# Biosolids and Compost as Soil Amendments within Rhode Island Roadsides

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# Agenda

- Background
- Problem
- Goal
- Method – Amendment Trial
- Results – Amendment Trial
- Conclusion

http://www.roadsbridges.com/sites/rb/files/styles/content_image/public/RB%20case%20study%20image%201.jpg?itc

# Background - Vegetation

Role of vegetation on roadsides

- Filter runoff
- Stabilize soil
- Prevent erosion
- Prevent nutrient leaching
- Be aesthetically pleasing

- Qualities of preferred roadside vegetation
  - Grass or forb (non-woody)
  - Perennial
  - Cheap
  - Native or localized
  - Tolerant of mowing
  - Tolerant of drought
  - Able to compete with annual, warm-season and invasive speci

# Problem

The roadside is not a great place to grow a lawn

Totally engineered

- Poor soils
  - Low nutrients
  - Large particle size
- High Stress
- Invasive species
- Pollutants
  - Road salt
  - Vehicle leaks and emissions

Designed to be:

- Well-drained
- Direct flow of water to drains

# Problem

Poor conditions = undersirable vegetation

Dominated by *Digitaria sp.* (Crabgrass)

- Able to grow in sandy, hot, dry soils
- Weedy annual
- Poor roots
- Leaves bare ground much of the year

***Digitaria sanguinalis***

extension.umass.edu

***Digitaria ischaemum***

extension.umass.edu

# Problem

How do we address this?

Restrictions on a solution:

- Keep costs low
- Keep maintenance minimal
- Maintain driver safety
- Maintain the functionality of the road and roadside

https://scontent.cdninstagram.com/hphotos-xaf1/t51.2885-15/e15/11356786_1588399351448795_1734685412_n.jpg

# Problem

Lack of nutrients, not the application of road salt, the largest challenge (Brown and Gorres 2012)

Biosolids (Sewage Sludge) and Yard Waste Compost

- Nutrient-rich
- High in OM
- Available
- Affordable
- Local
- Renewable

# Research Objective

To establish RIDOT guidelines for the use of biosolids and compost as an amendment for increasing soil nutrient density along highways in order to promote the establishment and persistence of perennial grasses

# Methods – Amendments - Biosoilds

"Boston Beans" (BB)

- Heat-treated Biosoids
- Dry, granular
- 4-3-0 +Iron
- US EPA Class A
- Distributed by Casella Organics as Earthlife Fertilizer

# Methods – Amendments - Biosolids

## I Biosolids (RMI)

- Wood-ash-stabilized Biosoilds
- Dewatered biosolids (raw cake) mixed with biomass fly ash (wood ash) at 1:1 v:v ratio
- US EPA Class A
- Produced by Resource Management Inc. and marketed as Heart+Soil Complete pH+Plus
- N-P-K of .008-.003-.0155 with 171 lbs of lime/ton
- Sold only as a bulk commercial product

# Methods – Amendments - Biosolids

## CRD Biosolids (CRD)

- Alkaline-stabilized biosolids
- Produced by the City of Concord, NH
- US EPA Class A
- Distributed by Resource Management Inc. as Heart & Soil Complete

https://nh-concord.civicplus.com/images/pages/N1361/Biosolids%204%20RMI%202.jpg

# Methods – Amendments - Biosolids

## WRB Biosolids (WRB)

- Anaerobically-stabilized Biosolids
- Produced by the Winnipesaukee River Basin Project in Franklin, NH
- US EPA Class B (Land application only)
- Managed by Resource Management Inc.
- Distributed at no cost to farmers

# Methods – Amendments - Biosolids

## West Warwick Biosolids (WW)

- Aerobically-composted Biosolids
- Dewatered sewage sludge composted in windrows
- Class A
- 0.8-1.26-0.05
- Formerly produced by the Town of West Warwick Wastewater Treatment Facility (no longer produced)

# Methods – Amendments - Composts

## Bristol Biosolids Co-Compost (BBCC)

- Biosolids/Yard waste co-compost
- Class A
- Biosolids processed using Siemens-IPS in-vessel technology
- Yard waste compost is screened, aerobically composted municipal leaf and yard clippings
- Yard waste added to biosolids until moisture content is approximately 35-40% solids
- Marketed and distributed by Agresource, Inc.


http://blog.blithewold.org/wp-content/uploads/2010/10/Bristol-compost.jpg

# Methods – Amendments - Composts

Rhode Island Resource Recovery Corp. Yard waste Compost (YWC)

- Aerobic compost produced from chipped yard waste
- Produced in windrows
- Class A
- Available direct to consumers or through Casella Organics
- Certified Organic

http://www.biocycle.net/wp-content/uploads/2012/01/46sb-300x151.jpg

# Methods - The Amendments - Biosolids

lication Rates:

- 1lb N (per 1000 $ft^2$) / 48kg N (per ha)
- 3lb N (per 1000 $ft^2$) / 144kg N (per ha)
- 6lb N (per 1000 $ft^2$) / 288 kg N (per ha)
- Expected first-year mineralized N

Products:

- Heat-treated – BB
  - High heat and pelletized
- Alkaline stabilized - CRD
  - Addition of lime to increase pH
- Anaerobically digested - WRB
  - Bacterially transformed
- Ash stabilized - RMI
  - Addition of fly ash (wood ash)
- Composted - WW
  - Windrow composted

# Methods - The Amendments - Composts

plication Rates:

- 15%, 30%, 45% of soil to 6 in/15 cm

Products:

- Yardwaste/biosolid compost - BBCC
  - Mix of yard waste and biosolids
  - Expected N mineralization after 586 days:
    - 15% - 937 kg N/ha
    - 30% - 1883 kg N/ha
    - 45% - 2819kg N/ha
- Municipal yardwaste compost - YWC
  - RIRRC Yard Waste Compost
  - Expected N mineralization after 586 days:
    - 15% - 413 kg N/ha
    - 30% - 828 kg N/ha
    - 45% - 1241 kg N/ha
  - Initial N-immobilization expected within YWC amended plots

N-mineralization rates according to Claassen and Carey 2004

# Methods – Application Amounts

| ent (amendment/ rate) | Application rate Mg/product/ha | Application rate Mg/C/ha |
|---|---|---|
| | Biosolids | |
| 3 48 kg N/ha | 1 | <1 |
| 144 kg N/ha | 3 | 1 |
| 288 kg N/ha | 6 | 2 |
| D 48 kg N/ha | 8 | 2 |
| D 144 kg N/ha | 24 | 7 |
| D 288 kg N/ha | 48 | 14 |
| W 48 kg N/ha | 7 | 2 |
| / 144 kg N/ha | 22 | 7 |
| / 288 kg N/ha | 44 | 14 |
| B 48 kg N/ha | 6 | 2 |
| B 144 kg N/ha | 19 | 7 |
| B 288 kg N/ha | 37 | 13 |
| II 48 kg N/ha | 7 | 2 |
| I 144 kg N/ha | 22 | 7 |
| I 288 kg N/ha | 44 | 15 |

| Treatment (amendment/ rate) | Application rate Mg/product/ha | Application Mg/C/ha |
|---|---|---|
| | Composts | |
| BBCC 15% | 103 | 36 |
| BBCC 30% | 207 | 73 |
| BBCC 45% | 310 | 109 |
| YWC 15% | 174 | 32 |
| YWC 30% | 349 | 63 |
| YWC 45% | 523 | 95 |

Lowest Compost Application Rate

**> 2X**

Greatest Biosolids Application Rates

THE UN OF

THE AN

# Methods – Seeding and incorporation

Amendments added to plots in September 2012

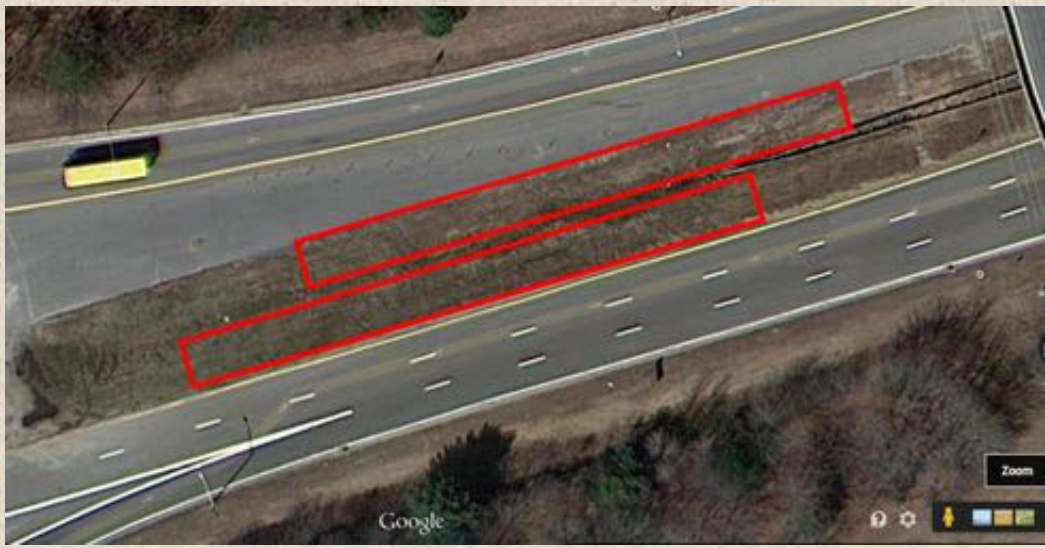
- Site rototilled to 3 inches, incorporating existing vegetation
- Amendments incorporated to 6 inches using tractor-pulled rototiller

Plots hydroseeded with RIDOT Park Mix.

- *70% Festuca rubra* (Creeping Red Fescue)
- *15% Poa pratensis* (Kentucky Bluegrass)
- *15% Lolium perenne* (Perennial Ryegrass)

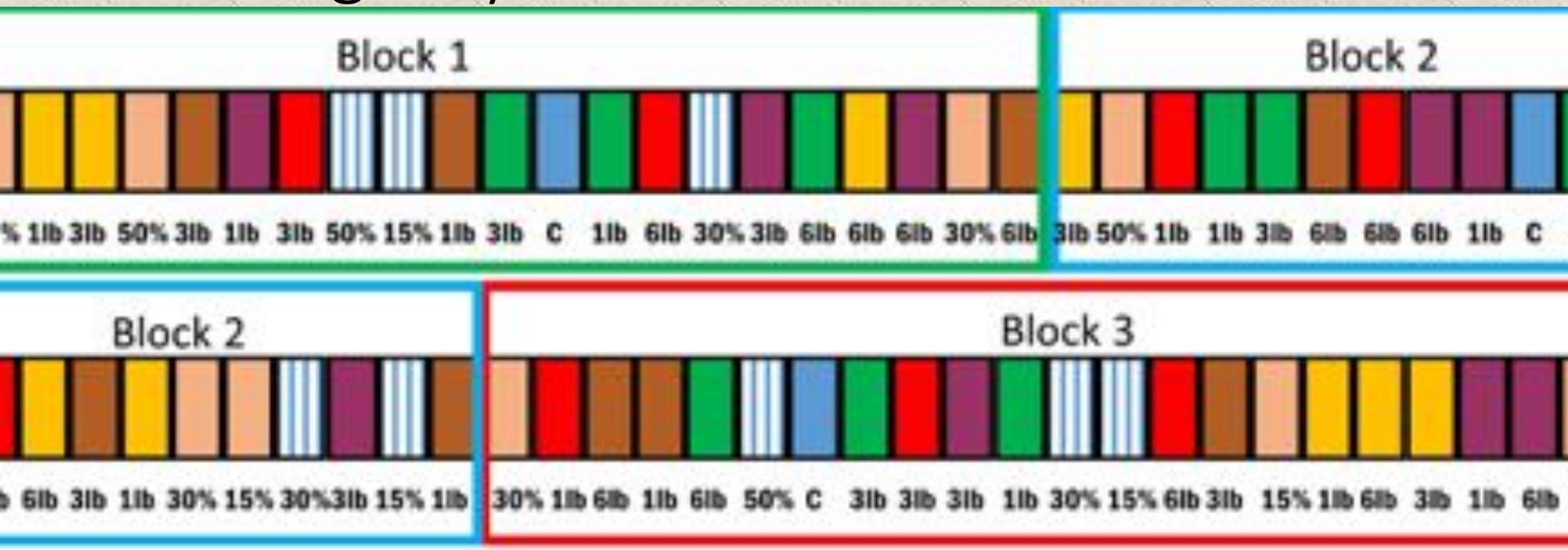
Plots mowed by RIDOT

- No other maintenance performed




Google

# hods - Design layout




RMI Biosolids

Bristol Biosolids Compost

CRD Biosolids

Boston Beans Biosolids

West Warwick Biosolids

Yard Waste Compost

WRB Biosolids

Control

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# Methods - Analysis

**Visual Turf Quality Score**

Nitrate and Ammonium

**Soil Moisture**

**Soil Organic Matter**

C/N

pH and EC

Statistics

- SAS 9.2

# Methods - Visual ratings

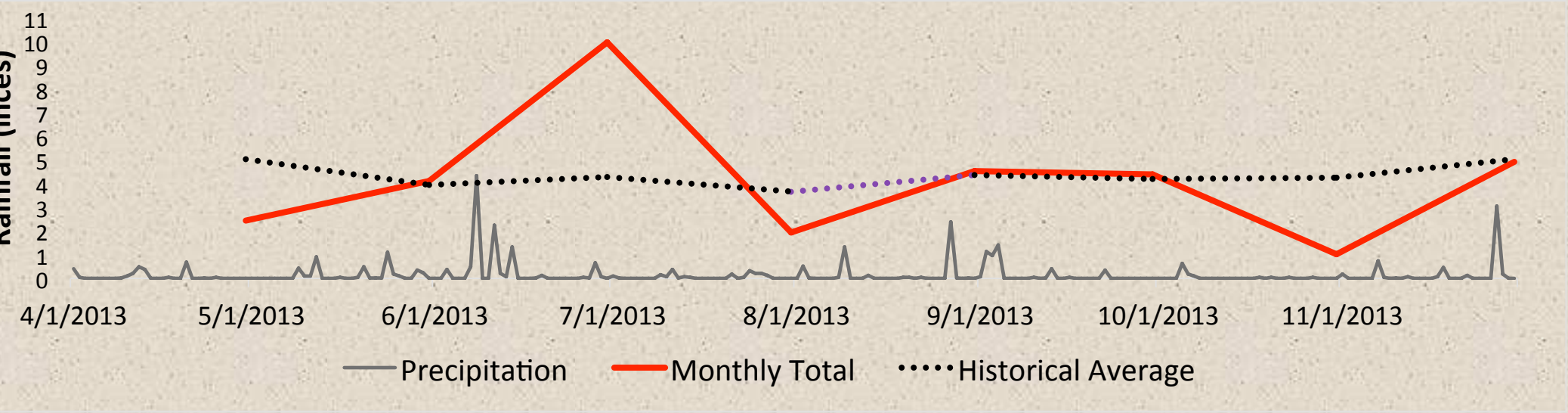

ubjective rating

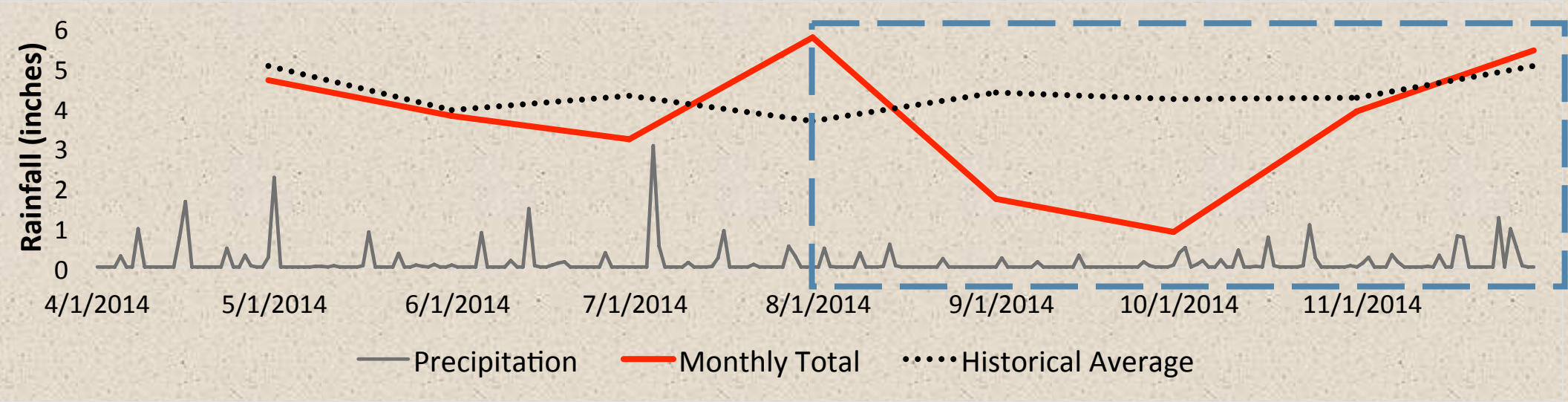
- 0-5 scale
- Accounts for multiple factors (Morris and Shearman 1998)
- Rating of 3 is seen as ideal
  - Indicates healthy growth without becoming a maintenance issue

1 2 3 4 5

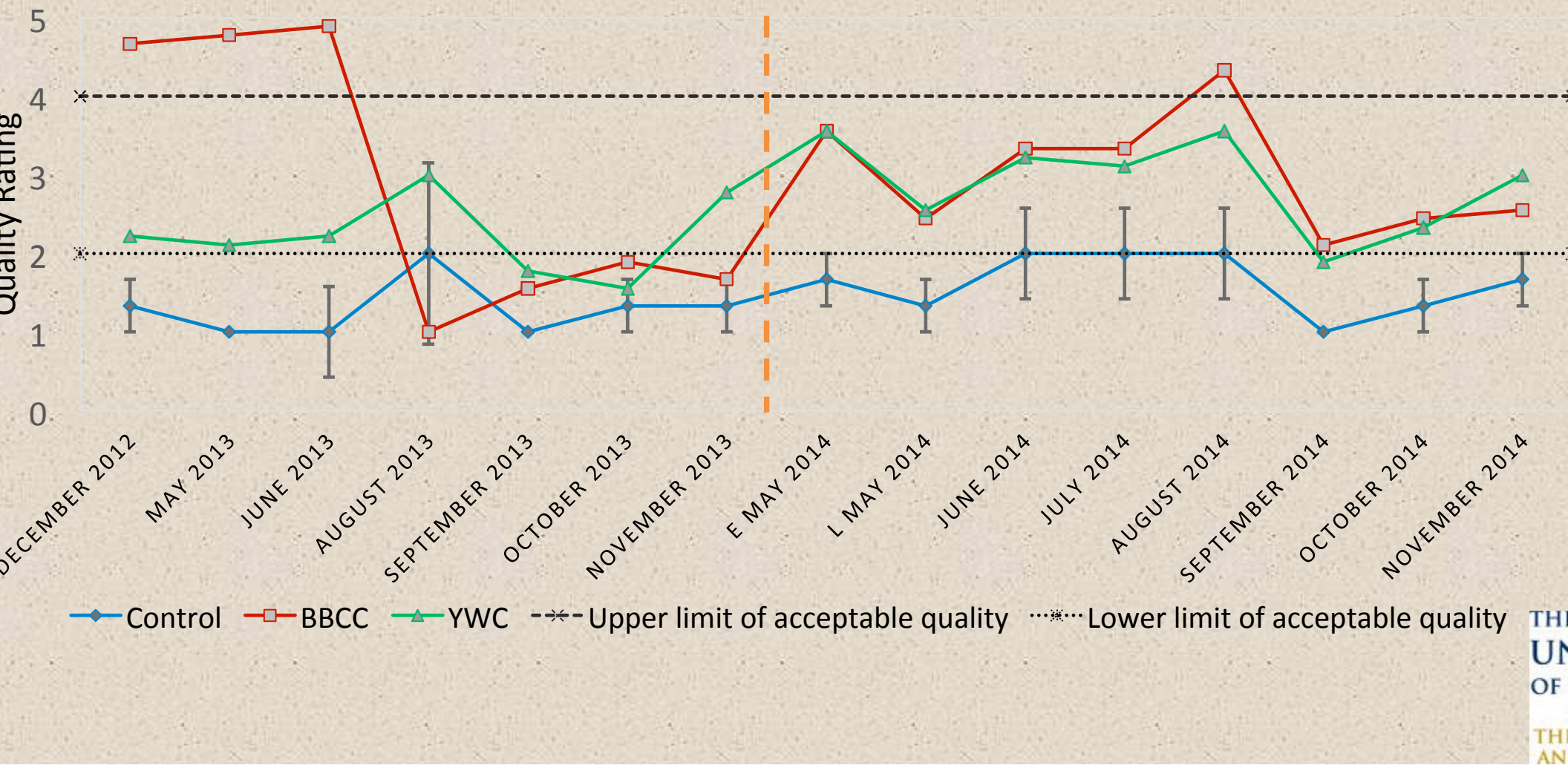
# Results – Quality - Biosolids - By Application Rate

# **Context:** Rainfall – Actually Daily and Monthly vs. Monthly Historic Average

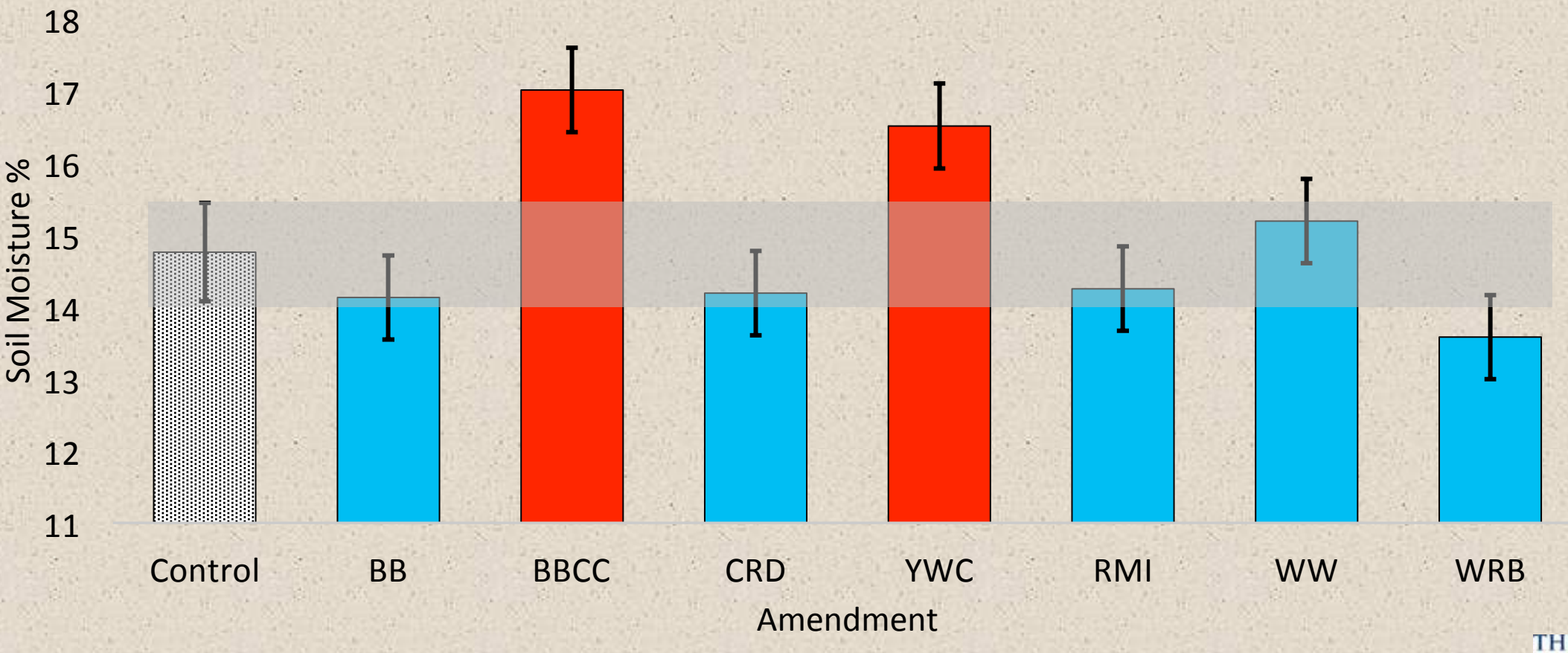


# Results – Quality - Composts by product

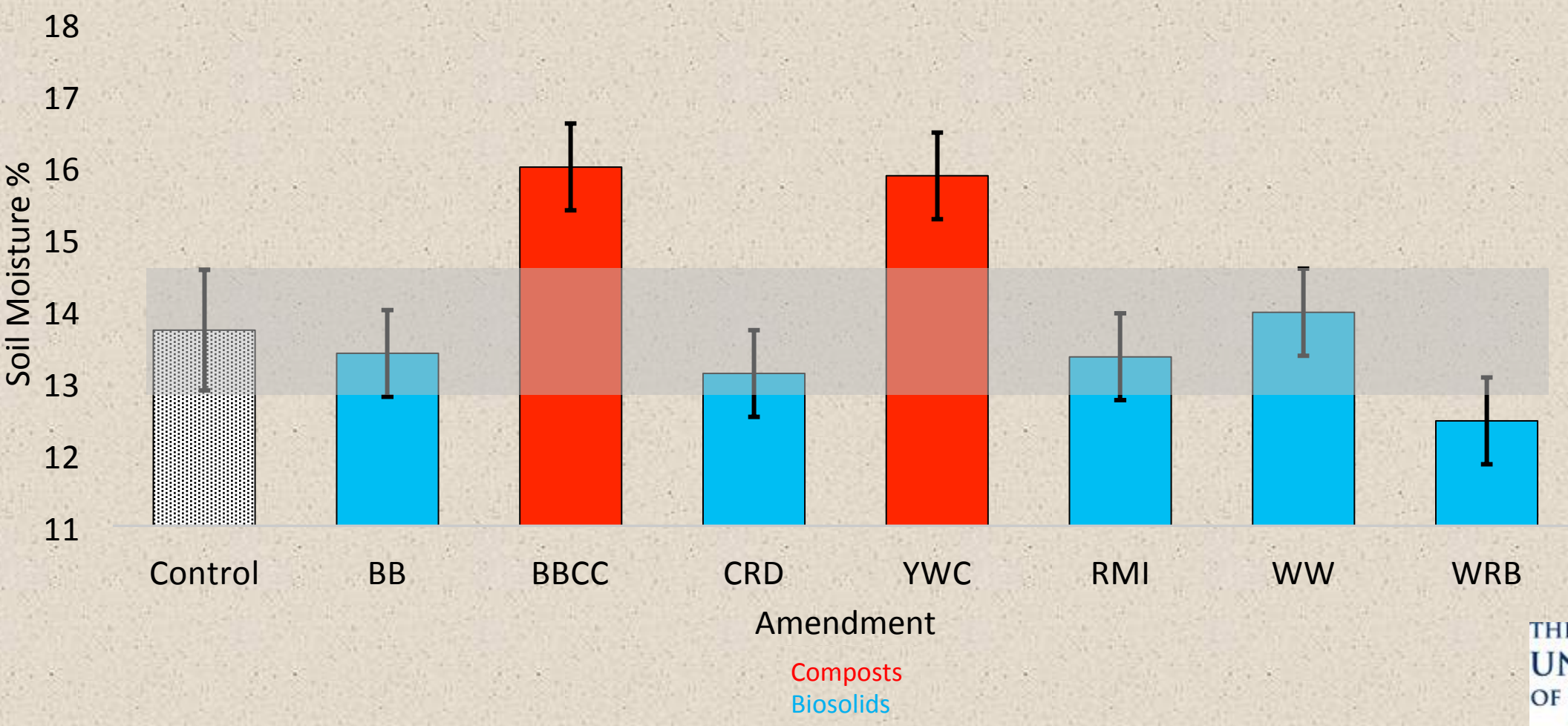


# Results – Soil Moisture – By Amendment



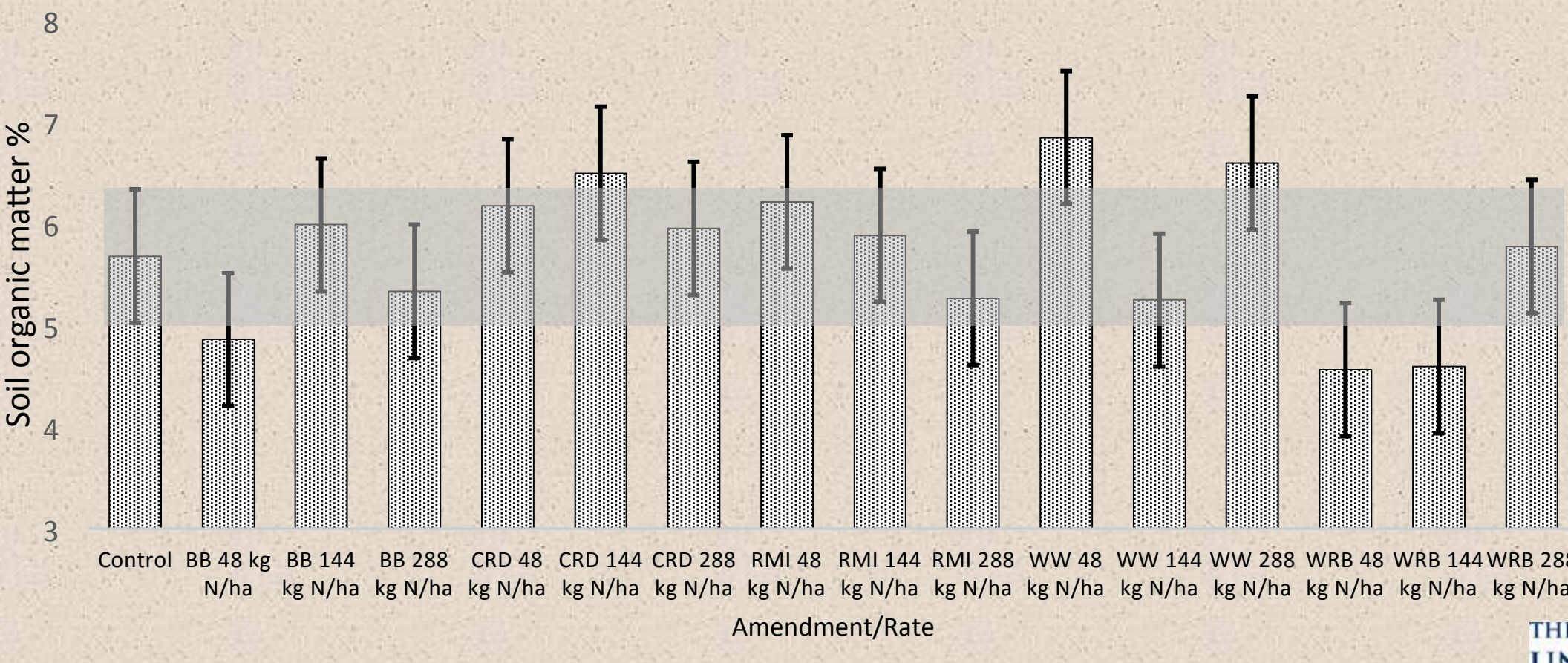

Note: Shaded area represents standard error of Control

# **Results –** Soil Moisture August 2014 to November 2014



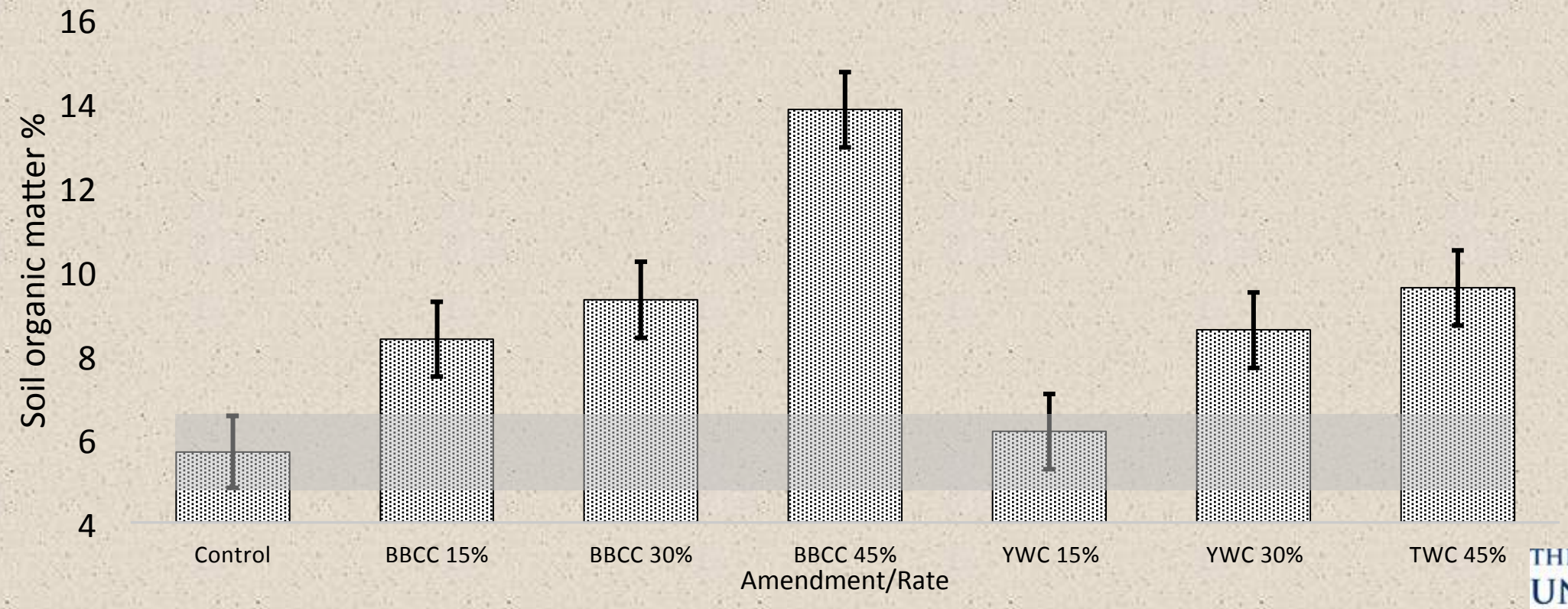

Note: Shaded area represents standard error of Control

# Results – Soil Organic Matter Content – Biosolids – By Treatment



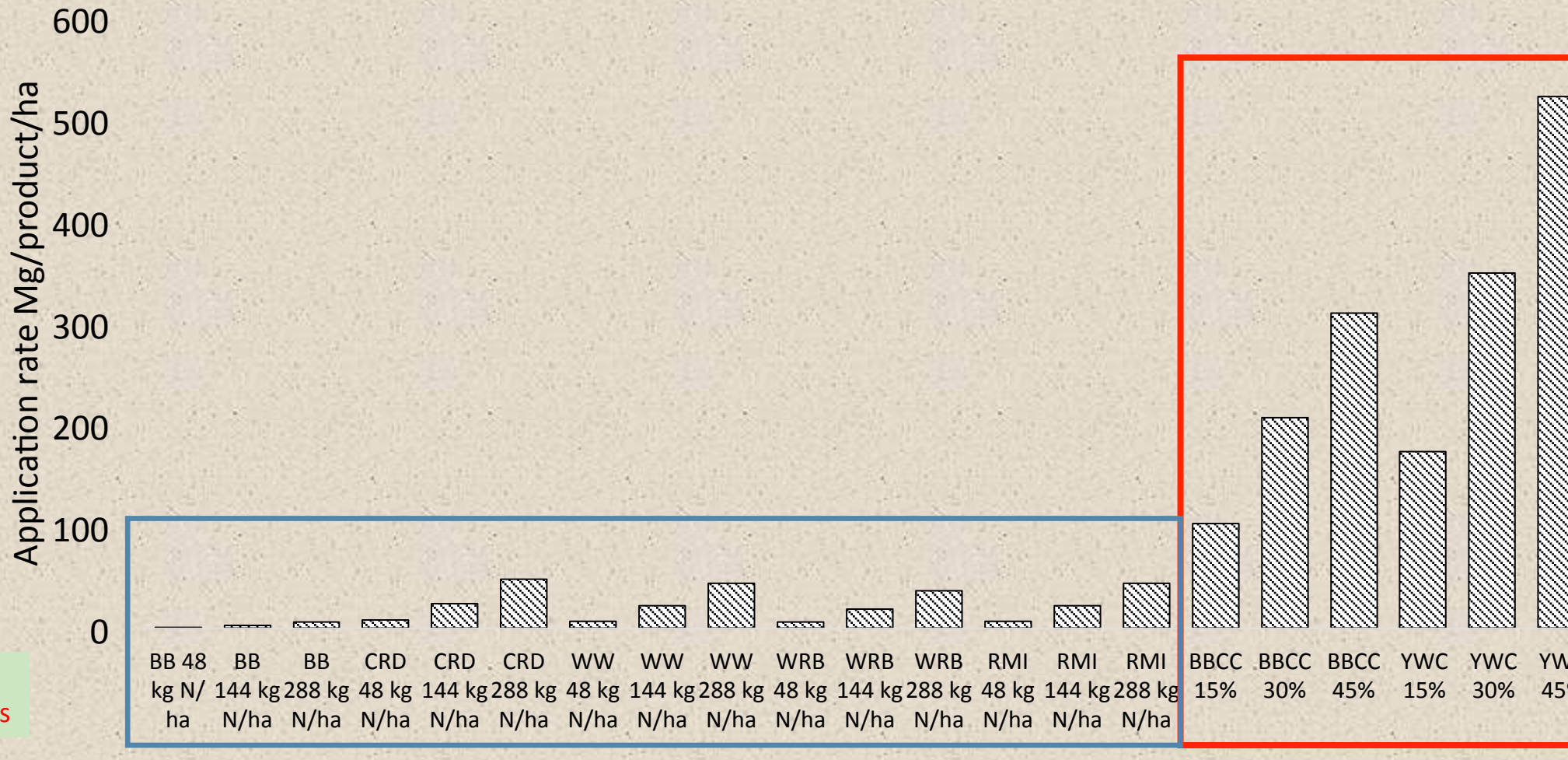

Note: Shaded area represents Least Significant Difference of Control

# Results – Soil Organic Matter Content – Composts – By Treatment



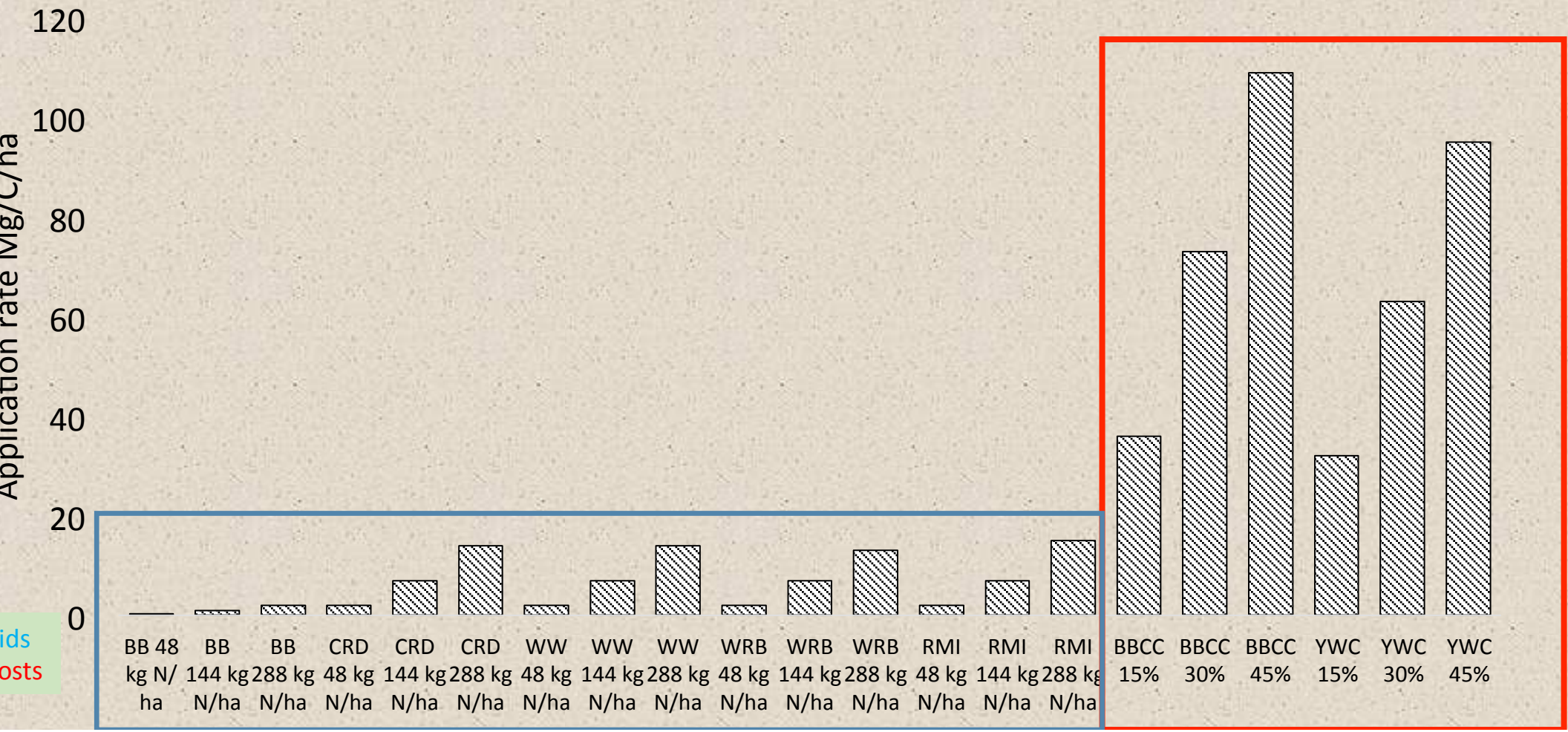

Note: Shaded area represents Least Significant Difference of Control

# Application Rate – Total Product




osolids
mposts

# Application Rate – Total Carbon

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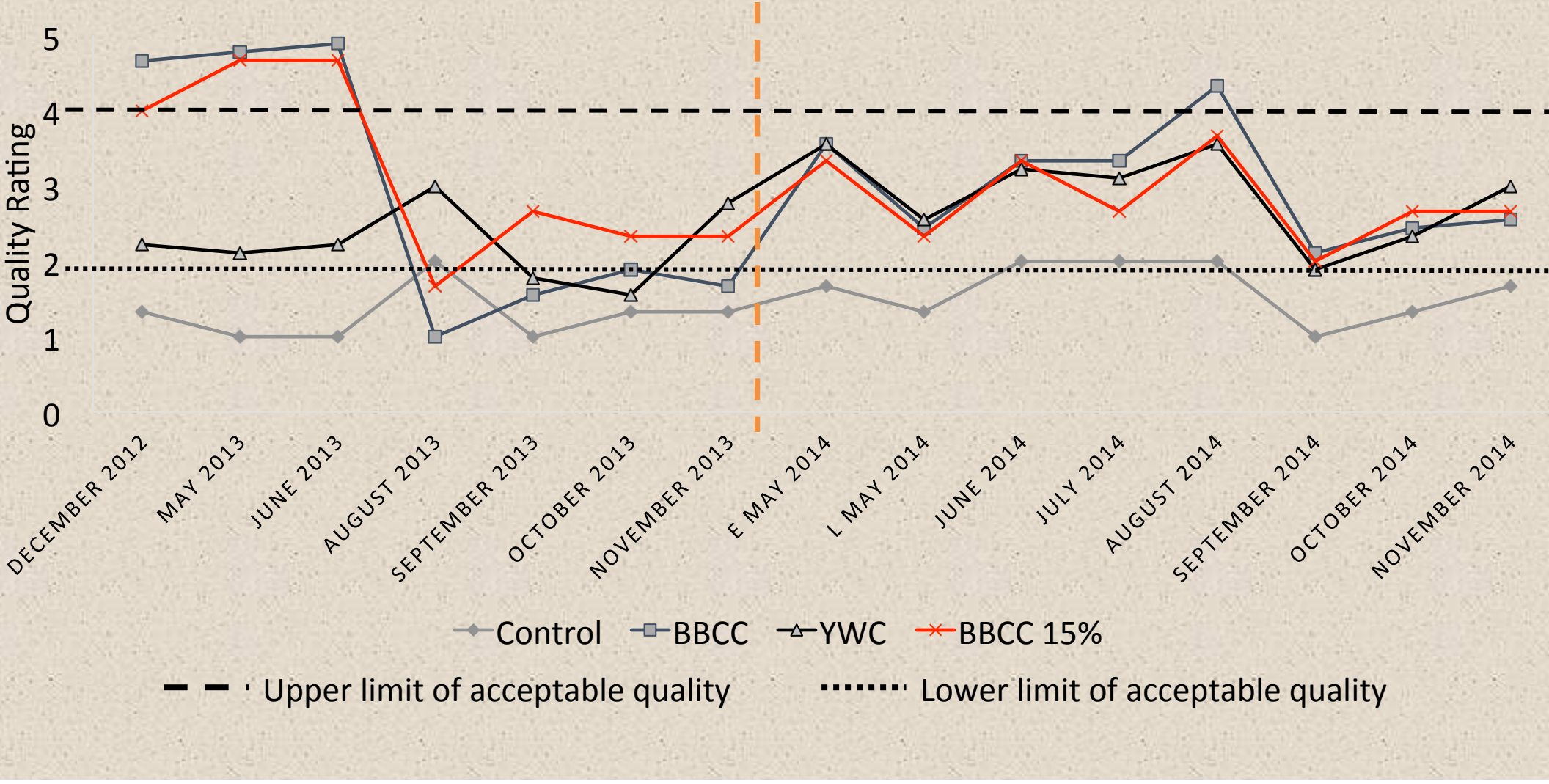
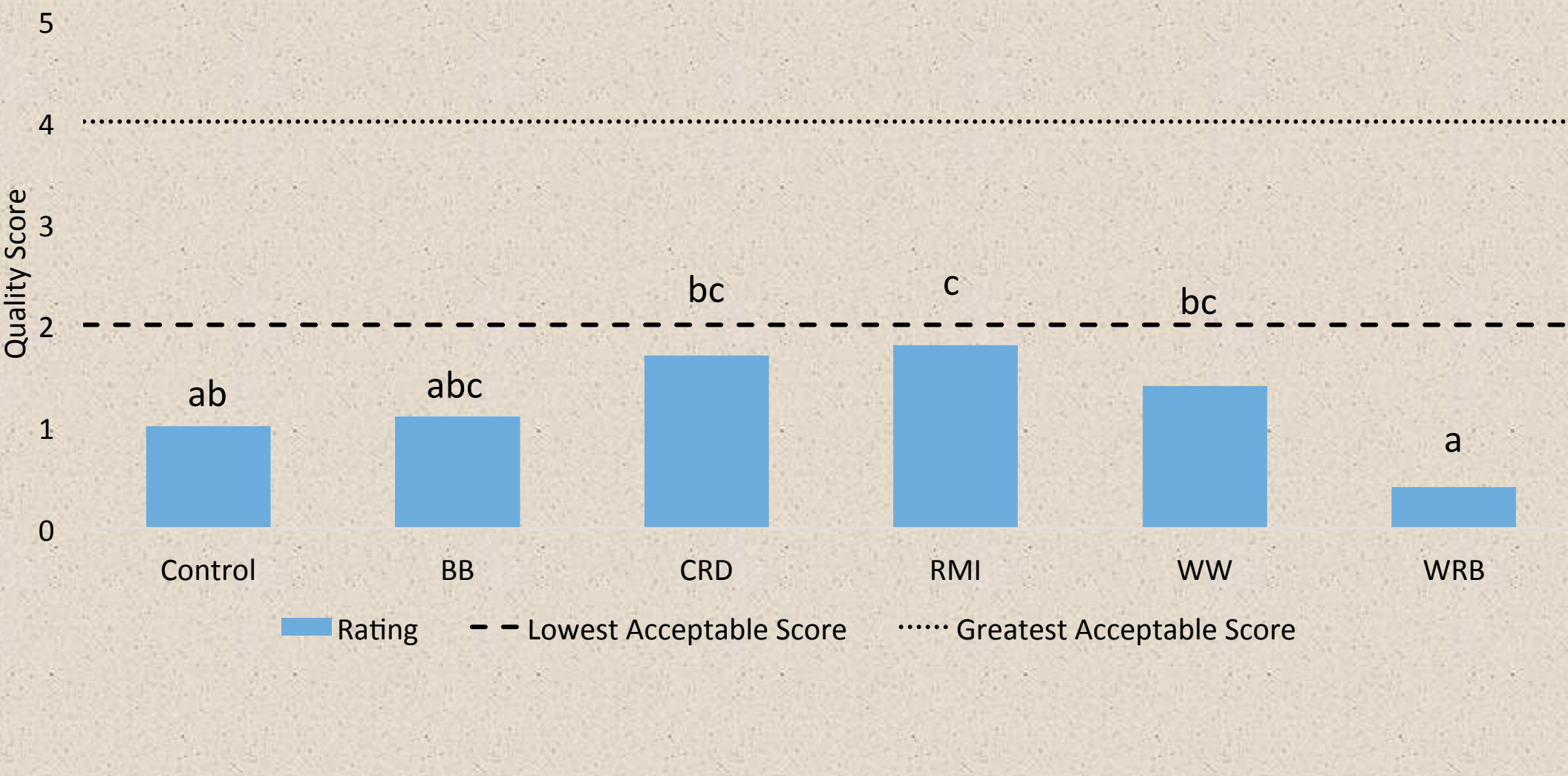
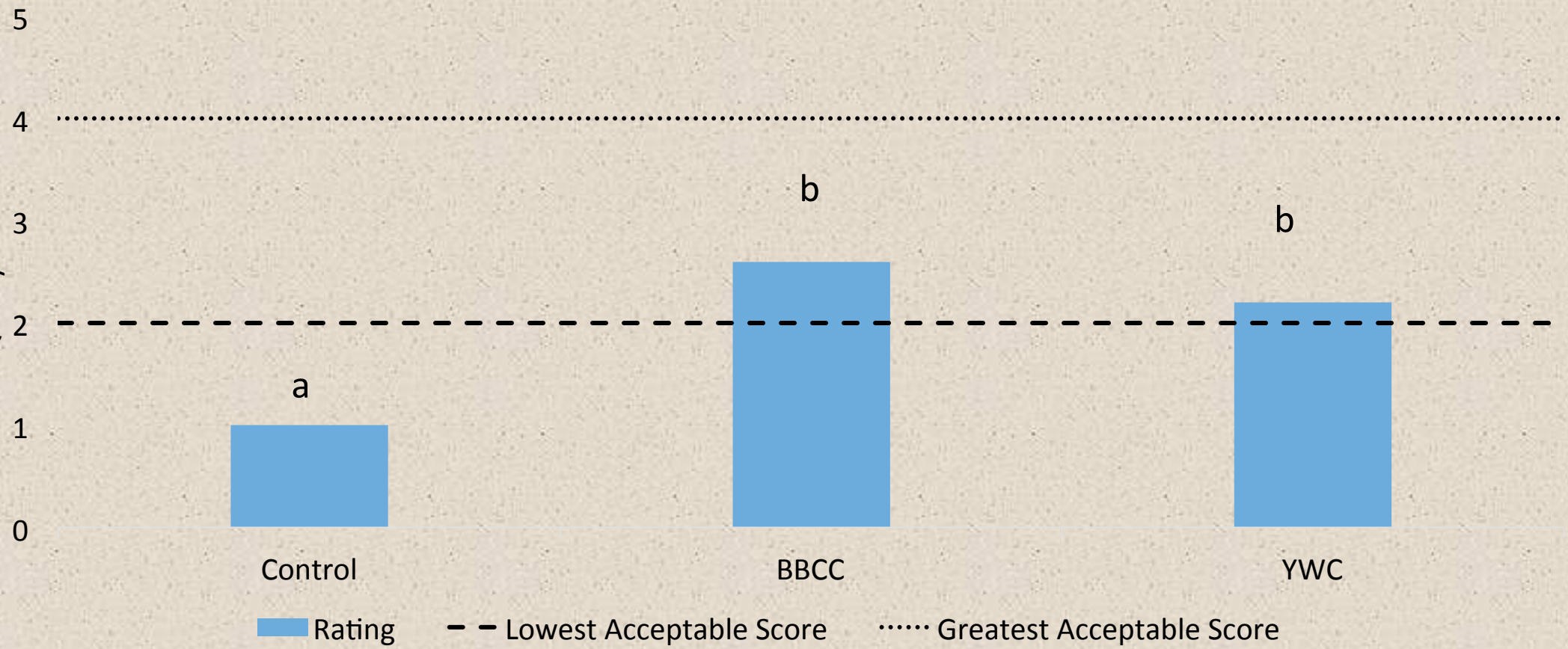
# Results – Quality – BBCC 15%



# Results - April 2015 Quality - Biosolids



# Results - April 2015 Quality - Composts



# Results – Nitrogen, pH and EC

pH and EC

- No significant differences between products and rates by 10/14.
- By 10/14 all pH and EC levels for all products at all rates with safe and acceptable ranges.

- Nitrate and Ammonium
  - Significant differences were present.
  - Nitrate spike in August 2013.
  - Nitrate and Ammonium levels in soil did not appear to explain differences in vegetation quality.

# Conclusions

Volume matters!

- Organic matter influences soil biology and chemistry.

Biosolids applied like synthetic fertilizers only have temporary benefits.

Composts applied as a soil amendment can improve vegetation and show potential for long-term benefits.

- 15% v:v sufficient
- Over-application can lead to problems.

Composts should not be treated as uniform materials.

- Different composts products should be applied based on their individual properties and not based upon guidelines for a general classification

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