



What research tells us about forage mixtures for pasture?  
Part 1

Carole Lafrenière, Ph.D.

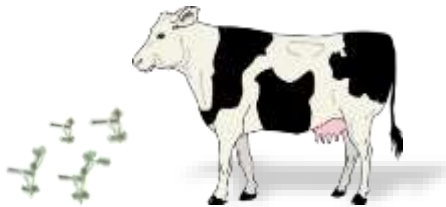


# Presentation Plan

- Introduction
  - ▣ Why using mixtures for grazing?
  - ▣ Why complex mixtures?
- Mixtures
  - ▣ Methodology approach
  - ▣ Binary mixtures
    - Species, dry matter yield, and nutritive value
  - ▣ Complex mixtures
    - Species, dry matter yield, and nutritive value,
    - Grazing results (Nappan site)
    - Production system to extend grazing to early fall
    - Carbon sequestration

# Forage Mixtures for Grazing

One specie



Easier to manage

Mixtures



↑ **Dry matter yield**  
(Papadopoulos and al., 2012)

↑ **Yield stability**  
(Deak and al., 2009)

↓ **Weeds**  
(Finn and al., 2013)

↑ **Nutritive value**  
(Peyraud and al., 2009)

↓ **N fertilizer**  
(Nyfeler and al., 2011)

More difficult to manage

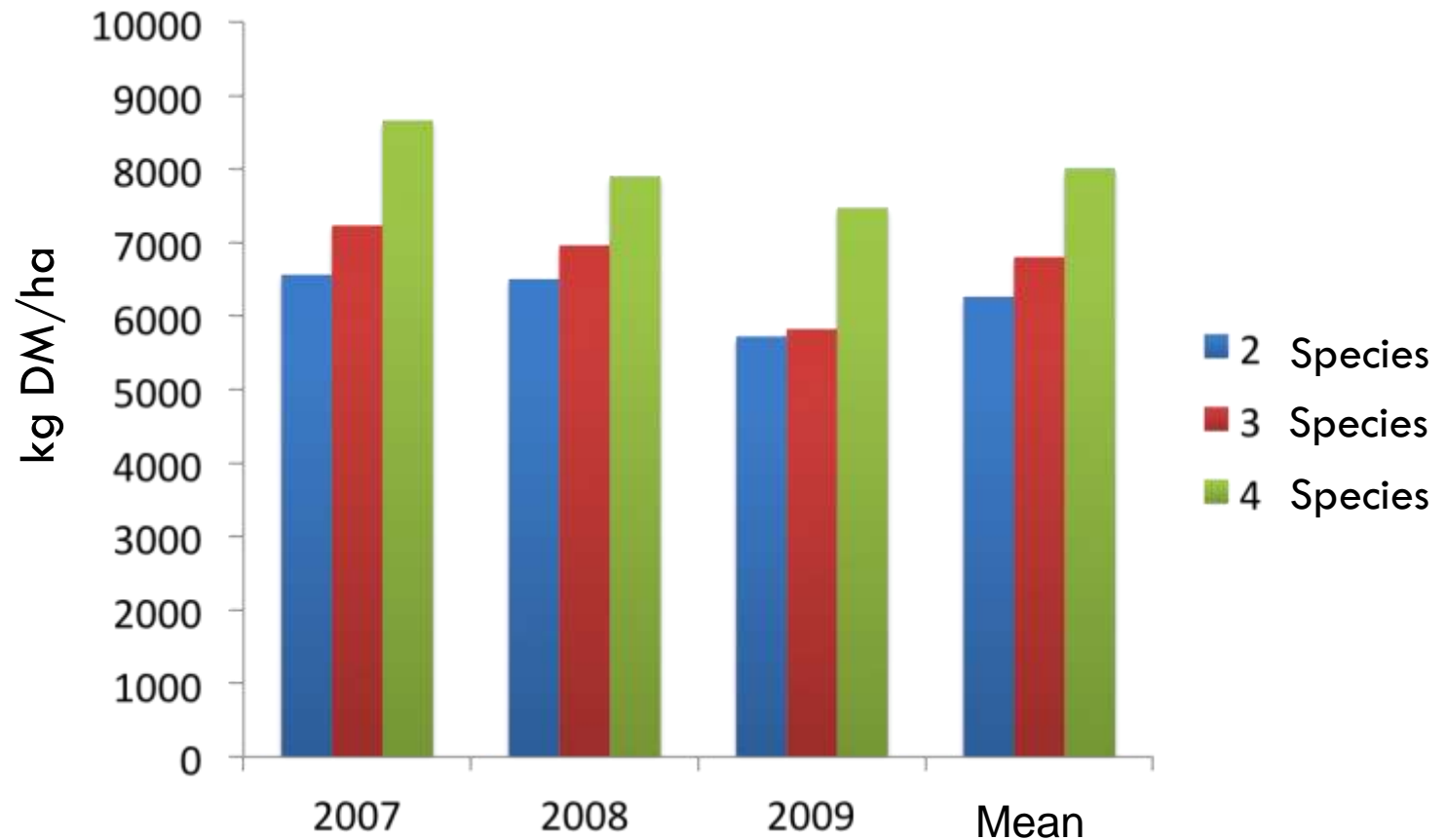
# Approaches for Complex Mixtures

- Two different approaches
  - ▣ Ecological approach
    - Based mainly on biodiversity
    - Number of species
  - ▣ Agronomic approach
    - Consider biodiversity but also productivity, regrowth during season, and persistence

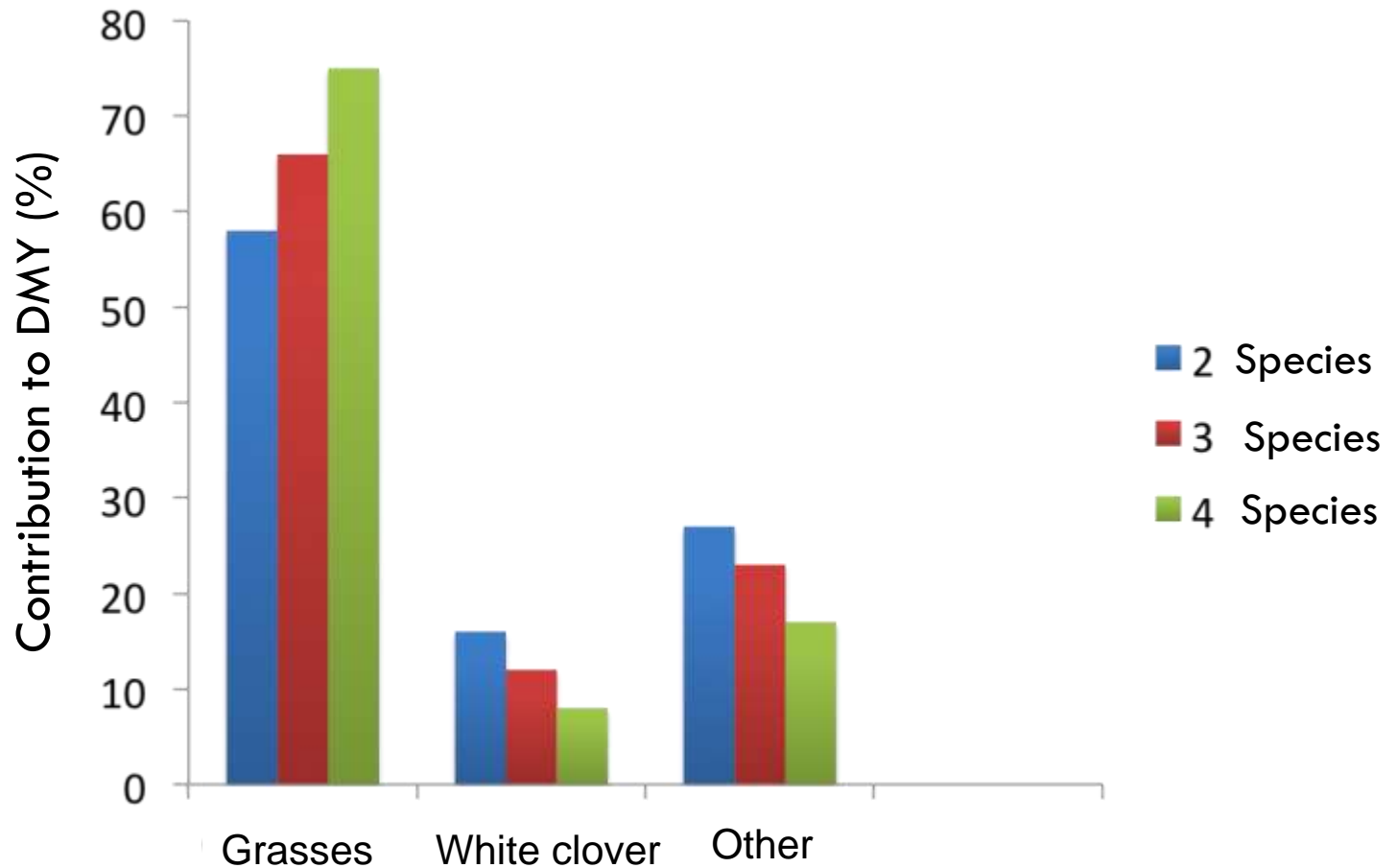
# Complex Mixtures: Trial with White Clover

- Mixtures: White clover with 2, 3 or 4 grasses
- Grasses: Timothy, Kentucky bluegrass, Reed canarygrass, Meadow fescue.
- Rotational grazing from mid-May to mid-October with dairy heifers from 2005 to 2009.

# Dry Matter Yield 2007-2009



# Contribution to DMY





# Main Results from that Trial

- Best productivity with 4 grass species which was the highest number of species tested in that trial
- Complex mixtures: an answer to the climatic variability

# Main Objective: Trial 1 and 2

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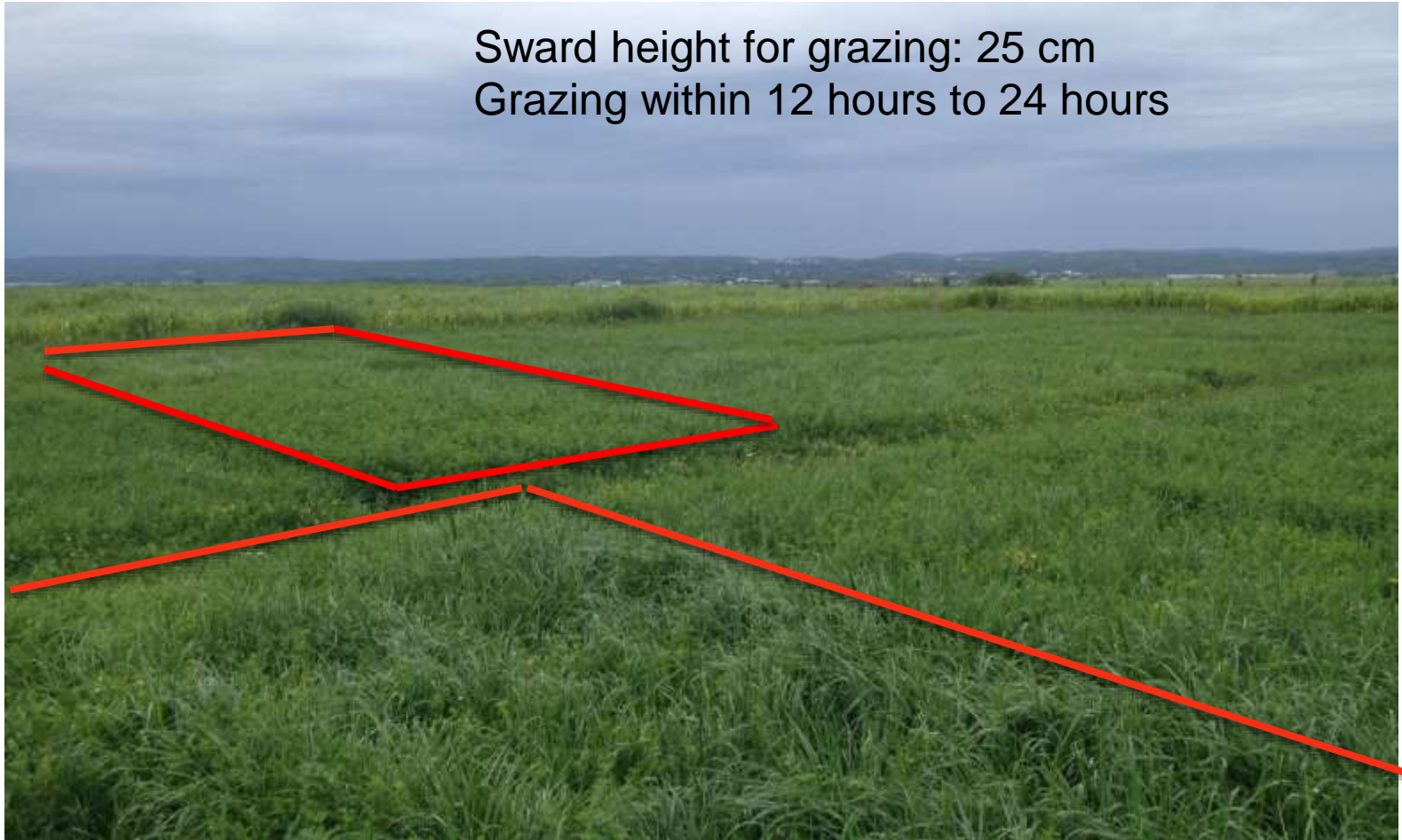
- ❑ Identify the best performing forage mixtures under grazing:
  - ❑ Binary mixtures (1 legume + 1 grass)
  - ❑ Complex mixtures (1 legume + many grasses)

# Methodology to Study Forage Mixtures

- Two major methodologies have been used
  - ▣ Plots grazing by animals (mob grazing technic)
  - ▣ Simulated grazing (mechanically harvested)

# Methodology: Mob Grazing Technic

Sward height for grazing: 25 cm  
Grazing within 12 hours to 24 hours



# Methodology: Mob Grazing Technic

Pros:

Plants are trampled by animals.

Prefered species can be identified.

Cons:

Not long enough to determine ADG.



# Methodology: Simulated Grazing

## Pros:

Evaluate many different mixtures.

## Cons:

No interaction between plant and animal.

Persistence of species may be different from grazing with animals.

Harvest mechanically: each time sward reached 25 cm



# Forage Mixtures Under Grazing

- Three trials at different sites since 2010:
  - Nappan (NS)
  - Lévis (QC)
  - Normandin (QC)
  - New Liskeard (ON)



# Climatic Normals (1980- 2010)

	Nappan (NS)	Lévis (QC)	Normandin (QC)	New Liskeard (ON)
Annual precipitation, mm	1155	1179	709	786
Annual temperature, °C	6.0	4.6	0.8	2.6
GDD (5 °C basis)	1762	1768	1329	1581
Latitude	45° 46' N	46° 48' N	48° 51' N	47° 51' N
Longitude	64° 15' W	71° 23' W	72° 32' W	79° 67' W



# Research Team: Binary and Complex Mixtures – Trials 1 and 2

- Yousef Papadopoulos, Project Leader, (AAFC)
- John Duynisveld (AAFC)
- Gilles Bélanger (AAFC)
- Gaëtan Tremblay (AAFC)
- Julie Lajeunesse (AAFC)
- Carole Lafrenière (UQAT)
- Sherry Fillmore (AAFC)

# Species in Binary Mixtures: Trial 1

## Legumes

- Alfalfa = Af
- Birdsfoot trefoil = Bt
- White clover = Wc

## Grasses

- Timothy = Ti
- Meadow fescue = Mf
- Tall fescue = Tf
- Orchardgrass = Og or Or
- Meadow brome = Mb
- Kentucky bluegrass = Kb

# Species and Cultivar in Binary Mixtures: Trial 1

## Legumes

- Alfalfa – CRS1001
- Birdsfoot trefoil – AC Langille
- White clover - Milkanova

## Grasses

- Timothy - Express
- Meadow fescue - Pradel
- Tall fescue - Courtney
- Orchardgrass - Killarney
- Meadow brome - Fleet
- Kentucky bluegrass - Troy

# Seeding Rate in Binary Mixtures: Trial 1

## Legumes

- Alfalfa 8 kg/ha
- Birdsfoot trefoil 8 kg/ha
- White clover 8 kg/ha

## Grasses

- Timothy 8 kg/ha
- Meadow fescue 15 kg/ha
- Tall fescue 15 kg/ha
- Orchardgrass 12 kg/ha
- Meadow brome 15 kg/ha
- Kentucky bluegrass 22 kg/ha

# Trial 1:

## Binary Mixtures for Grazing

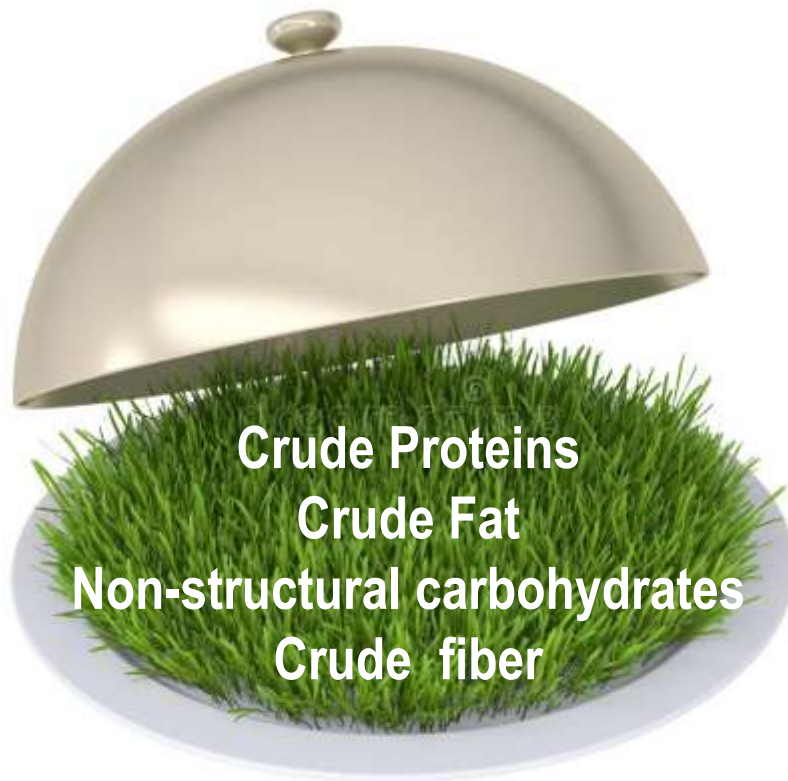
- 18 binary mixtures (1 legume + 1 grass)
- 3 sites
  - ▣ Nappan – Mob grazing with steers (25 cm)
  - ▣ Lévis – Simulated grazing (25 cm)
  - ▣ Normandin – Simulated grazing (25 cm)
- Seeded in 2010
- Data recorded in the next five years (2011-2015)

# What was Measured?

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- Dry matter yield (DMY)
- Contribution of seeded species to DMY (June and August)
- Nutritive value
  - ▣ TDN (Energy)

# Total Digestible Nutrients (TDN)



Total digestible  
energy in forages

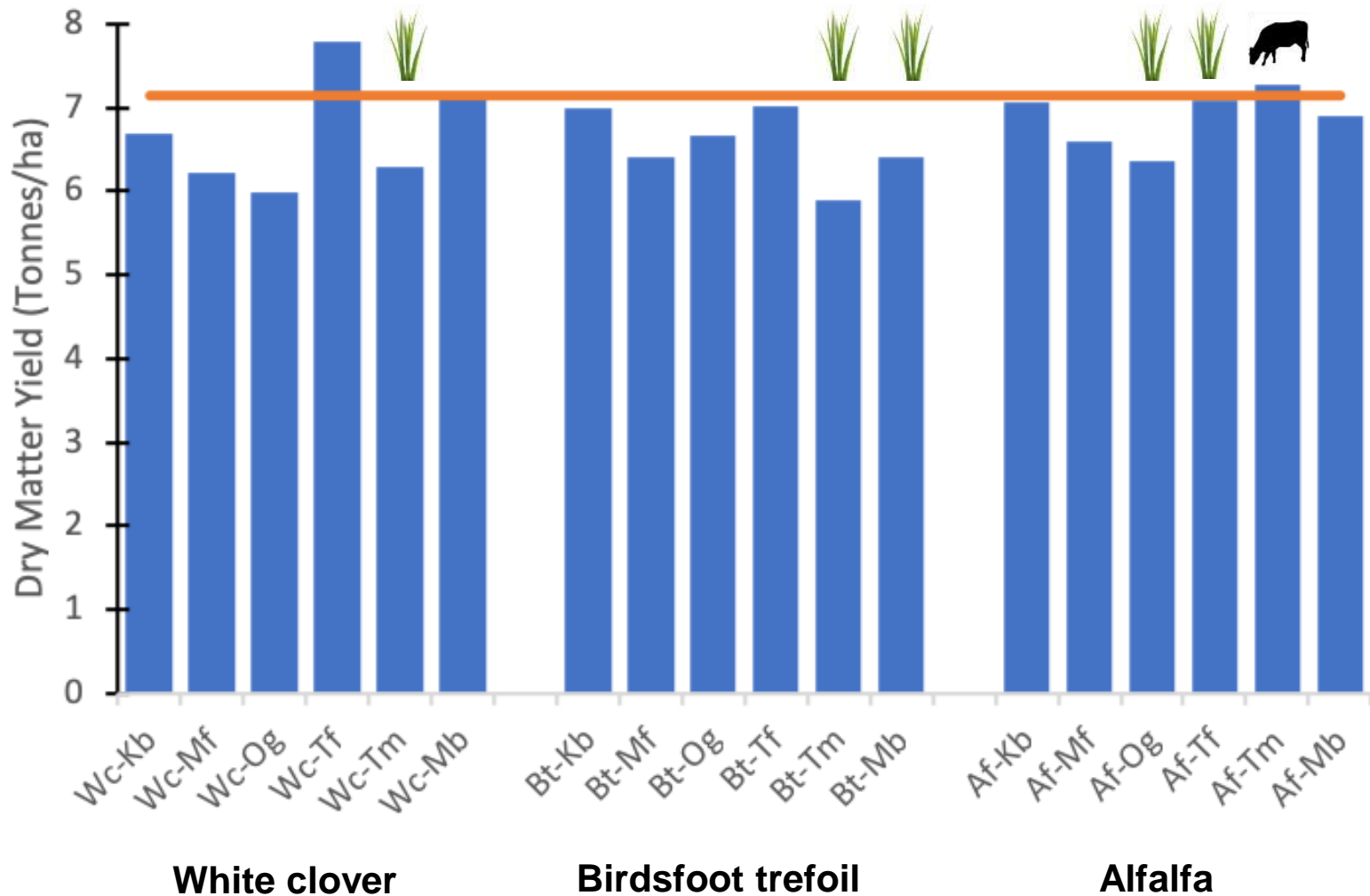
# How to Understand Next Three Slides

- Higher DMY: All forage mixtures (blue bar) above the orange line
- Higher DMY and higher TDN: All forages mixtures (blue bar) above the orange line and 
- Higher TDN but lower DMY: All forages mixtures (blue bar) below the orange line and 



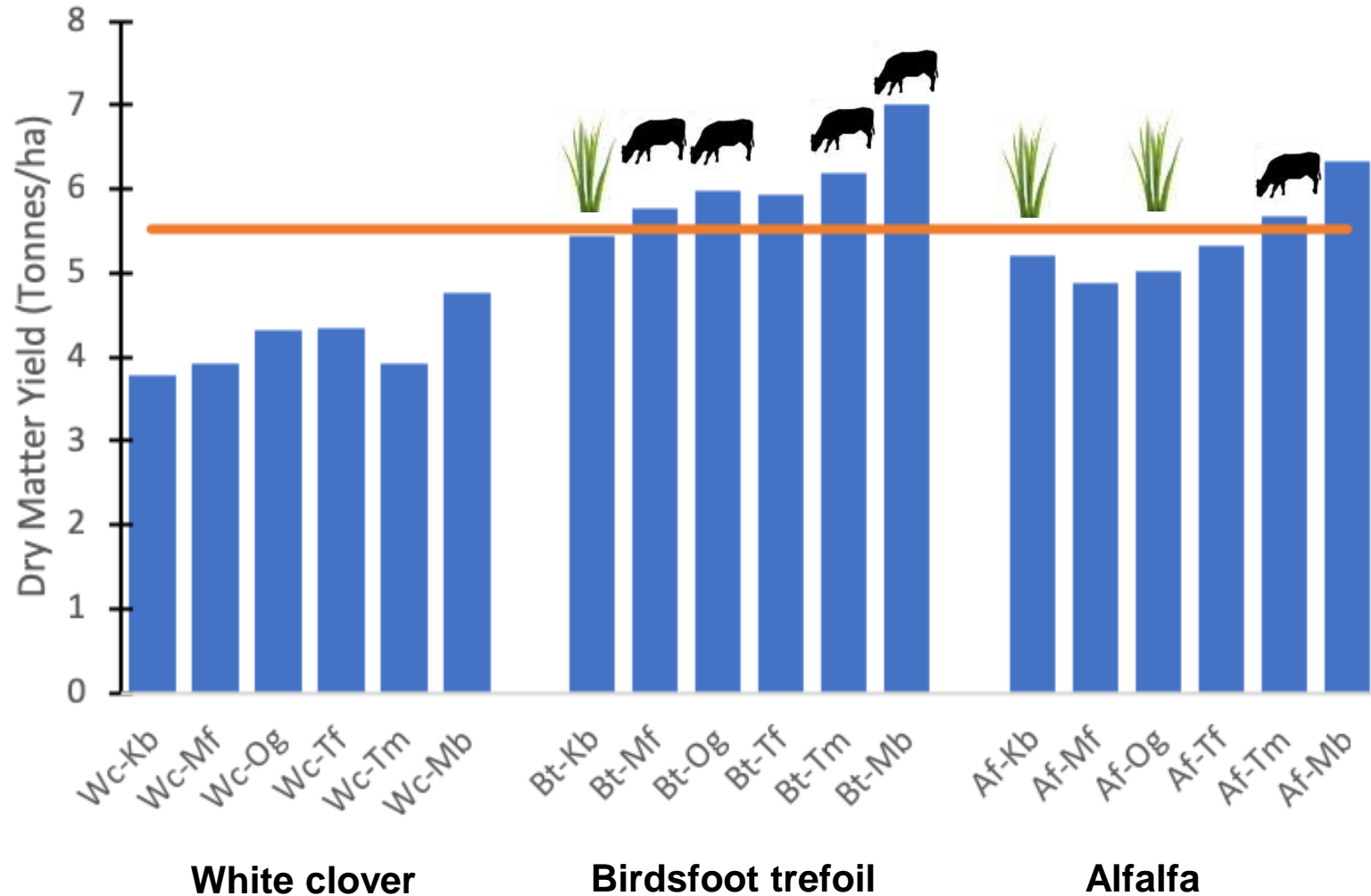
# Binary Mixtures: Nappan

## DMY and TDN: 5 Years Average



# Binary Mixtures: Lévis

## DMY and TDN: 5 Years Average

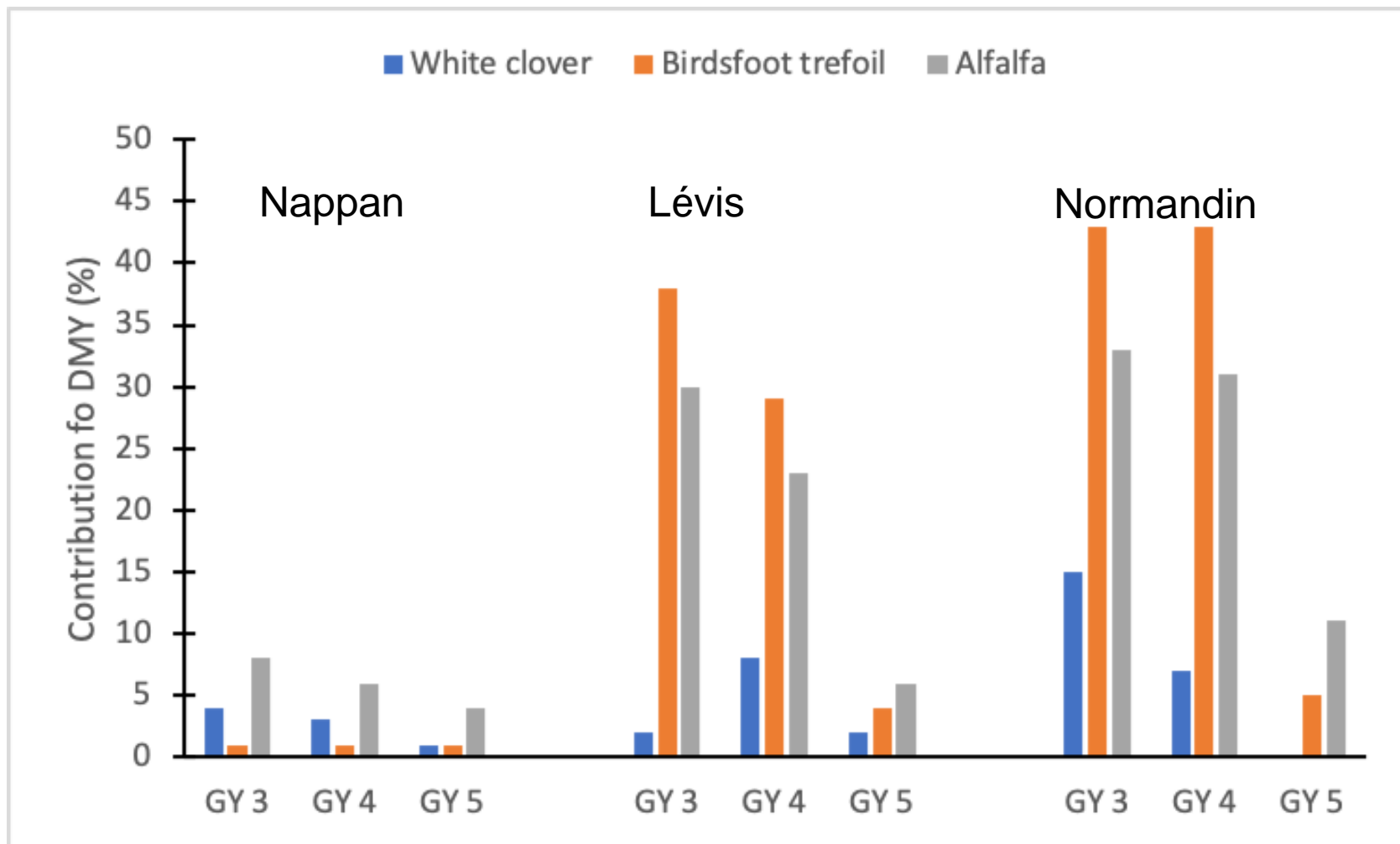


# Binary Mixtures: Normandin

## DMY and TDN: 5 Years Average

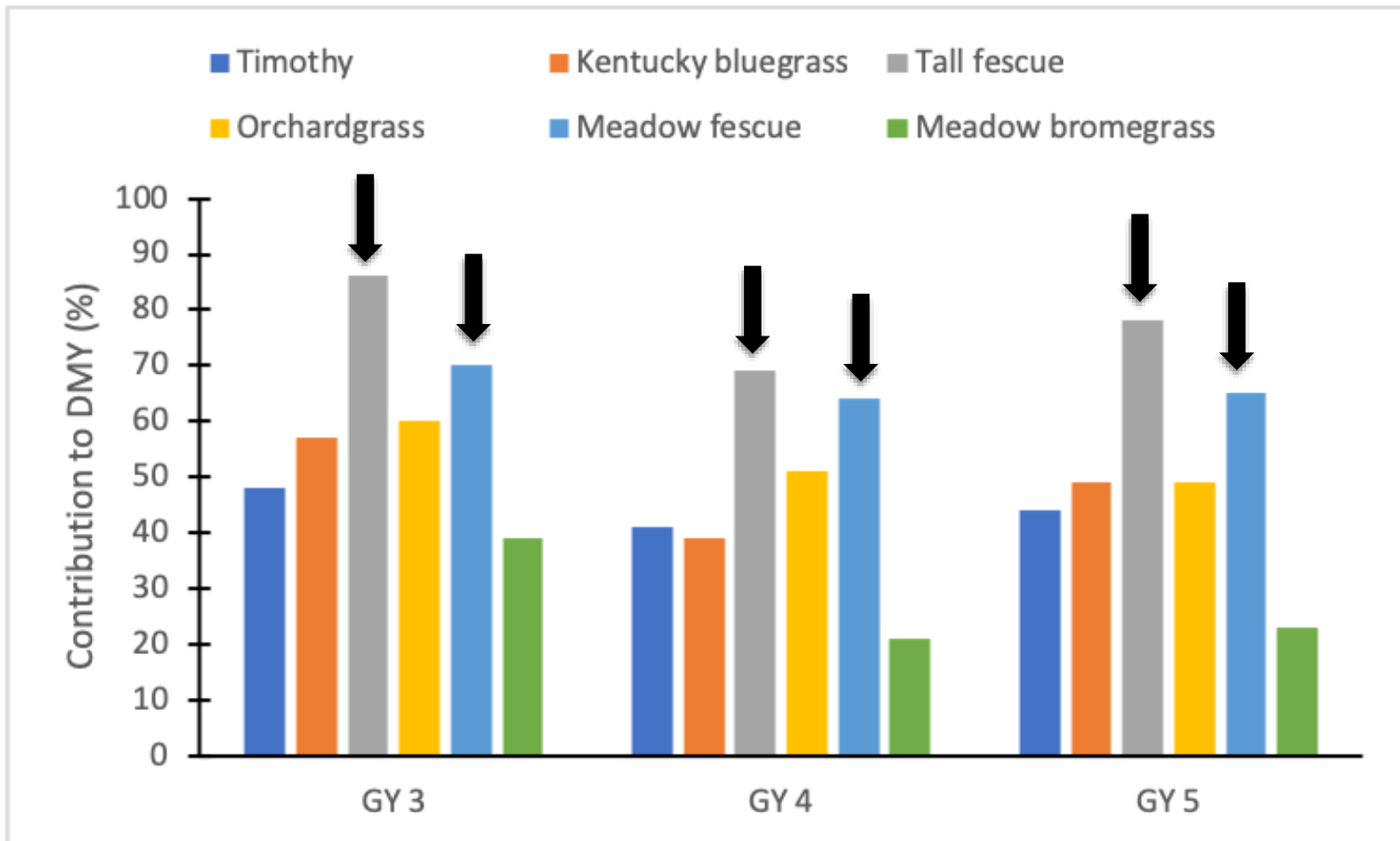


# Binary Mixtures: Contribution of Legume to DMY



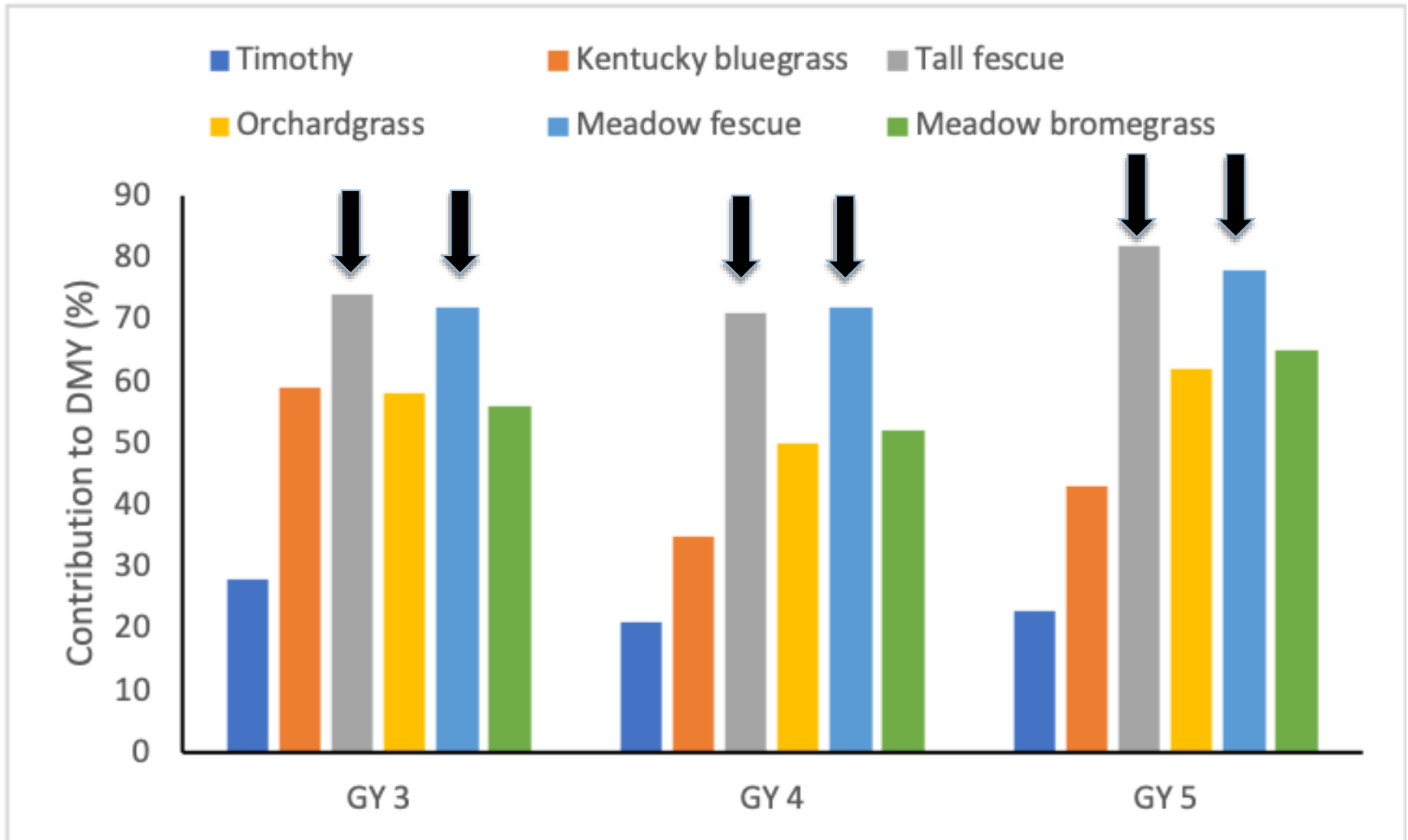
# Binary Mixtures: Nappan

## Contribution of Grasses to DMY



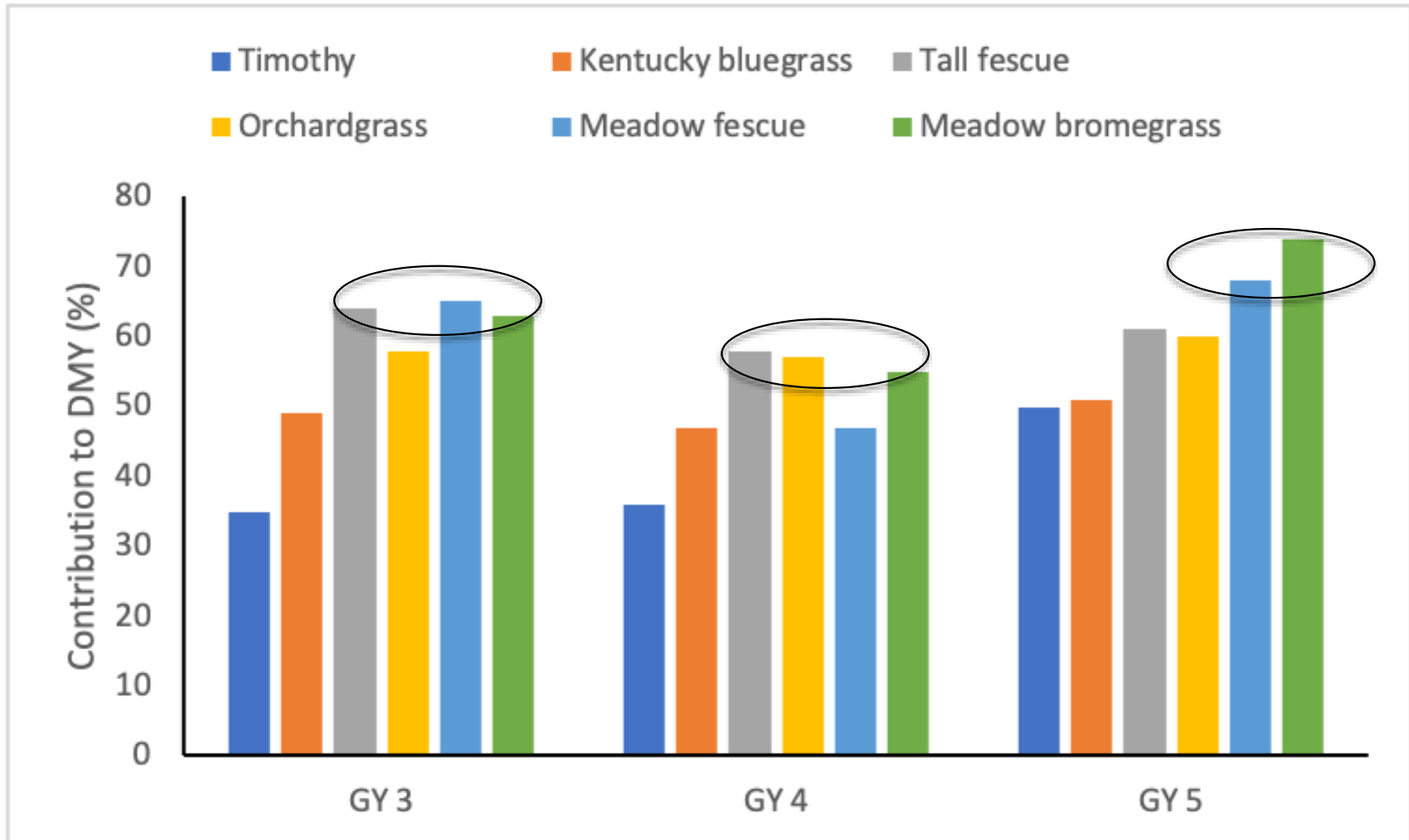
# Binary Mixtures: Lévis

## Contribution of Grasses to DMY



# Binary Mixtures: Normandin

## Contribution of Grasses to DMY



# Take-home Message: Trial 1

- Under grazing (Nappan), productivity of binary mixtures are not very much different.
- Over all, tall fescue and meadow fescue are species that contributed to DMY at high level.
- Legume disappeared rapidly within 2-3 years when grazed with animals



# Complex Mixtures: Trial 2

- 8 complex mixtures
- 3 sites
  - ▣ Nappan – Grazing with steers (25 cm)
  - ▣ Lévis – Simulated grazing (25 cm)
  - ▣ Normandin– Simulated grazing (25 cm)
- Seeded in 2010
- Data recorded in the next five years (2011-2015)

# Species and Cultivar : Trial 2

## Legumes

- Alfalfa – CRS1001
- Birdsfoot trefoil – AC Langille

## Grasses

- Timothy - Express
- Meadow fescue - Pradel
- Tall fescue - Courtnay
- Orchardgrass - Killarney
- Meadow brome - Fleet
- Kentucky bluegrass – Troy
- Reed canarygrass - Venture

# Grass Mixtures and Seeding Rate: Trial 2

- **Mix 1:** Timothy (4 kg/ha), Meadow fescue (7 kg/ha), Reed Canarygrass (2 kg/ha) Kentucky bluegrass (3 kg/ha)
- **Mix 2:** Tall fescue (6 kg/ha), Meadow brome (7 kg/ha), Orchardgrass (4 kg/ha), Kentucky bluegrass (3 kg/ha)
- **Mix 3:** Timothy (5 kg/ha), Meadow fescue (7 kg/ha), Kentucky bluegrass (3 kg/ha)
- **Mix 4:** Tall fescue (6 kg/ha), Meadow brome (5 kg/ha), Reed canarygrass (2 kg/ha), Kentucky bluegrass (3 kg/ha)

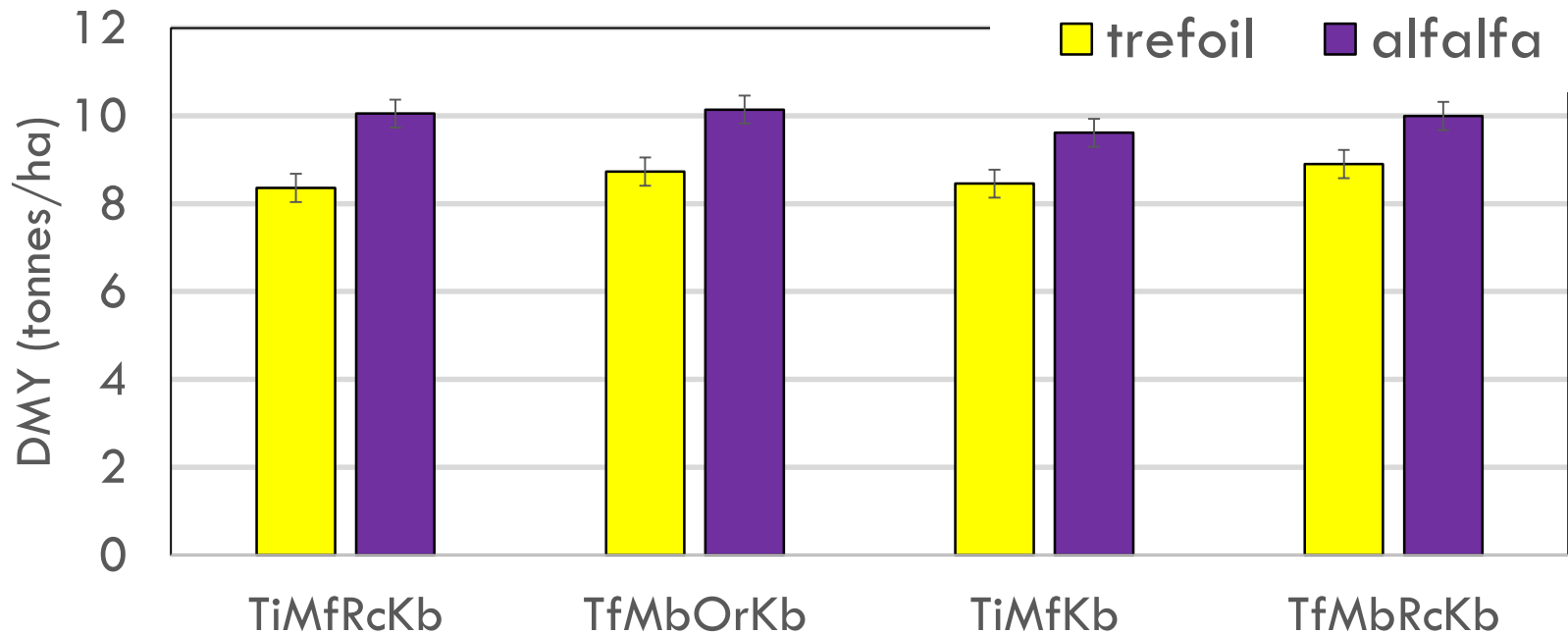
# Mixtures and Seeding Rate of Legume species: Trial 2

- **Mix 1:** with alfalfa (6 kg/ha) or birdsfoot trefoil (6 kg/ha) Af + TmMfRcBg      Bt + TmMfRcBg
- **Mix 2:** with alfalfa (6 kg/ha) or birdsfoot trefoil (6 kg/ha) Af + TfMbOrKb      Bt + TfMbOrKg
- **Mix 3:** with alfalfa (6 kg/ha) or birdsfoot trefoil (6 kg/ha) Af + TmMfKb      Bt + TmMfKb
- **Mix 4:** with alfalfa (6 kg/ha) or birdsfoot trefoil (6 kg/ha) Af + TfMbRcKb      Bt + TfMbRcKb

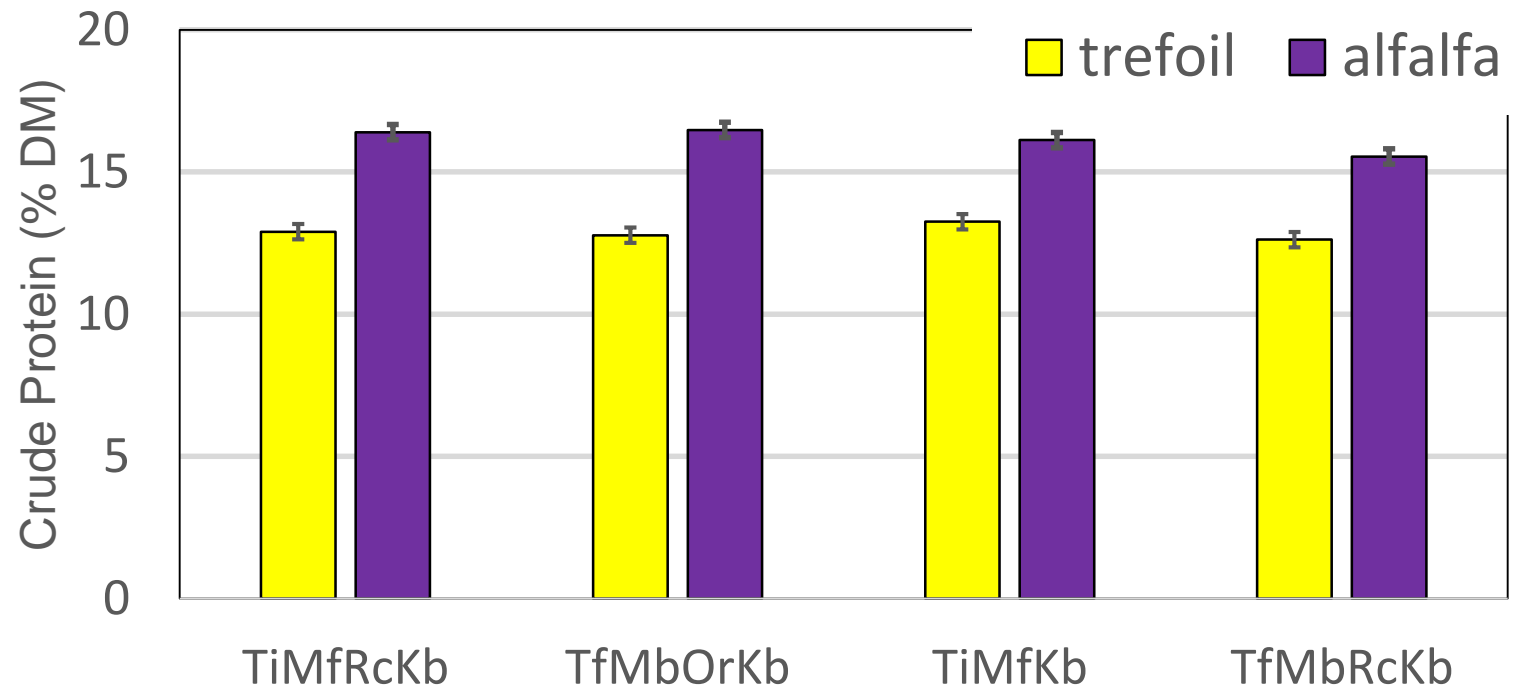
# Nappan Site: What was Measured?

- Dry matter yield (DMY)
- Nutritive value
  - ▣ TDN (Energy)
  - ▣ Crude Protein
  - ▣ Average daily gain

# Nappan: Seasonal Dry Matter Yield, 5 Years Average

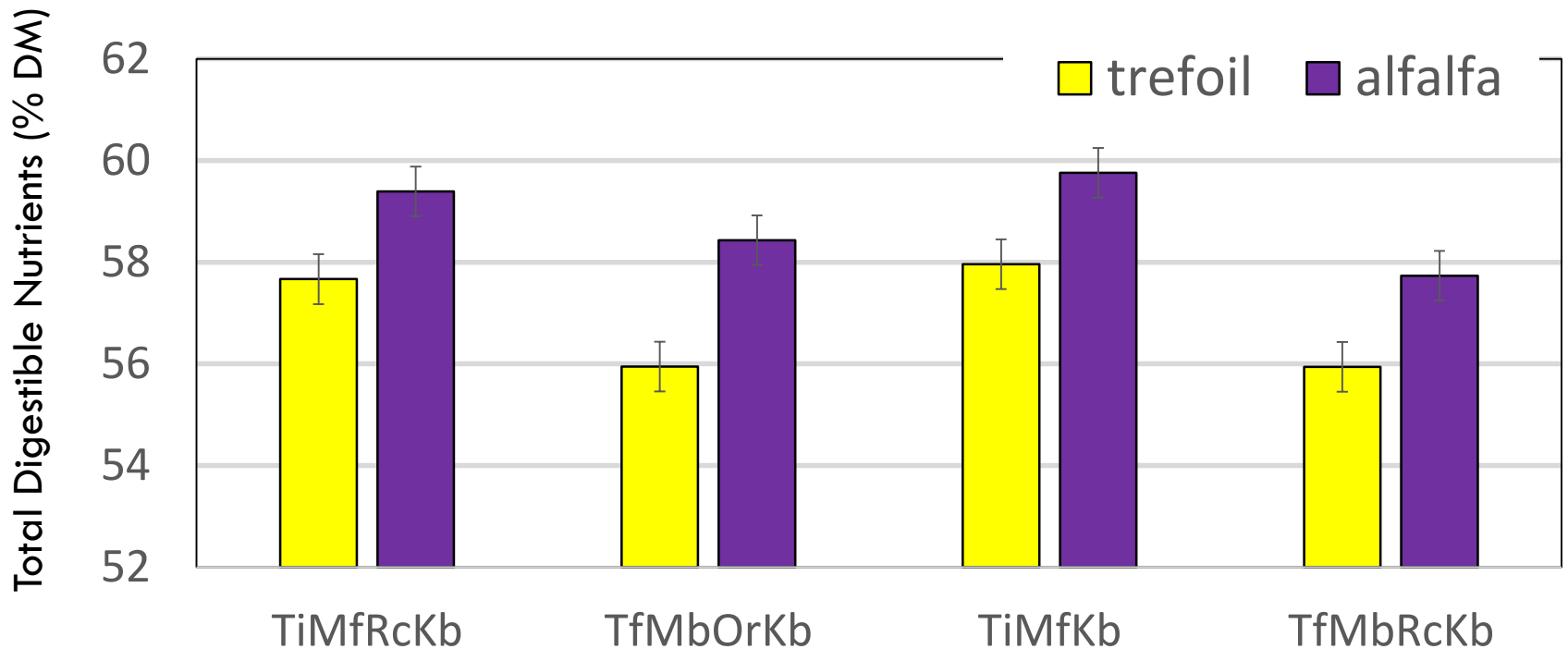


# Nappan: Crude Protein Content 5 Years Average



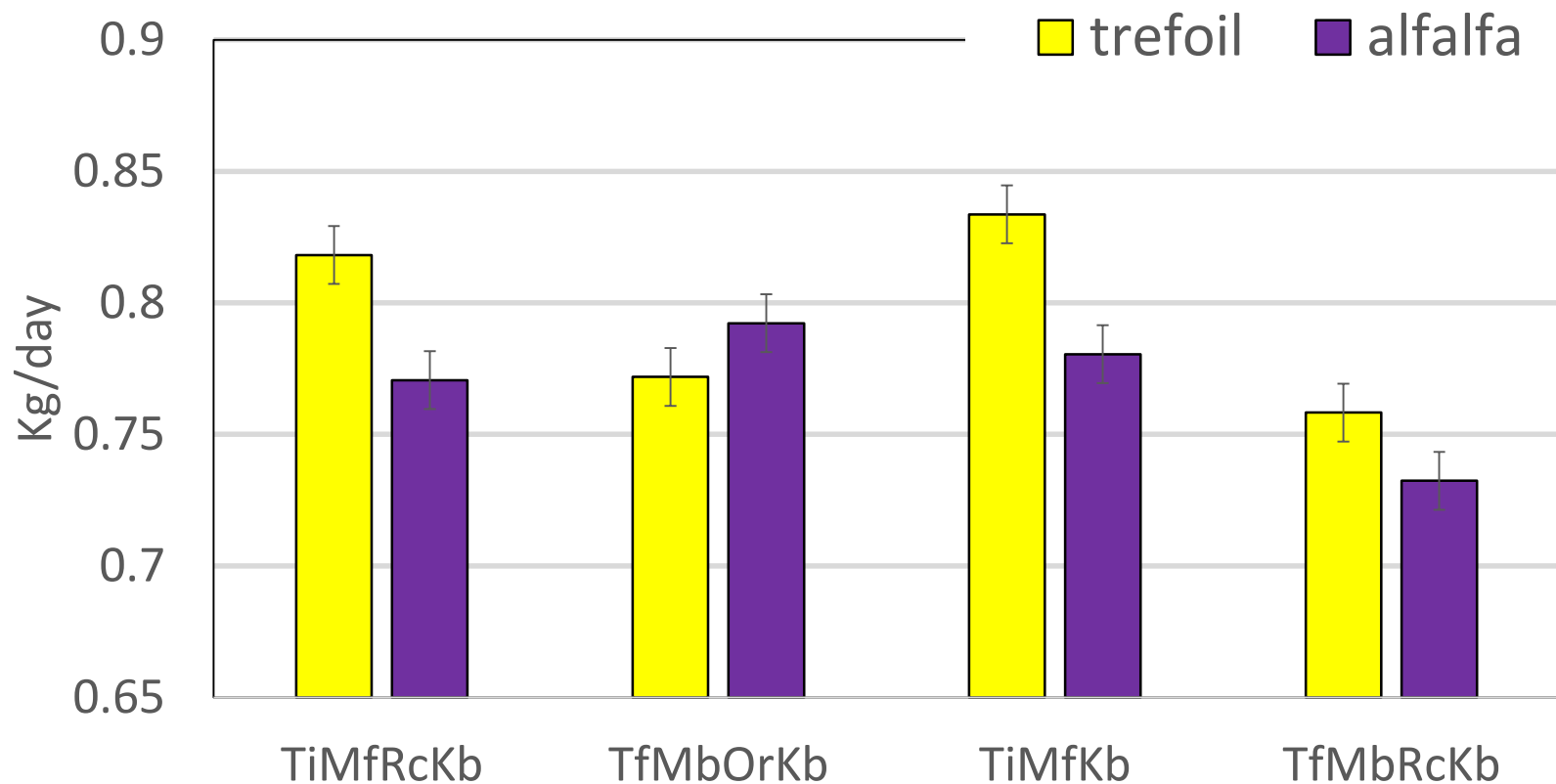
# Nappan: TDN Content

## 5 Years Average

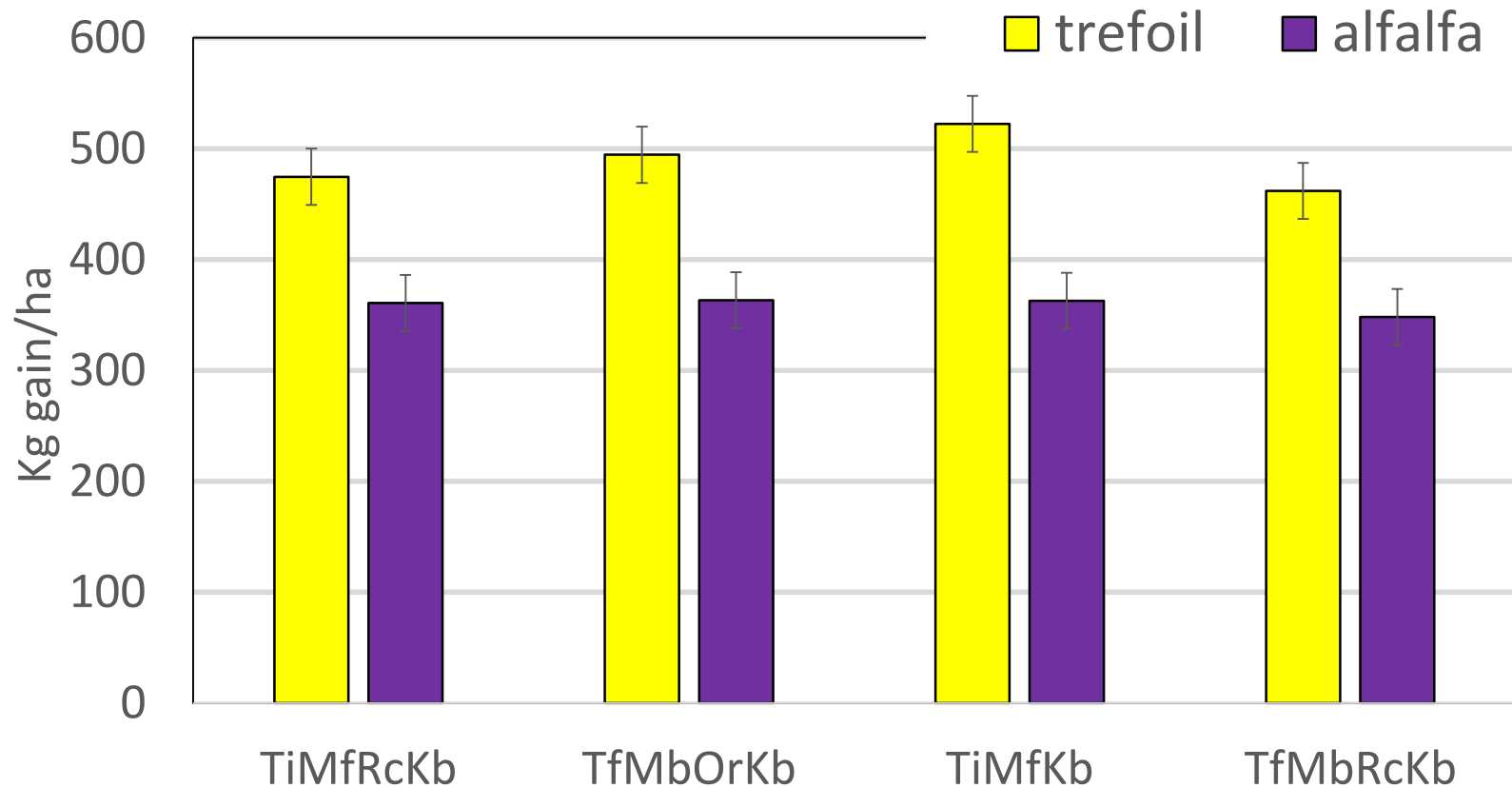




# Nappan: Steer Daily Weight Gain 5 Years Average



# Nappan: Gain per Unit of Land Area 5 Years Average



# Take-home Message: Trial 2

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- Mixtures with birdsfoot trefoil had lower DMY than alfalfa but produced more gain per day and per hectare.

# Research Team: N- Fertilisation of Complex Mixtures – Trial 3

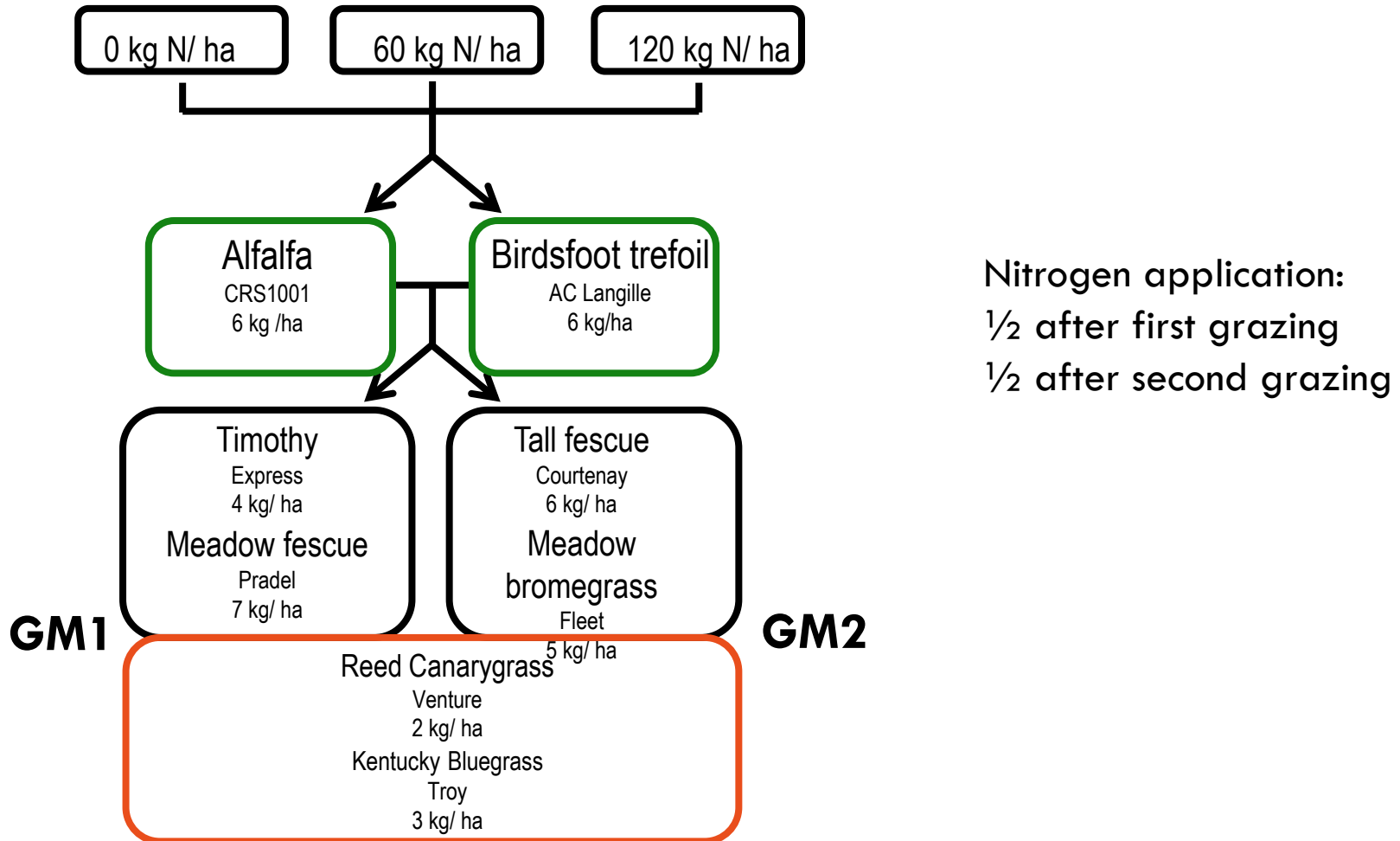
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- Julie Lajeunesse (AAFC)
- Carole Lafrenière (UQAT)
- Sherry Fillmore (AAFC)
- Ira Mandell (UofGuelph)

# N - Fertilisation of Complex Mixtures: Trial 3

- 4 complex mixtures
- 3 sites
  - ▣ Nappan – Grazing animals (25 cm)
  - ▣ Normandin – Grazing animals (25 cm)
  - ▣ New Liskeard – Grazing animals (25 cm)
- Seeded in 2013
- Data recorded in the next three years (2014-2016)

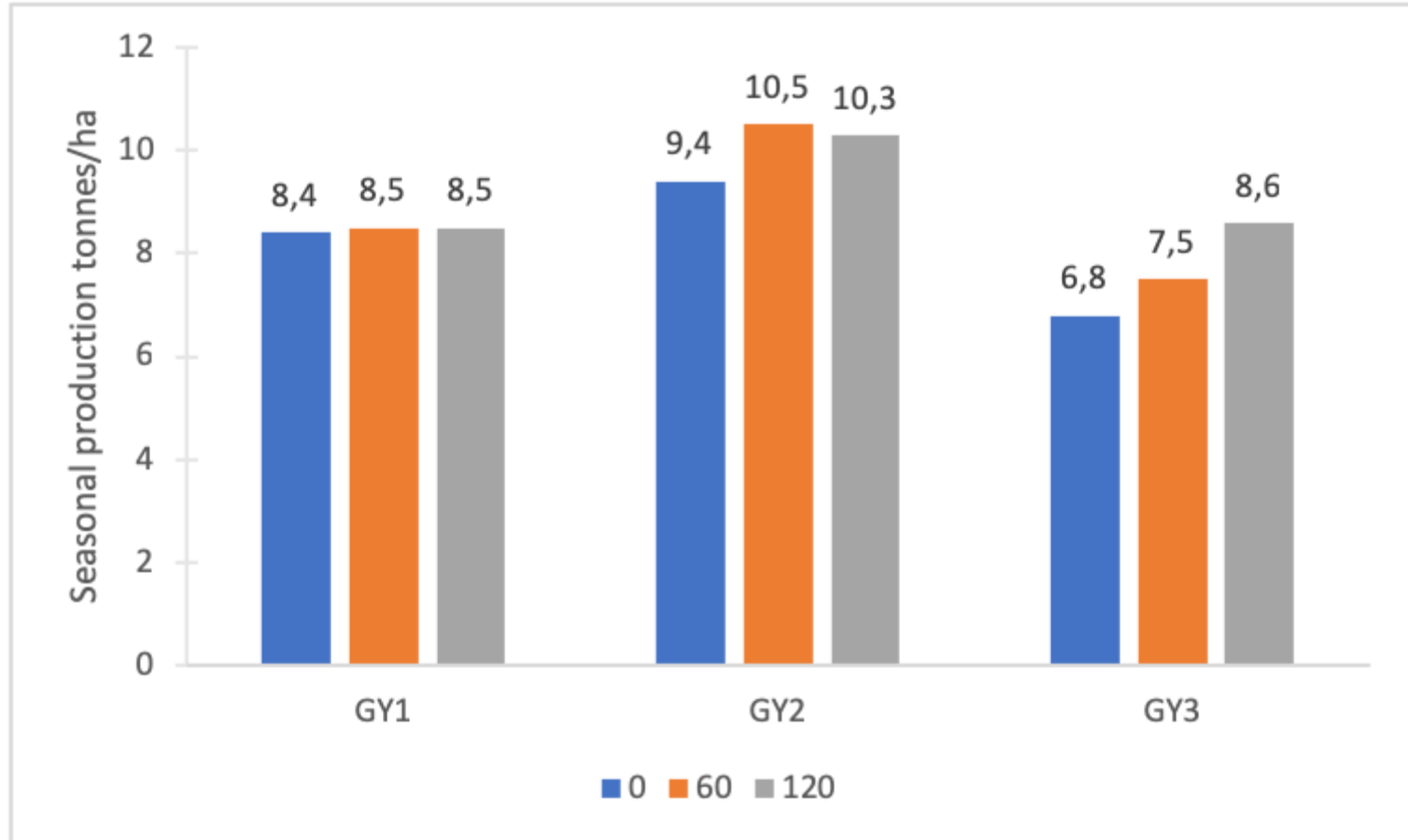
# Methodology

## Complex Mixtures - Nitrogen Fertilisation

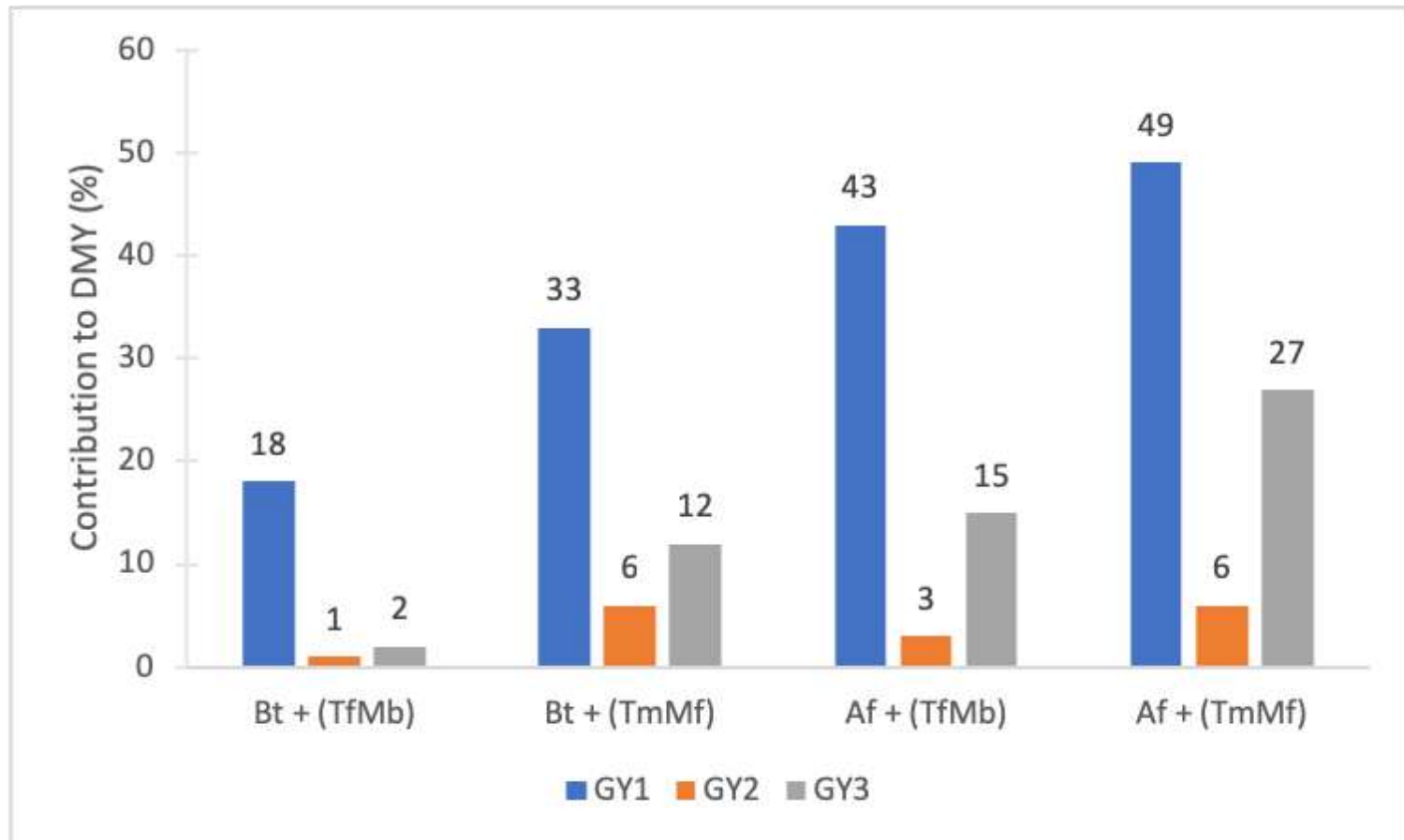


# Nitrogen Trial : Seasonal DMY

## New Liskeard Site

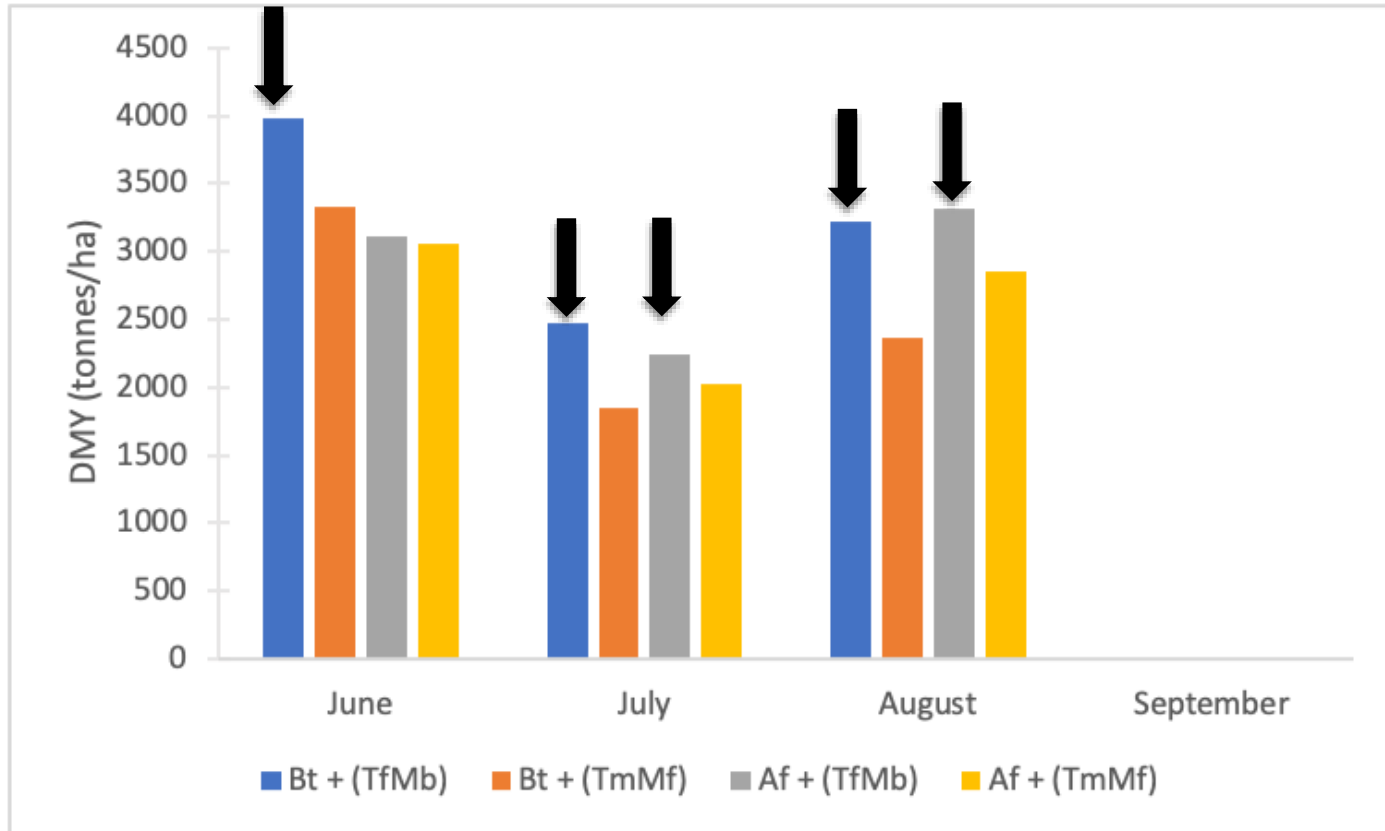


# Contribution of Legume Species to DMY New Liskeard Site

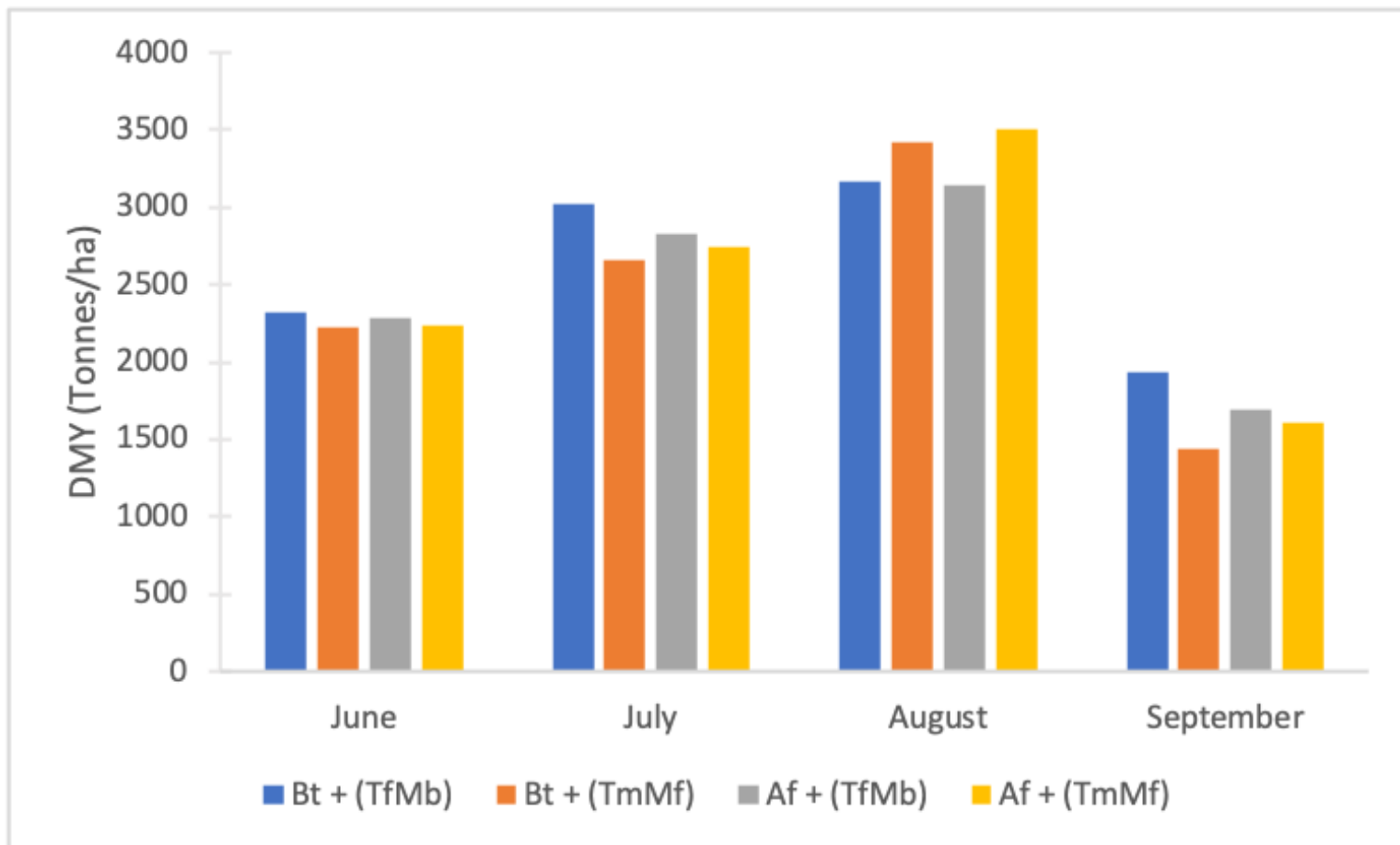




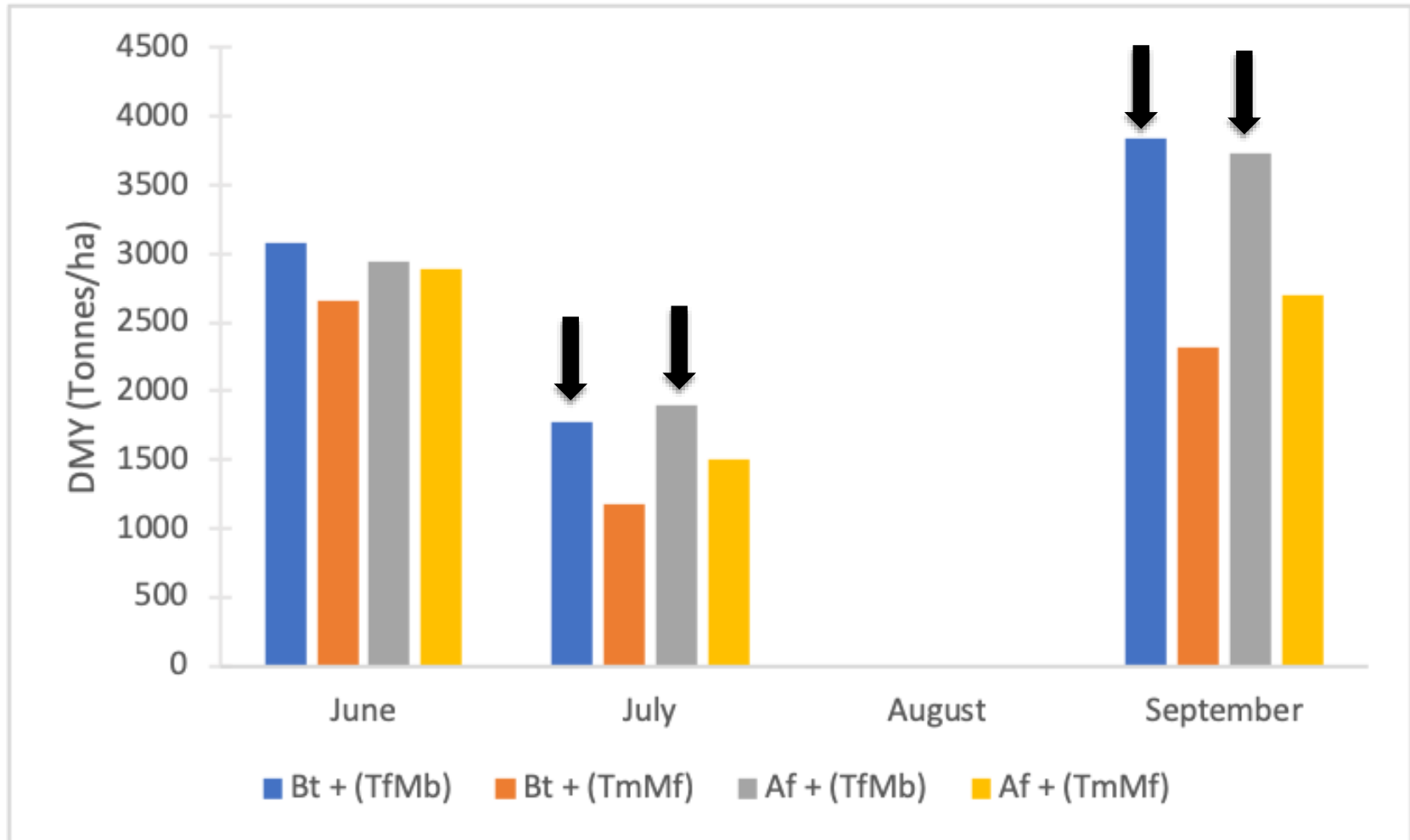
# DMY for Each Grazing Cycle 2014: New Liskeard site



# DMY for Each Grazing Cycle 2015: New Liskeard Site



# DMY for Each Grazing Cycle 2016: New Liskeard Site



# Timothy/Meadow Fescue vs Tall Fescue/Meadow brome



# Year 2016: Early August vs End-September



# Take-home Message:

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- Tall fescue can secure forage availability during dry season.
- Maturity of tall fescue is important for grazing.
- Animals must be used to tall fescue.

# Acknowledgments:

- These projects were funded by AAC through Growing Forward 2: Beef Cluster in collaboration with Beef Cattle Research Council.
- Beef Producers of Ontario and Producteurs de Bovins du Québec also participated in this funding.



# Acknowledgments:

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- Special thanks to the New Liskeard Research staff that worked on the Nitrogen Forage Mixture trial:

Leo Giesen, Hal Brown, Albert Koekkoek,  
John Kobler, Kaley Rodman