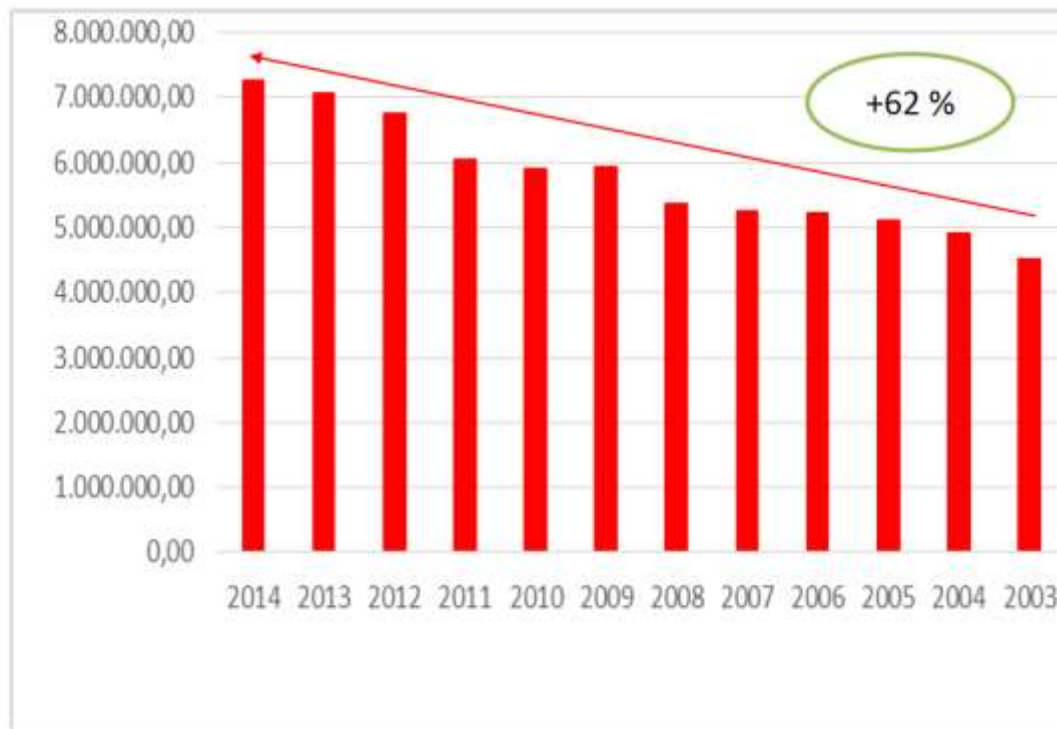
Philippe Binard  
Freshfel Europe



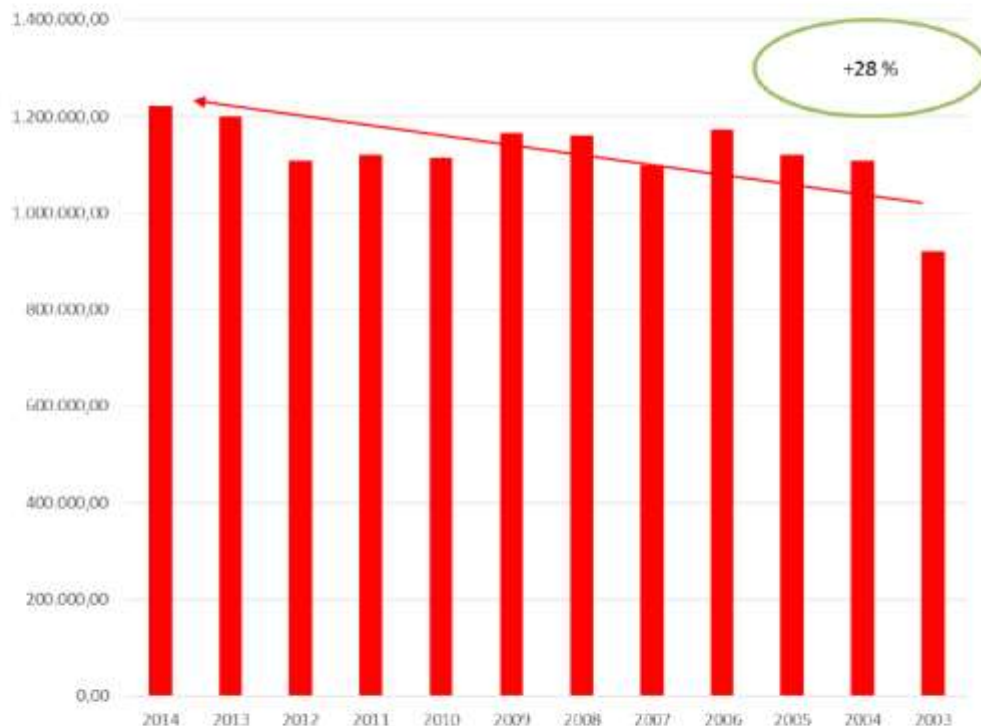
**3<sup>RD</sup> INTERNATIONAL  
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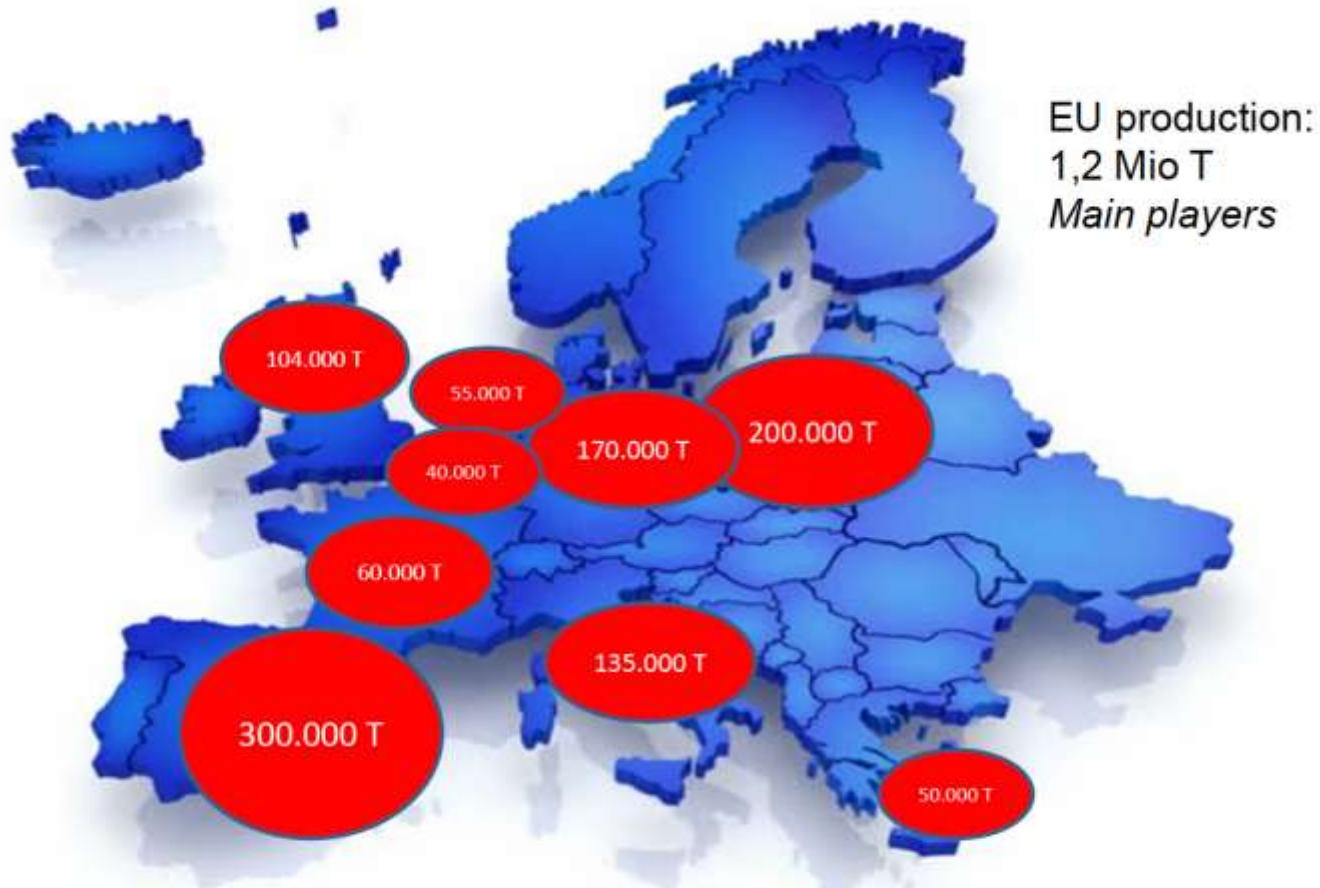
- Permanent steady growth
- Top 10 producers = 95% of production
- China = 39%
- EU and USA = 17% each
- Mexico 6%

| Production in T | 2014                |
|-----------------|---------------------|
| <b>Total</b>    | <b>7.278.553,80</b> |
| China           | 2.809.832,40        |
| United States   | 1.234.415,70        |
| EU              | 1.220.336,00        |
| Mexico          | 413.074,80          |
| Turkey          | 338.463,00          |
| Egypt           | 255.123,90          |
| South Korea     | 188.910,90          |
| Russia          | 170.100,00          |
| Japan           | 147.600,00          |
| Morocco         | 123.649,20          |



- ❖ Production 1,2 Mio T
- ❖ Slower pace growth than world =>28% since 2003
- ❖ Top 5 producers =  
75% of EU production
  - ❖ Spain = 24%
  - ❖ Poland= 17%
  - ❖ Germany = 14%
  - ❖ Italy = 11%
  - ❖ UK = 9%
- ❖ Growing segment inside dynamic berry category but within a relatively stagnating fruit production
- ❖ Primarily western EU





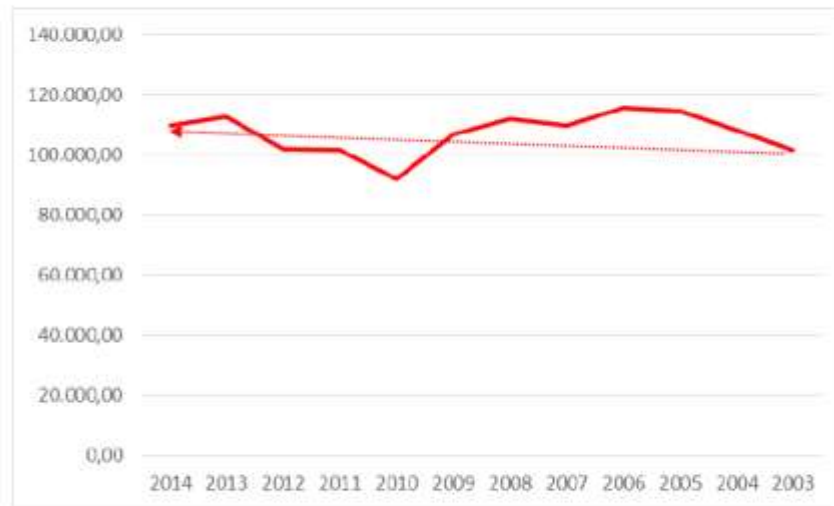
*ca 3,5% of EU fresh fruit production and 60% of berries production*

## European strawberries acreage = 110.000 HA

⇒ Poland = 47% of surface with 52.000 HA ( but 16% of EU production)

⇒ Stable acreage while overall production growth : increased productivity

| Acreage        | 2014              |
|----------------|-------------------|
| <b>Total</b>   | <b>109.584,00</b> |
| Poland         | 52.673,00         |
| Germany        | 15.352,00         |
| Spain          | 7.790,00          |
| Italy          | 5.685,00          |
| United Kingdom | 4.535,00          |
| Finland        | 3.300,00          |
| France         | 3.192,00          |
| Romania        | 2.422,00          |
| Sweden         | 1.940,00          |
| Netherlands    | 1.792,00          |
| Belgium        | 1.700,00          |



# Conclusions

| 2016                       |           |     |
|----------------------------|-----------|-----|
| Production (est.) ( in t)  | 1.200.000 |     |
| Processing ( in t)         | 288.000   |     |
| Production fresh ( in t)   | 912.000   |     |
| Import ( in t)             | 29.500    |     |
| Export ( in t)             | 55.000    |     |
| Balance ( in t)            | 886.500   |     |
| Intra trade ( in t)        | 450.000   | 56% |
| Local supply fresh ( in t) | 436.500   | 44% |
| Consumption (kg/capita)    | 1,64      |     |

- Production : ca 1,2 Mio T
  - primary consumed or processed locally: ca 436,500 T for fresh + ca 288,000 T for processing)
  - primarily for fresh market => ca 76% fresh ( 912,000 T) and 24% for processing ( 288,000 T)
- Business value close/> 2 billion €
  - Local sales: > 800/850 Mio €(?)
  - Intra trade: 1 billion €
  - Export: 130 Mio €
  - Import : 90 Mio €
- Consumption : Gross 2,1 kg/cap , net fresh 1,6 kg/cap with discrepancies among MS & tendency to growth further among the dynamic high value berry category





# Strawberry Market Overview – North America

International Strawberry Symposium  
August 2017

# Strawberries In North America



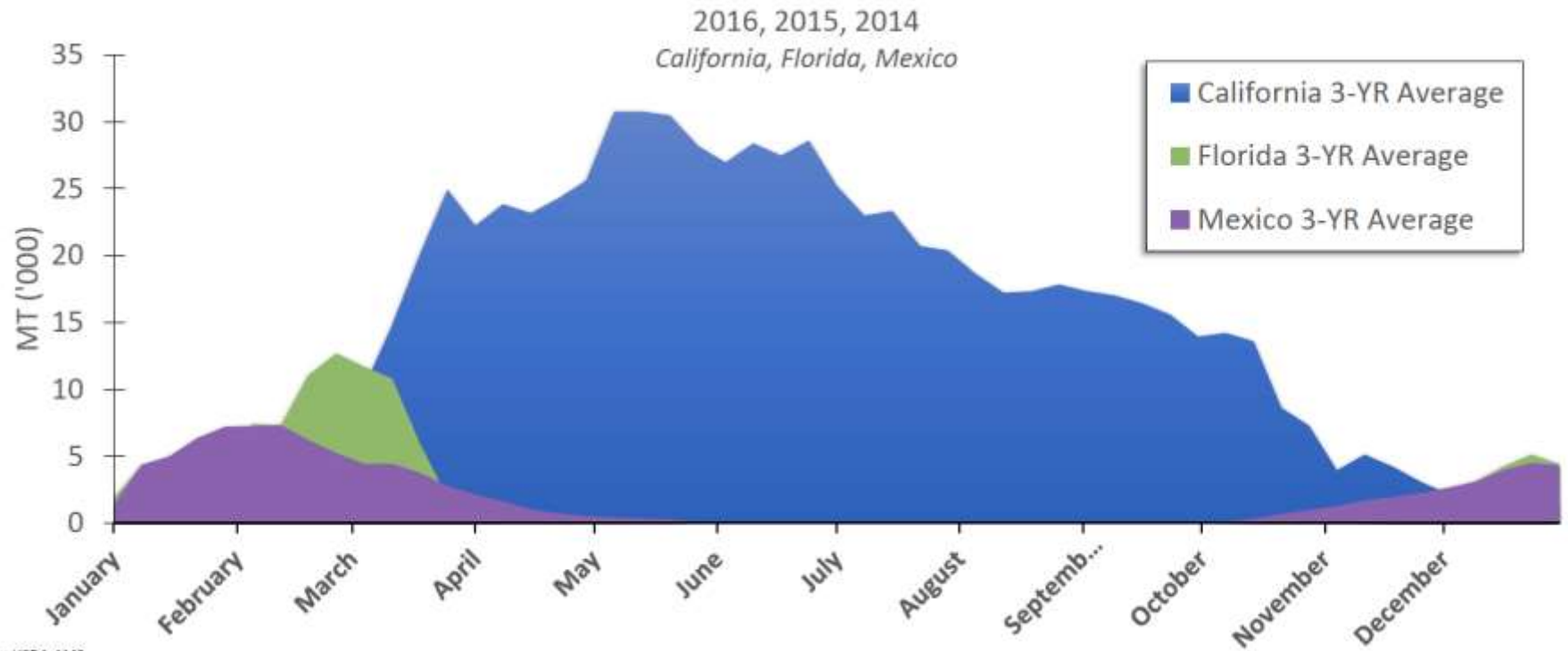
| CANADA (tonnes '000)                            | 2015       |
|---|------------|
| Local Production                                | 23         |
| Imports   | 101        |
| Exports   | 0.7        |
| Total Consumption                               | 123        |
| Kg consumption per Capita<br>(change from 2010) | 3.4 (-11%) |
| Net Export                                      | (101)      |

| USA (tonnes '000)                               | 2015      |
|---|-----------|
| Local Production                                | 1,166     |
| Imports   | 194       |
| Exports   | 145       |
| Total Consumption                               | 1,215     |
| Kg consumption per Capita<br>(change from 2010) | 4.4 (+6%) |
| Net Export                                      | (50)      |

| MEXICO (tonnes '000)                            | 2015       |
|---|------------|
| Local Production                                | 393        |
| Imports   | 15         |
| Exports   | 92         |
| Total Consumption                               | 322        |
| Kg consumption per Capita<br>(change from 2010) | 2.5 (+74%) |
| Net Export                                      | 77         |

# Strawberry Production in North America

## Fresh Strawberry Production 3-YR Average Comparison



Source: USDA-AMS

# U.S. Strawberry Market



|   |           |
|---|-----------|
| USA (tonnes '000)                               | 2015      |
| Local Production                                | 1,166     |
| Imports   | 194       |
| Exports   | 145       |
| Total Consumption                               | 1,215     |
| Kg consumption per Capita<br>(change from 2010) | 4.4 (+6%) |
| Net Export                                      | (50)      |

# California Strawberry Production (2016)

**Fresh:** 804 MT('000)

**Frozen:** 216 MT('000)

**Crop Value:** \$2.0 Billion

**85%** U.S. Strawberry Production

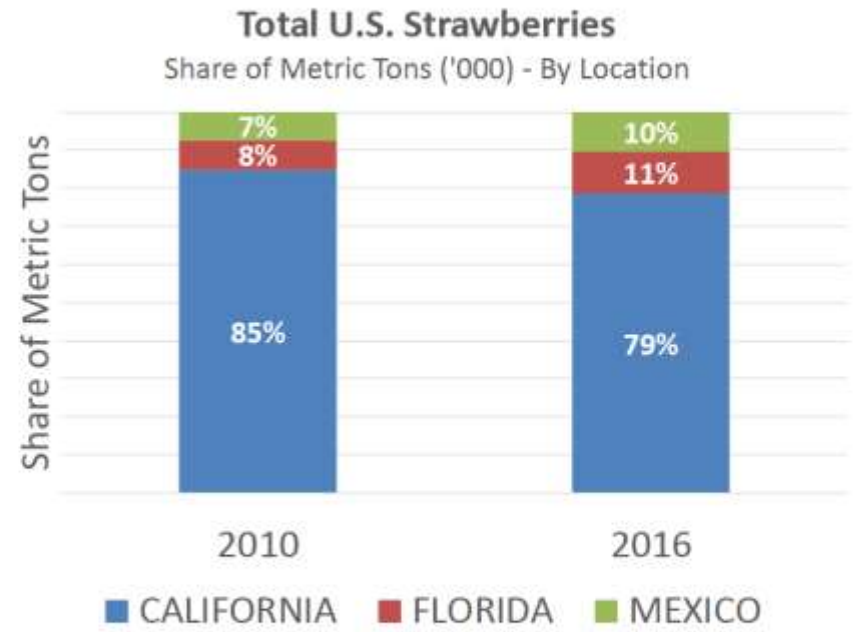
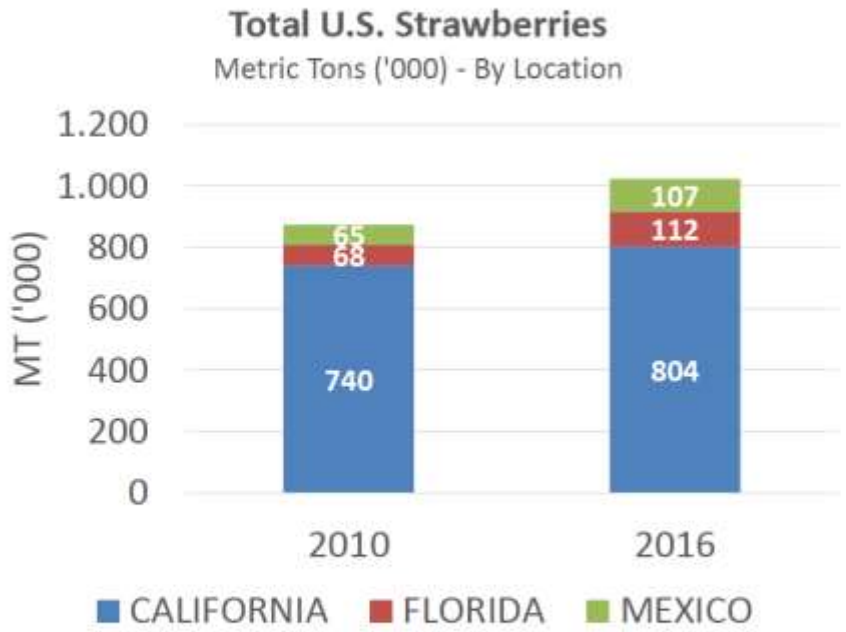
**Area** 14,600 hectares

**Fresh Yield** 55,094 Kg/ha (average)

**Varieties** University 57%  
Proprietary 43%



# Market Share Trends – U.S. Fresh

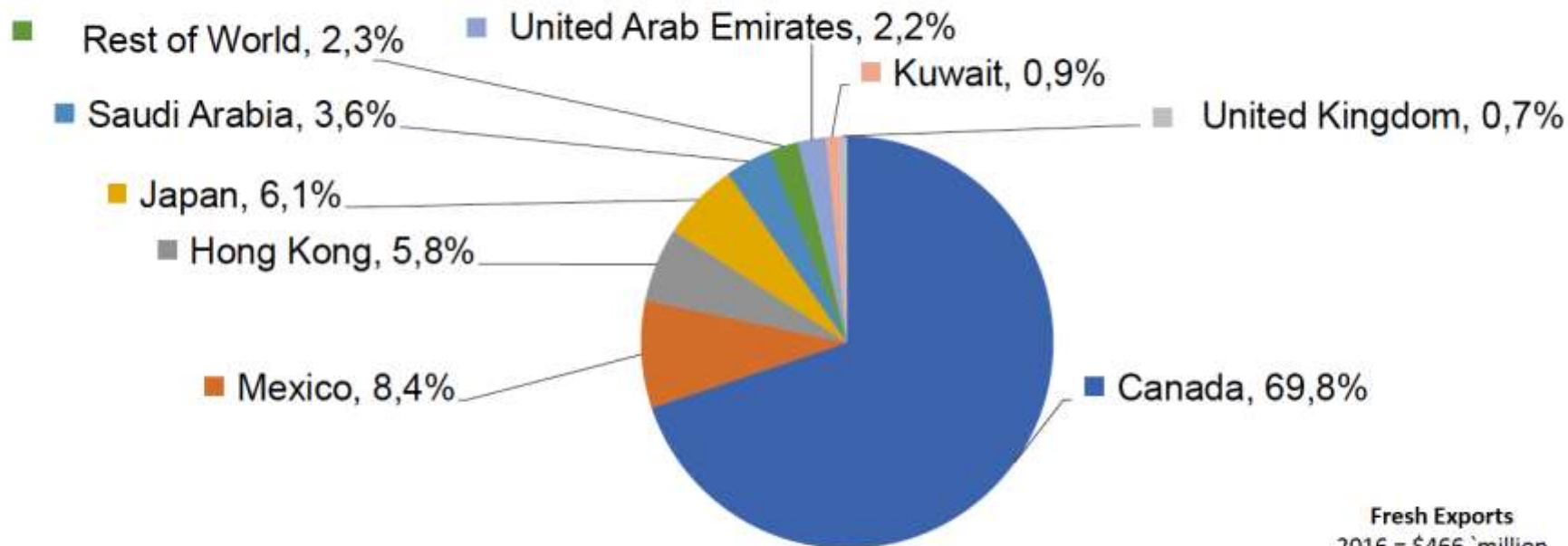


- In 2016, California produced 804,000 metric tons of strawberries, accounting for 79% of North American production.
- Florida and Mexico account for the remaining 21% (Florida 11%, Mexico 10%).

Source: USDA-AMS

# U.S. Fresh Export Markets

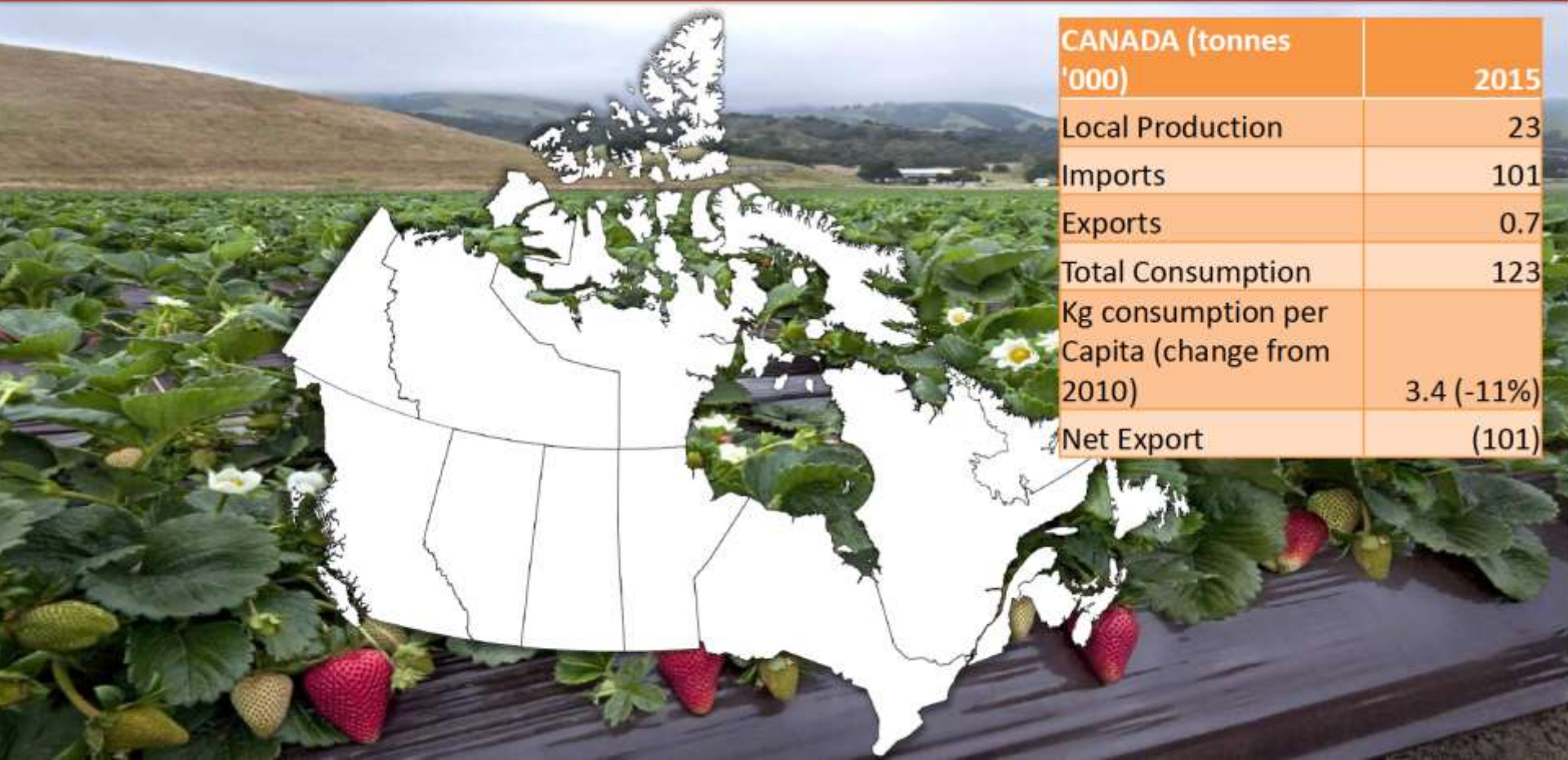
## 2016 U.S. Fresh Exports



- **Canada, Japan, Hong Kong and Mexico are the top U.S export markets**

**Fresh Exports**  
2016 = \$466 million  
2015 = \$460 million  
2014 = \$482 million

# Canada Strawberry Market



| CANADA (tonnes '000)                         | 2015       |
|--|------------|
| Local Production                             | 23         |
| Imports                                      | 101        |
| Exports                                      | 0.7        |
| Total Consumption                            | 123        |
| Kg consumption per Capita (change from 2010) | 3.4 (-11%) |
| Net Export                                   | (101)      |

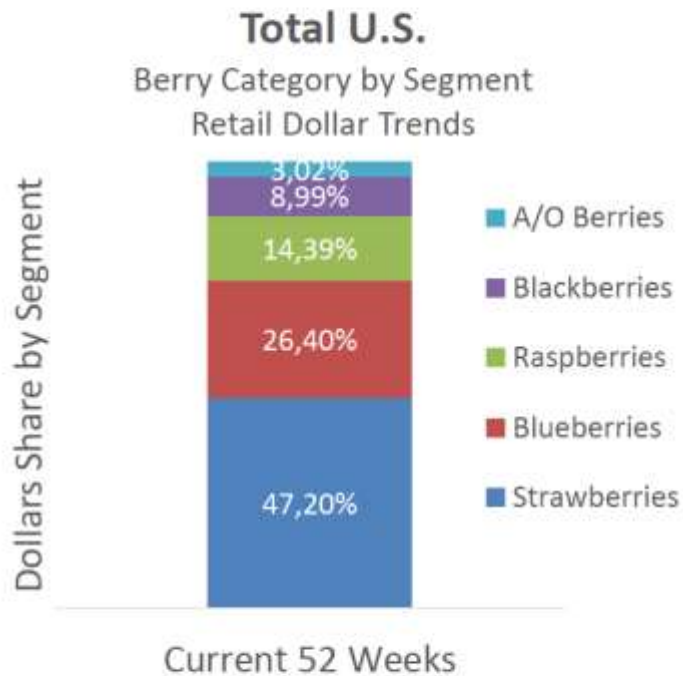


# Mexico Strawberry Market



| MEXICO (tonnes '000)                            | 2015       |
|---|------------|
| Local Production                                | 393        |
| Imports   | 15         |
| Exports   | 92         |
| Total Consumption                               | 322        |
| Kg consumption per Capita<br>(change from 2010) | 2.5 (+74%) |
| Net Export                                      | 77         |

# Berry Dollar Sales – U.S.

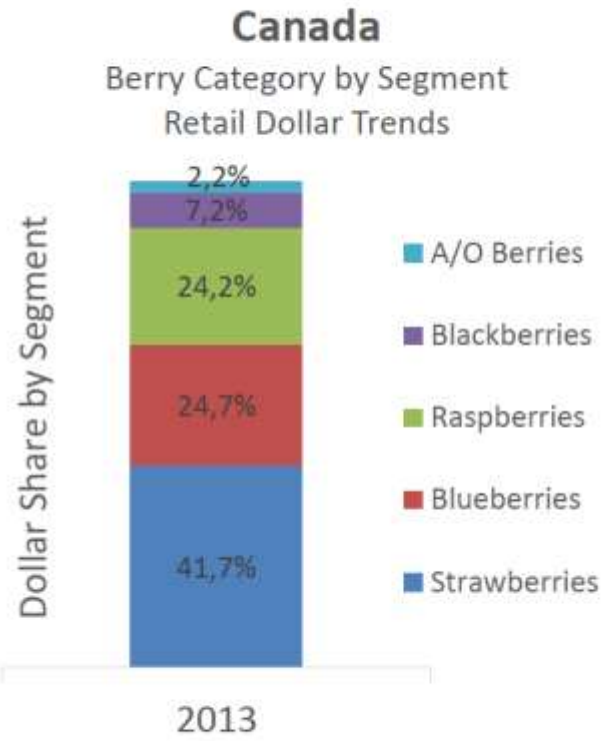


- **Strawberries are the largest segment, accounting for 47.2% of berry dollar sales.**

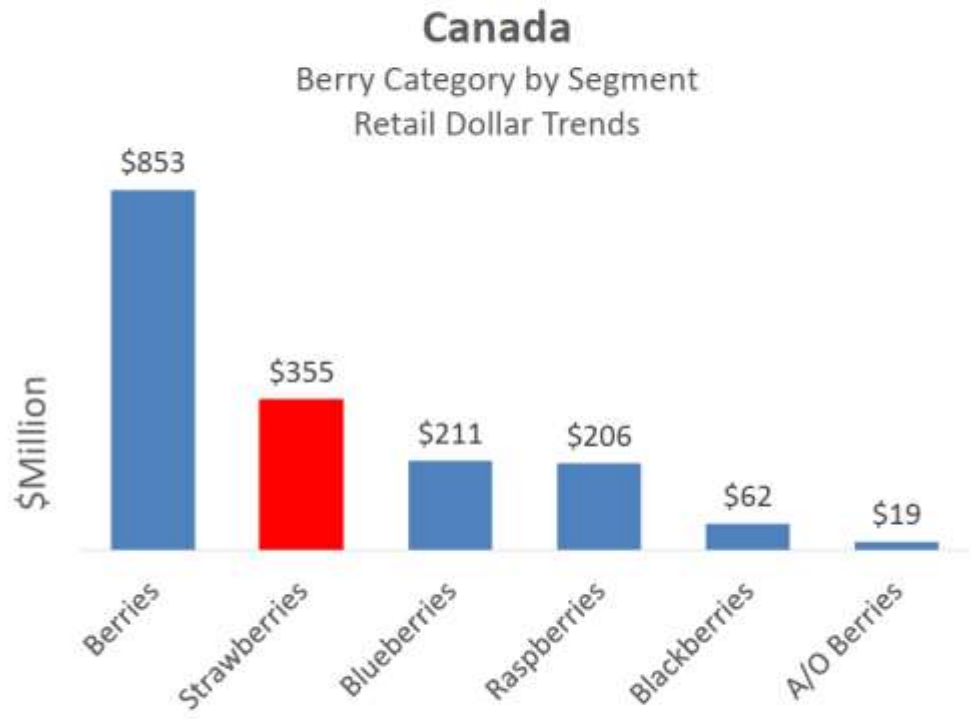


- **Berry dollars are up 8.3% versus year ago; strawberry dollars are up 8.1%**

# Berry Category Sales – Canada



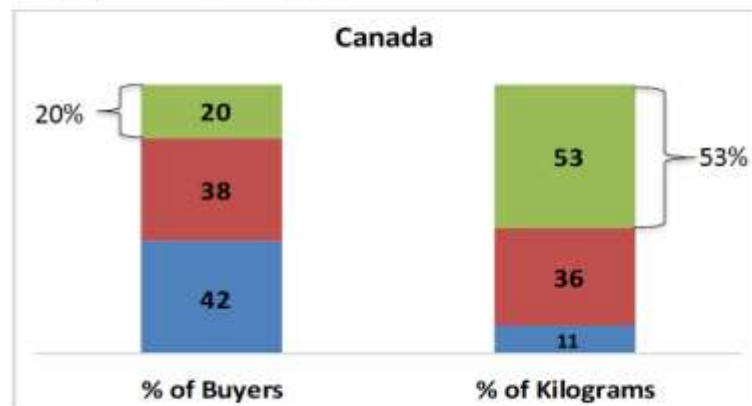
- **Strawberries are the largest segment, accounting for 41.7% of berry dollar sales.**



- **Berries are an \$853 million category in Canada; strawberries account for \$355 million.**

# Strawberry Buying Groups – U. S. & Canada

■ Light Buyers ■ Medium Buyers ■ Heavy Buyers ■ Super Heavy Buyers



| Total U.S.  | Buying Rate (kg) | Purchase Frequency |
|-------------|------------------|--------------------|
| Super Heavy | 23               | 27                 |
| Heavy       | 7                | 10                 |
| Medium      | 3                | 4                  |
| Light       | 1                | 2                  |
| Total       | 6                | 8                  |

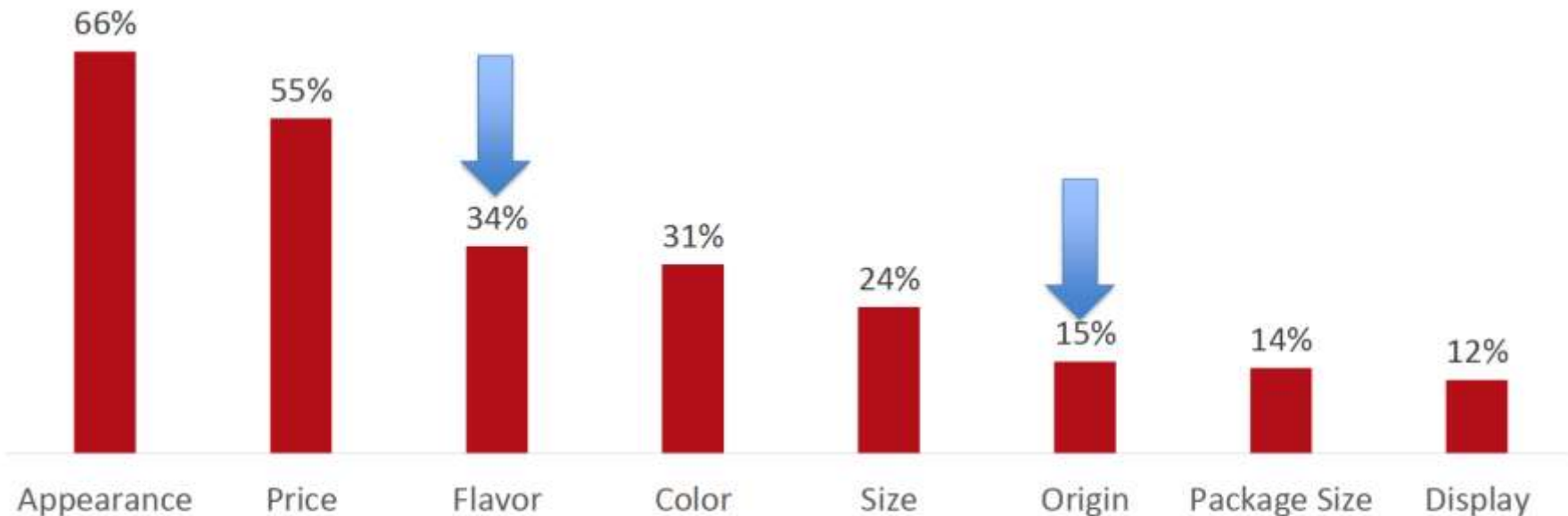
- ◆ Super heavy and heavy buyers account for 38% of buyers, yet 81% of volume.
- ◆ Super heavy buyers purchase 23 kilograms of strawberries annually on 27 shopping occasions.

| Canada | Buying Rate (kg) | Purchase Frequency |
|--------|------------------|--------------------|
| Heavy  | 13               | 19                 |
| Medium | 5                | 8                  |
| Light  | 1                | 2                  |
| Total  | 5                | 8                  |

- ◆ Heavy buyers account for 20% of buyers, yet 53% of volume
- ◆ Heavy buyers purchase 13 kilograms of strawberries annually on 19 shopping occasions

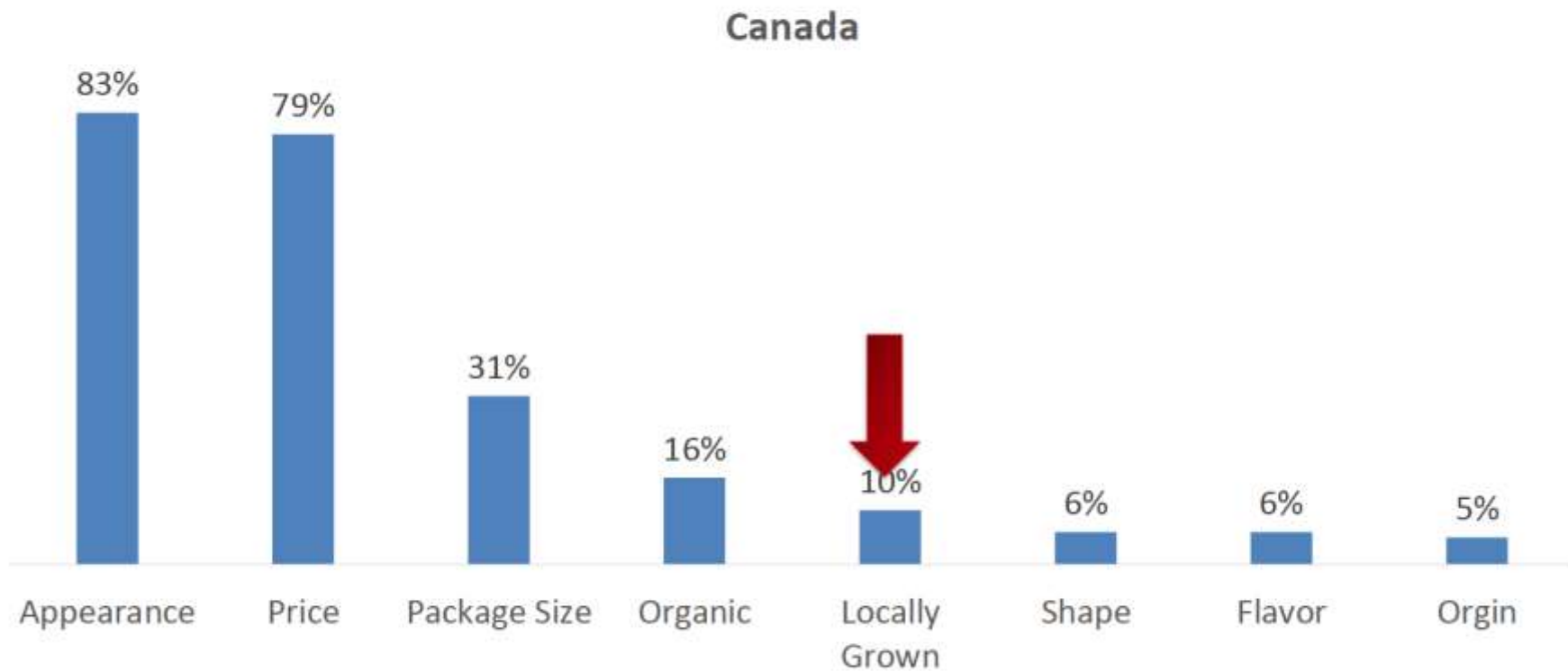
# Fresh Strawberry Purchase Factors – U.S.

## Total U.S.



- Appearance and price are the top two considerations when purchasing fresh strawberries, in both the U.S. and Canada.

# Fresh Strawberry Purchase Factors – Canada



# Summary

- Strawberry production and consumption are on the rise in North America.
- Mexico is experiencing strongest growth as many U.S. operations expand year-round supply capability.
- Consumer interest in fruits with unique health benefits to aging populations is expected to continue to drive demand.
- Most strawberry purchases are still made by a small percentage of buyers, providing opportunities for marketers to transform medium buyers into heavy buyers.



CALIFORNIA  
STRAWBERRY  
COMMISSION



A glimpse into the future: looking for synergies between science and marketing

# Cross-Kingdom Interactions of Two Complicated Organisms

Kevin M. Folta  
Professor and Chair  
Horticultural Sciences Department  
University of Florida

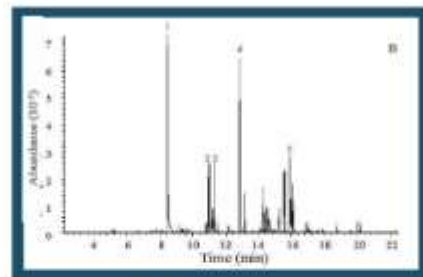




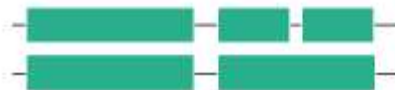
# “Consumer-Assisted Selection”



Consumer sensory panels and psychophysics evaluation

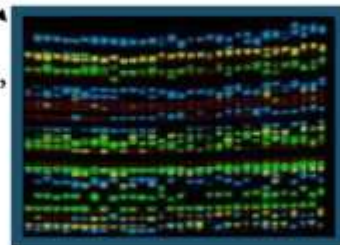


Analytical chemistry



Resequencing and allele discovery

Marker development, selection and validation



# CONSUMER-ASSISTED SELECTION

- **Psychophysics** – QUANTIFIES THE RELATIONSHIP between physical stimuli and the sensations and perceptions they effect (**behavior & emotions**)

*Like*



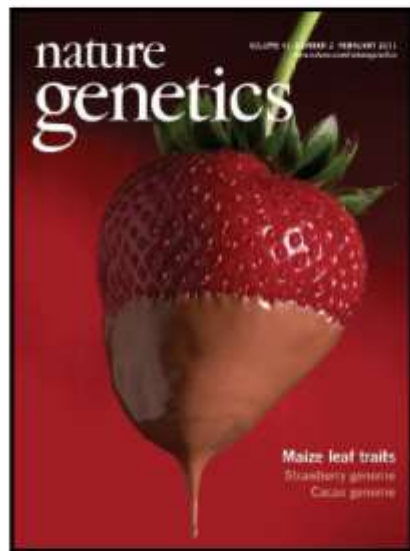
*Buy*



## **Application to Strawberry**

- **Identify targets – what volatiles influence liking?**
- **Identify genes that control volatile production/stability.**
- **Develop molecular markers to hasten breeding efforts.**
- **Use marker-assisted breeding to speed variety development**

## Consumers agree... We can do better

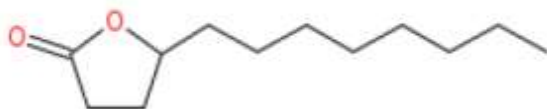


- California strawberry commission notes that the average household buys 1-2 0.5 kg clamshells per year (2009).
- We need to eat more fruits and vegetables.
- Flavor vs. nutrition

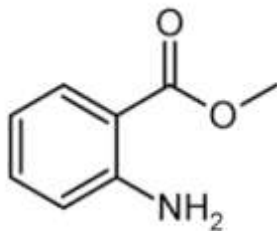
**Problem: Flavor and aroma are complex**

**Human sensors vary**

## Gamma Decalactone – imparts peachy flavors



## Methyl Anthranilate – “sticky sweet” grape

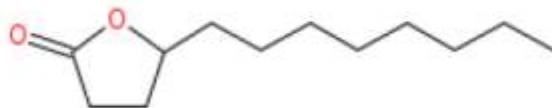


## The Strawberry Volatile-ome

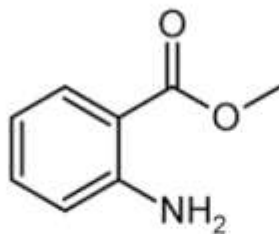


Chris Barbey

## Gamma Decalactone – imparts peachy flavors



## Methyl Anthranilate – “sticky sweet” grape





**taskFORCE**  
*Drosophila suzukii*



## **Currant IPM strategies against SWD In Swiss Berries**

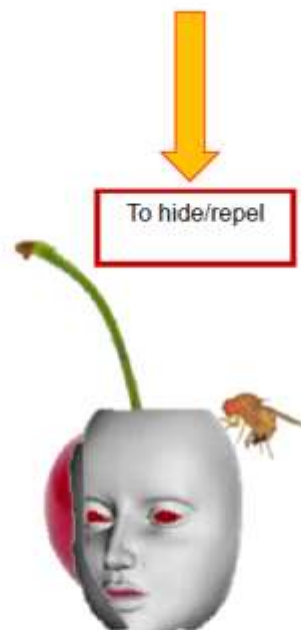
**M. Dorsaz, F. Kuonen, C. A. Baroffio**

07.09.2017





# Alternatives to insecticides





## Alternative measures: lime

To hide / repel



- Used to increase soil pH and for its disinfecting properties
- Hypothesis: Direct application on fruits as a solution would contribute to fight against *D. suzukii*
  - Repellent effect
    - Temporary pH change on the surface of fruit
    - Rapid lime neutralisation by CO<sub>2</sub> in the air



# A1: Lime treatment in semi-field on blueberries



- Trial duration: 4 weeks
  - 14 blueberry bushes individually placed in insect-proof cages
  - 2 modalities: treated (7 bushes) and non-treated (7bushes)
  - Treatment: 1.8 kg/ha  $\text{Ca}(\text{OH})_2$  in 1000 l of water weekly apply
  - 10 *D. suzukii* (5 males, 5 females) weekly added in each cage
  
- Result assessment:
  - 10 fruits / plant with binocular magnifier
  - Larvae and eggs number / fruit / modality / week

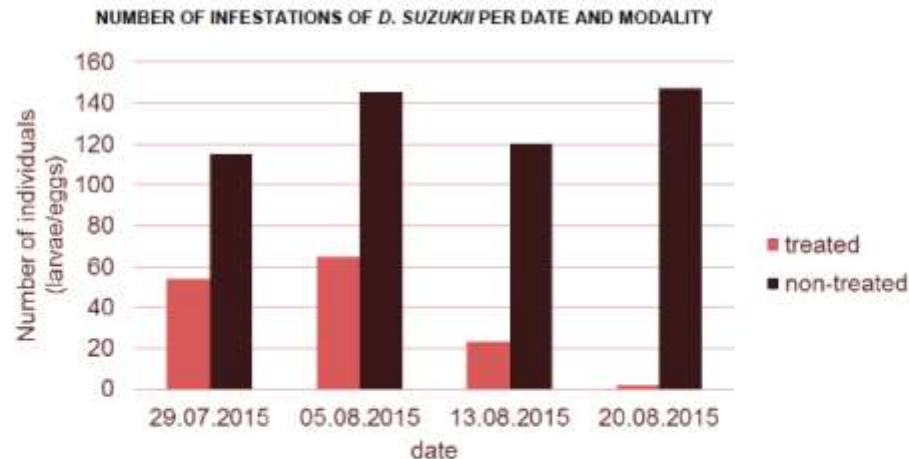




# A1: Lime treatment in semi-field on blueberries



- Positive effect of lime treatment observed on semi-field
- Significant reduction of SWD infestation after several applications





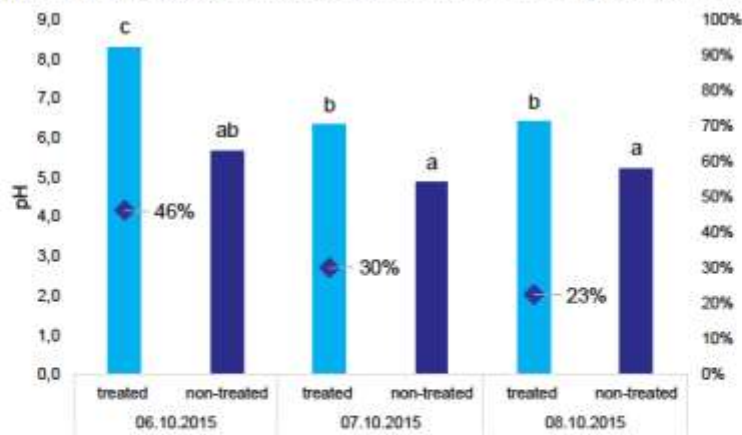
# B: pH evolution of strawberries epidermis

To hide / repel



- Treatment effect: pH significantly higher for the treated strawberries
  - Possible explanation of repulsive effect of lime against *D. suzukii*
- Time effect: rapid pH decline
  - Lime reduction by the CO<sub>2</sub> level in the air

pH EVOLUTION OF STRAWBERRIES TREATED AND UNTREATED WITH LIME AND % OF DIFFERENCE





## IPM vs chemical pest control

Comparing an integrated pest management with a chemical control strategy in multiple strawberry cultivations

Marieke Vervoort – Research Centre Hoogstraten



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# Strawberry residue

## 1. Botrytis

Throughout cultivation  
Flower → Fruit

## 2. Powdery Mildew

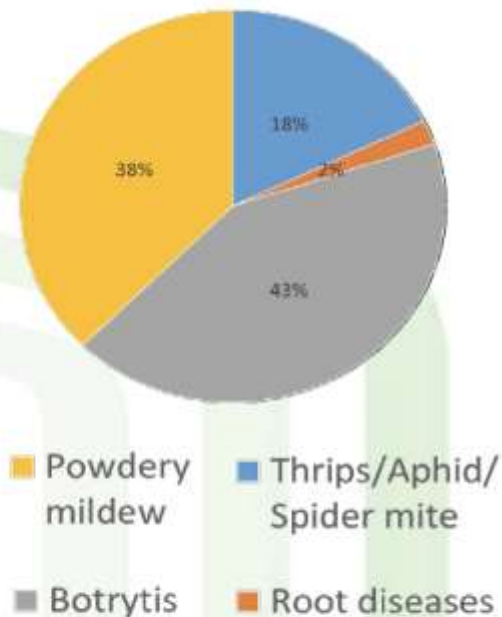
Throughout cultivation  
Weekly alternation of chemical treatments

## 3. Pests

Preventive and curative treatments

## 4. Root diseases

Only start cultivation



# Residue in cultivation

| CULTIVATION    |   | # RESIDUE   |             |
|----------------|---|-------------|-------------|
|                |   | Chemical    | IPM         |
| 2016           | Early cultivation Clery – glasshouse    | 5           | 1           |
|                | Double cropping – glasshouse            | 9           | 3           |
|                | Spring cultivation – plastic greenhouse | 5           | 3           |
|                | Summer cultivation – glasshouse         | 3           | 0           |
|                | Autumn cultivation – plastic greenhouse | 5           | 1           |
|                | Autumn cultivation – glasshouse         | 10          | 3           |
| 2017           | Early cultivation Clery – glasshouse    | 6           | 2           |
|                | Double cropping – glasshouse            | 7           | 1           |
|                | Spring cultivation – plastic greenhouse | 7           | 2           |
| <b>AVERAGE</b> |   | <b>6.33</b> | <b>1.78</b> |


  
 – 72%

**Reduction in residue without quality loss**







Thank you for your attention!

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[www.proefcentrum.be](http://www.proefcentrum.be)

Ctifl



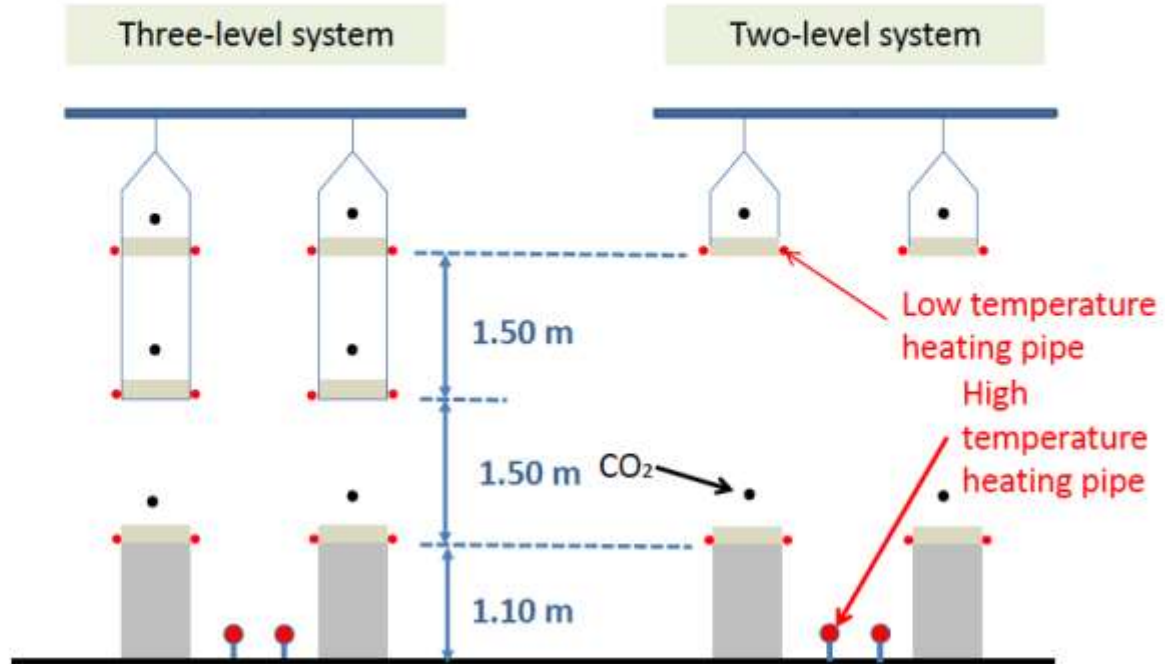
# Growing strawberries with superimposed levels of cropgutters Effect on yield and quality

Jean-Philippe BOSC  
Ctifl

Ctifi



- Three-dimensional use of the greenhouse
  - Superimposition of fixed gutters
- “Move the people, not the crop”



Ctifl



## Work on upper levels: mobile platforms



Three-level system



Two-level system





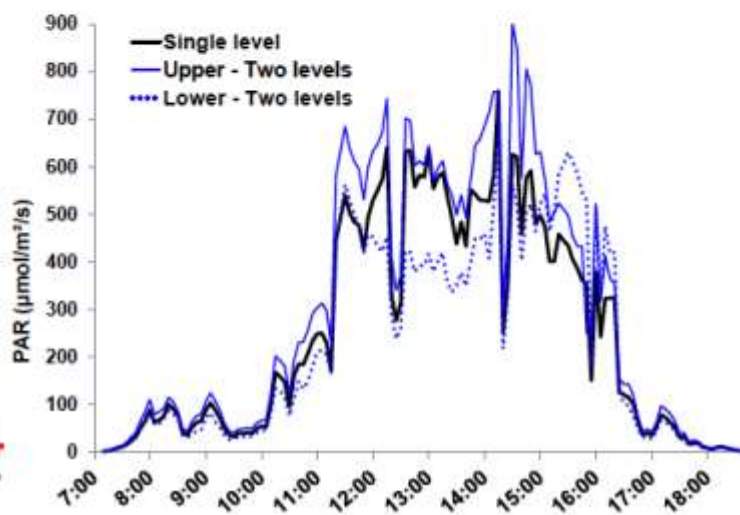
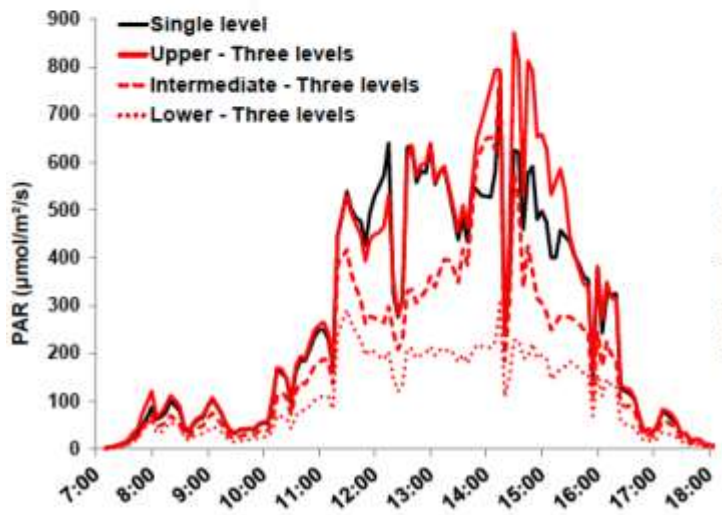
## Sunny day – March 2<sup>nd</sup>

### PAR light measurement – top of canopy

Three levels: high shading effect



Two levels: less shading effect





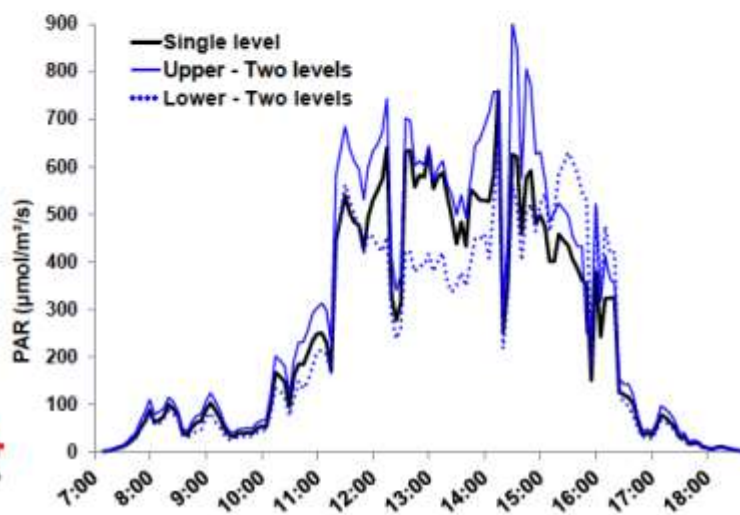
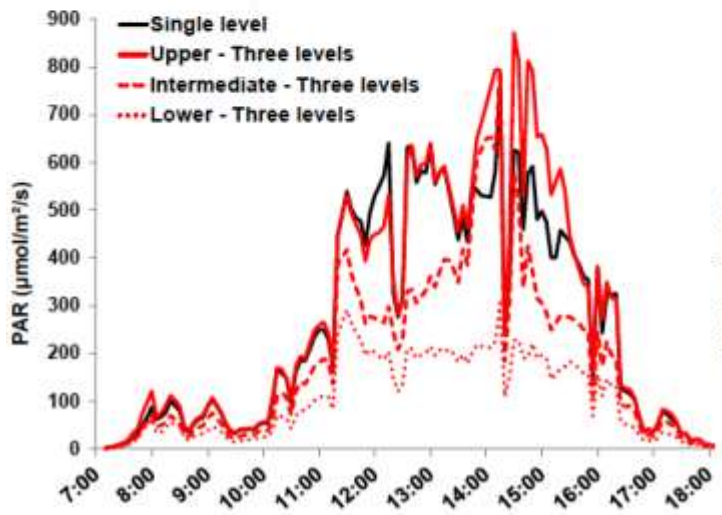
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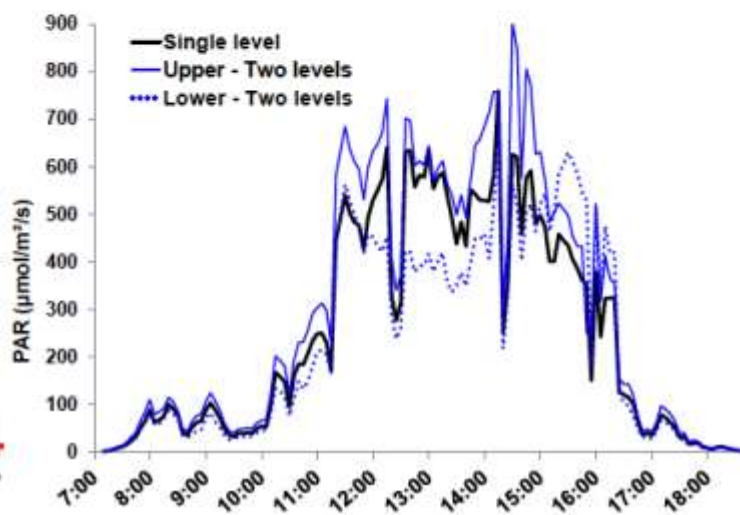
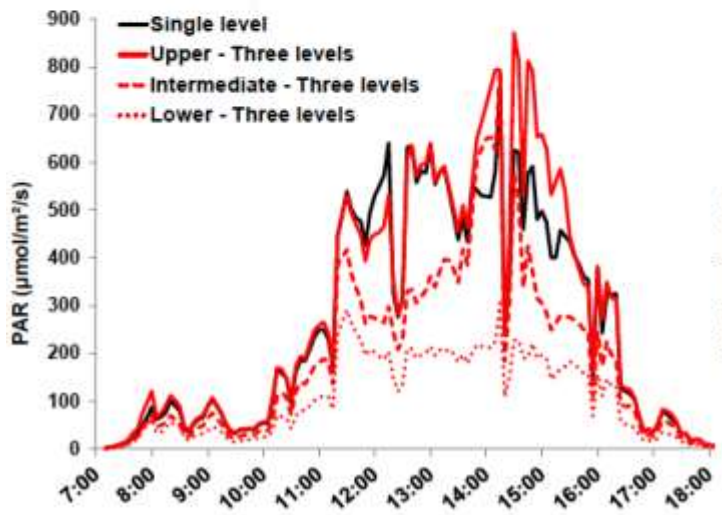


## Sunny day – March 2<sup>nd</sup> PAR light measurement – top of canopy

### Three levels: high shading effect



### Two levels: less shading effect





# *Human Health Effects of Strawberry:* **Strawberry Polyphenols bioavailability and modulation of the gut microbiota**

Yves Desjardins, Ph.D., Agr.

Professor  
Institute of Nutrition and Functional Foods





## A strawberry a day keeps the oxidative stress away?



By Arina-Rose Harrison-Dunne BSc  
17-Mar-2014  
Last updated on 17-Mar-2014 at 14:28 GMT



Researchers investigate antioxidant potential of daily...

## Strawberry extracts may prevent inflammation: Study

By Stephen Daniells BSc, 25-May-2011  
Last updated on 25-May-2011 at 16:51 GMT



...berry, a nutraceutical fruit to discover!»



## Strawberries show significant heart health benefits: Human data

By Stephen DANIELLS BSc, 27-Feb-2014  
Last updated on 27-Feb-2014 at 18:23 GMT

## Strawberries show significant heart health benefits: Human data

By Stephen DANIELLS BSc, 27-Feb-2014  
Last updated on 27-Feb-2014 at 18:23 GMT

## Strawberry extracts show heart benefits in obese people

By Stephen Daniells BSc, 08-Dec-2011  
Last updated on 08-Dec-2011 at 17:57 GMT



Related tags: Strawberry, Oxidant, Inflammation





## Strawberry and cranberry polyphenols improve insulin sensitivity in insulin-resistant, non-diabetic adults: a parallel, double-blind, controlled and randomised clinical trial

Martine Paquette<sup>1,2</sup>, Ana S. Medina Larqué<sup>1,2</sup>, S. J. Weisnagel<sup>2,3</sup>, Yves Desjardins<sup>1</sup>, Julie Marois<sup>1,2</sup>, Geneviève Pilon<sup>1,4</sup>, Stéphanie Dudonné<sup>1</sup>, André Marette<sup>1,4</sup> and Hélène Jacques<sup>1,2\*</sup>

<sup>1</sup>*Institute of Nutrition and Functional Foods, Laval University, Quebec, Canada, G1V 0A6*

<sup>2</sup>*School of Nutrition, Laval University, Quebec, Canada, G1V 0A6*

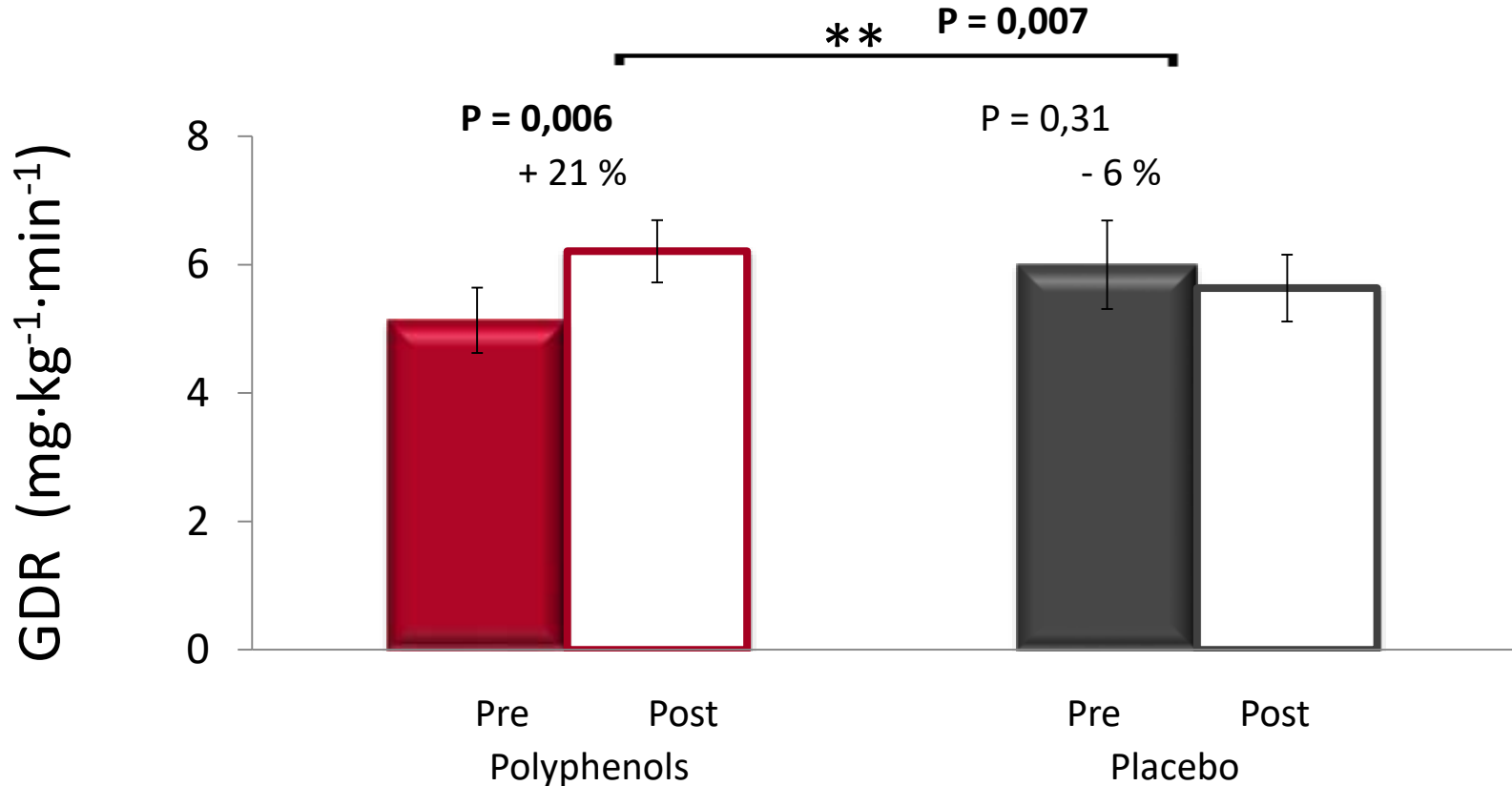
<sup>3</sup>*Diabetes Research Unit, Endocrinology and Nephrology Axis, Research Centre, Laval University Health Center of Quebec, Quebec, Canada, G1V 4G2*

<sup>4</sup>*Quebec Heart and Lung Institute, Quebec, Canada, G1V 4G5*

*(Submitted 3 June 2016 – Final revision received 13 January 2017 – Accepted 28 January 2017)*



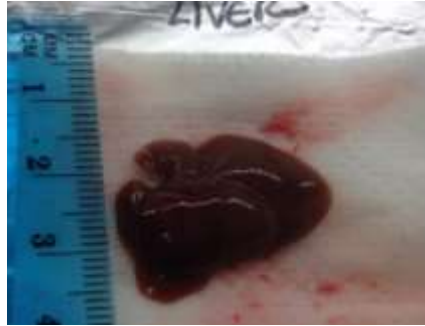
# Glucose disposal rate (GDR)



n = 39

# Effect of a cranberry extract on hepatic steatosis

**Chow**



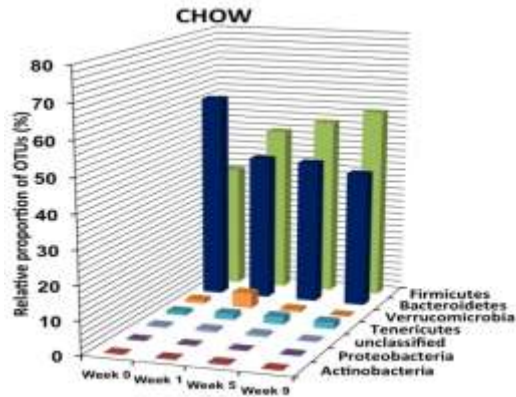
**HFHS**

**HFHS  
+  
Cranberry**

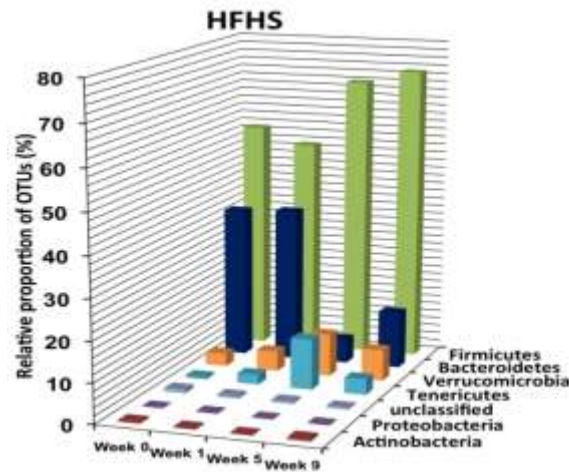


# Evolution of the gut microbiota under a HFHS diet or a diet supplemented with cranberry extract.

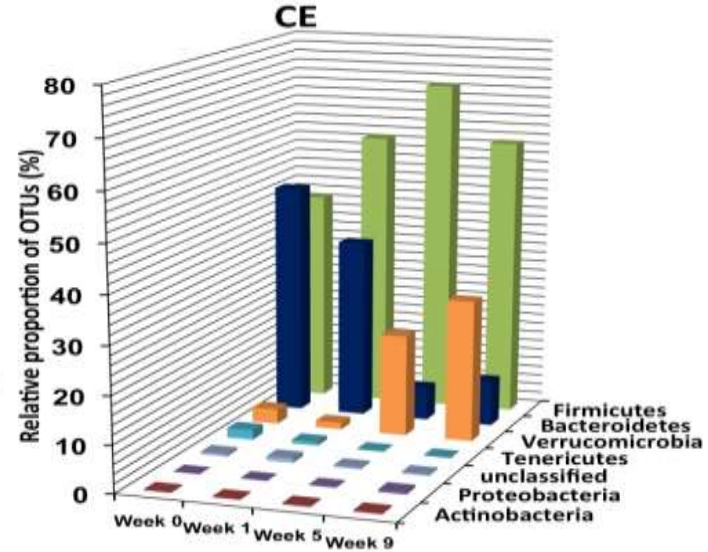
**CHOW**



**HFHS**



**HFHS + cranberry**



# Cross-talk between *Akkermansia muciniphila* and intestinal epithelium controls diet-induced obesity

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Edited\* by Todd R. Klaenhammer, North Carolina State University, Raleigh, NC, and approved March 28, 2013 (received for review November 8, 2012)

NATURE | NEWS

## Gut microbe may fight obesity and diabetes

Bacterium helps to regulate metabolism in mice.

Brian Owens

13 May 2013

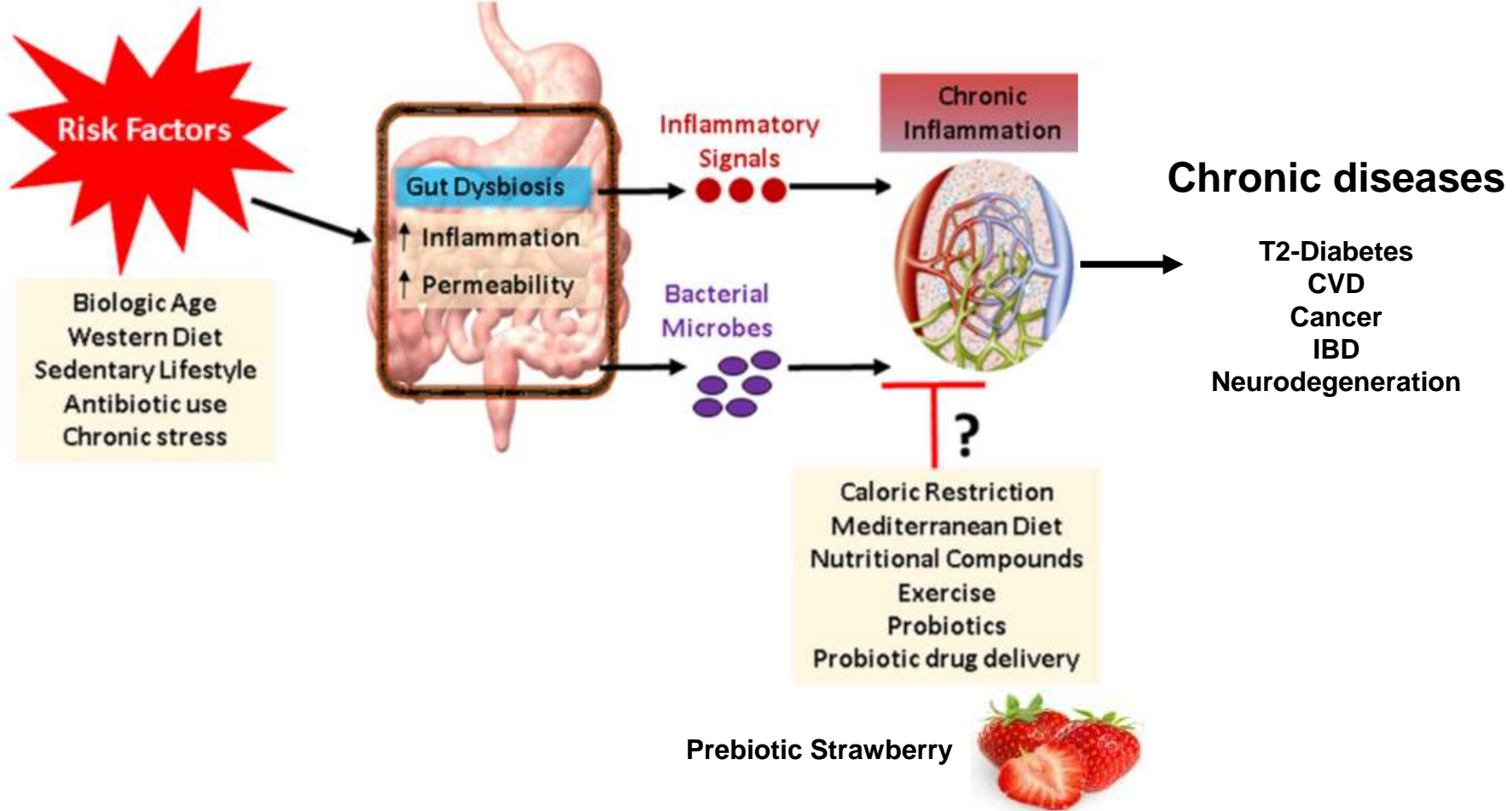
### The Buzz About *Akkermansia muciniphila*: It's More Than Just Weight Loss

May 17, 2013 by Terri Sundquist

★★★★☆ 3 Votes



The bacterium *Akkermansia muciniphila* is creating quite a stir in science news, with people calling it the “weight loss bacterium”. While it’s exciting to think about a bacterium that has the ability to reduce body weight with no change in food intake, there’s another reason to get excited: The potential to treat obesity-related metabolic disorders such as [type-2](#)







# Remerciements

## Y. Desjardins

Stéphanie Dudonné  
Pascale Dubé  
Véronique Richard

## A. Marette

Geneviève Pilon  
Philippe St-Pierre  
Fernando Arhe  
Bruno Marcotte

## D. Roy

Sébastien Matamoros  
Thibault Varin

## E. Levy

M.-C. Denis  
Carole Garofalo  
Quentin Lemoyne

## H. Jacques

J. Marois  
M. Paquette

## J. Weisnagel