

The use of Adjuvants in Aquatic Weed Control: Good idea or bad Practice?

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Talk Aims:

- Present data from glyphosate and TopFilm trials on *Phragmites*
- Discuss the benefits of aquatic approved adjuvants in a modern herbicide formulation context

Reducing Glyphosate Doses

- Glyphosate used as Roundup Pro Bio
 - (360 g/L formulation with modern surfactant in formulation)
- Target Weed: Common reed,
 - *Phragmites australis* / *P. communis* complex
- Agricultural drainage ditches
 - 6 – 12 m wide
 - 1 – 2 m deep
 - Reed fringe

Spray Application Timing

- Apply from late Summer onwards until first frosts, when flowering
 - Usually achieves about 95% control
- Earlier application will give you control in season 1, but regrowth in year 2 will be normal.



Middle Level Site



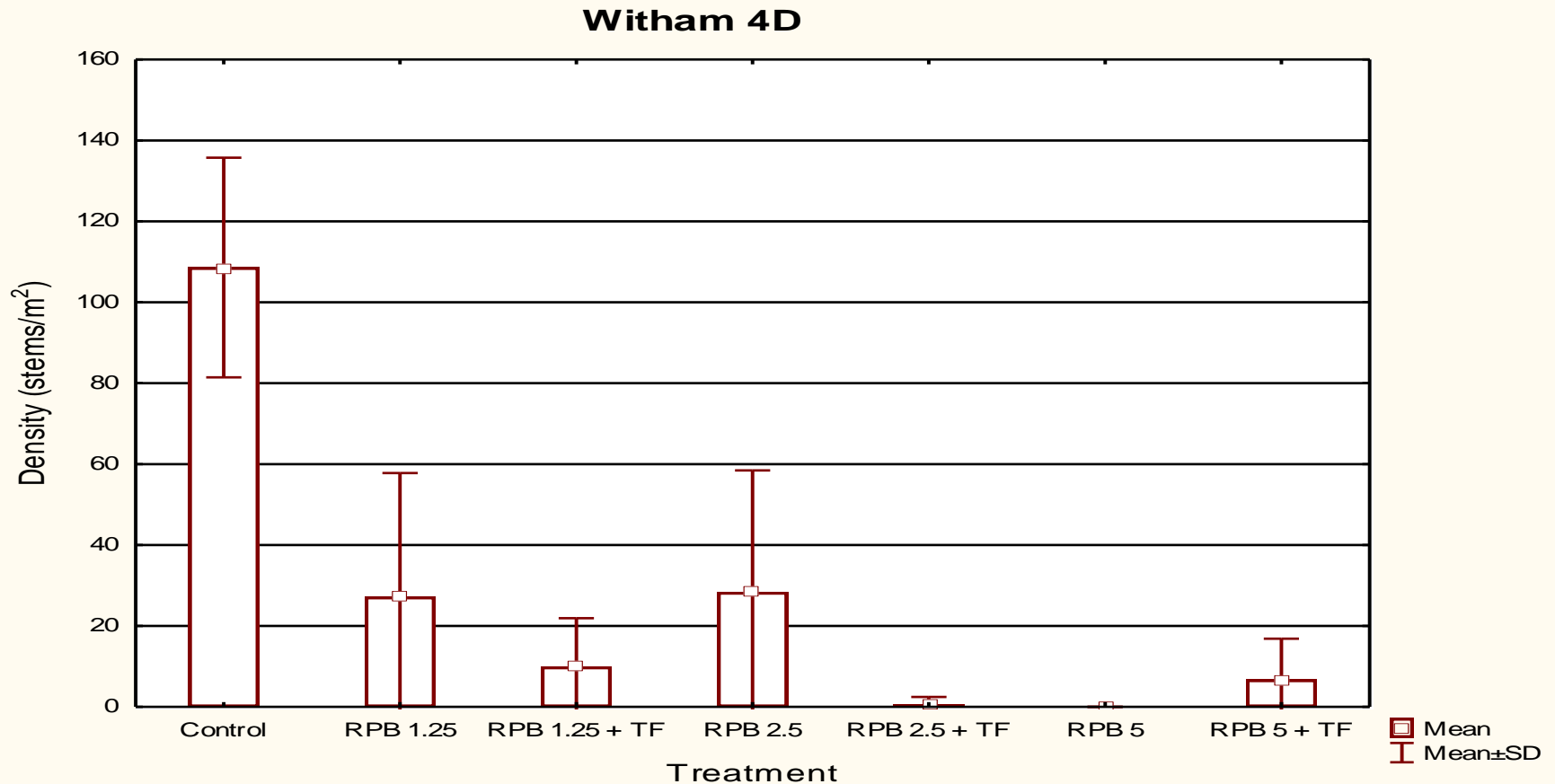
Witham 4th Site



North Level Site - after treatment

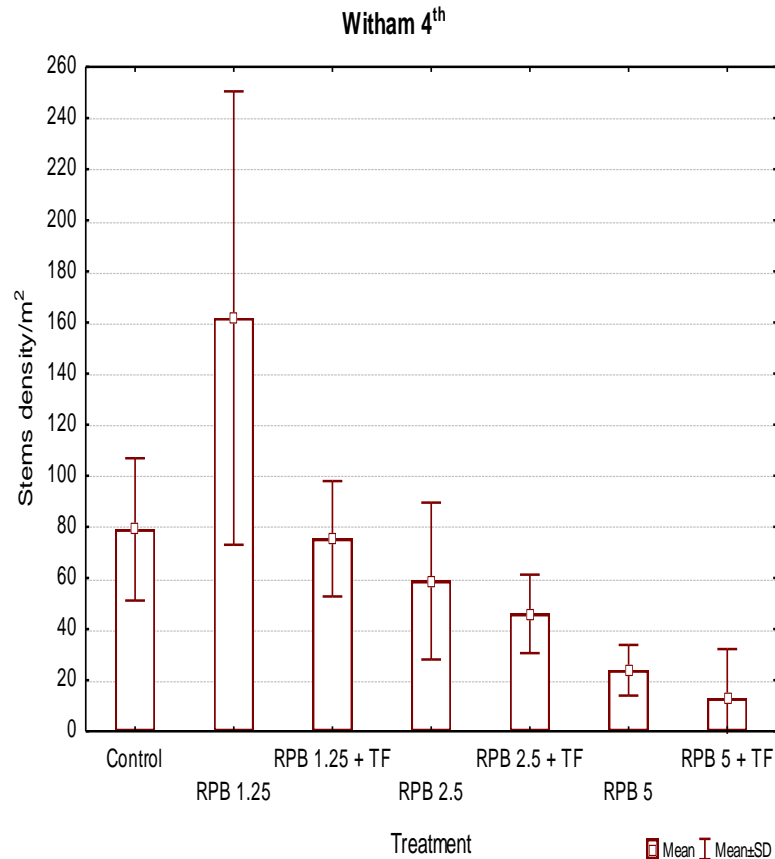


Regrowth – June 2014 (8 Months after Treatment)

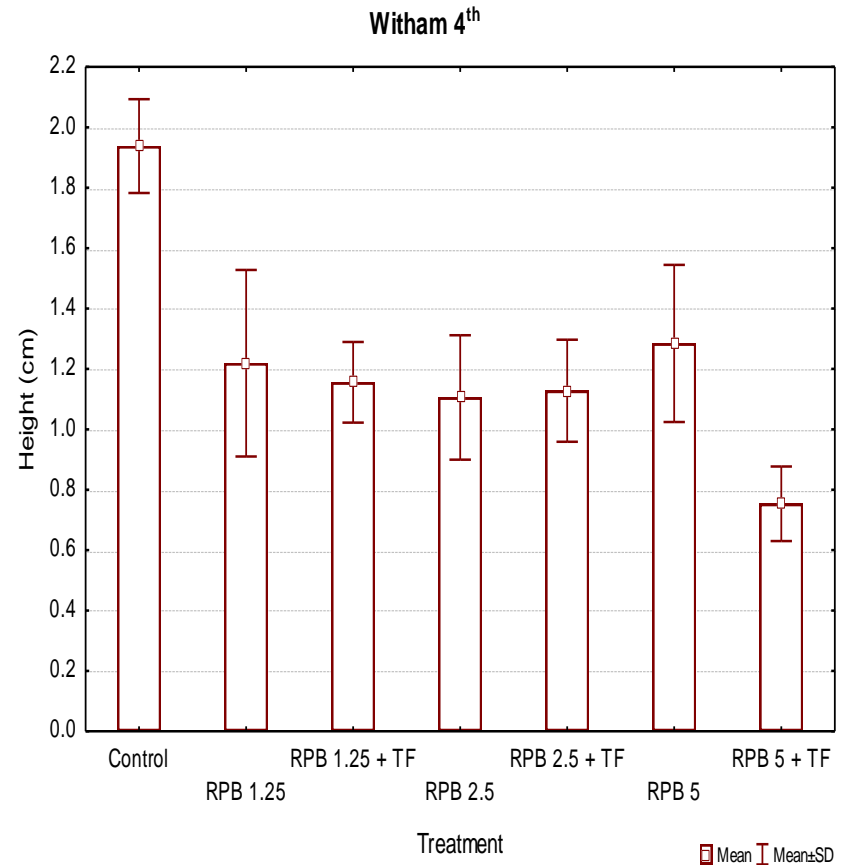


Witham 4th | Year After treatment

Stem Density

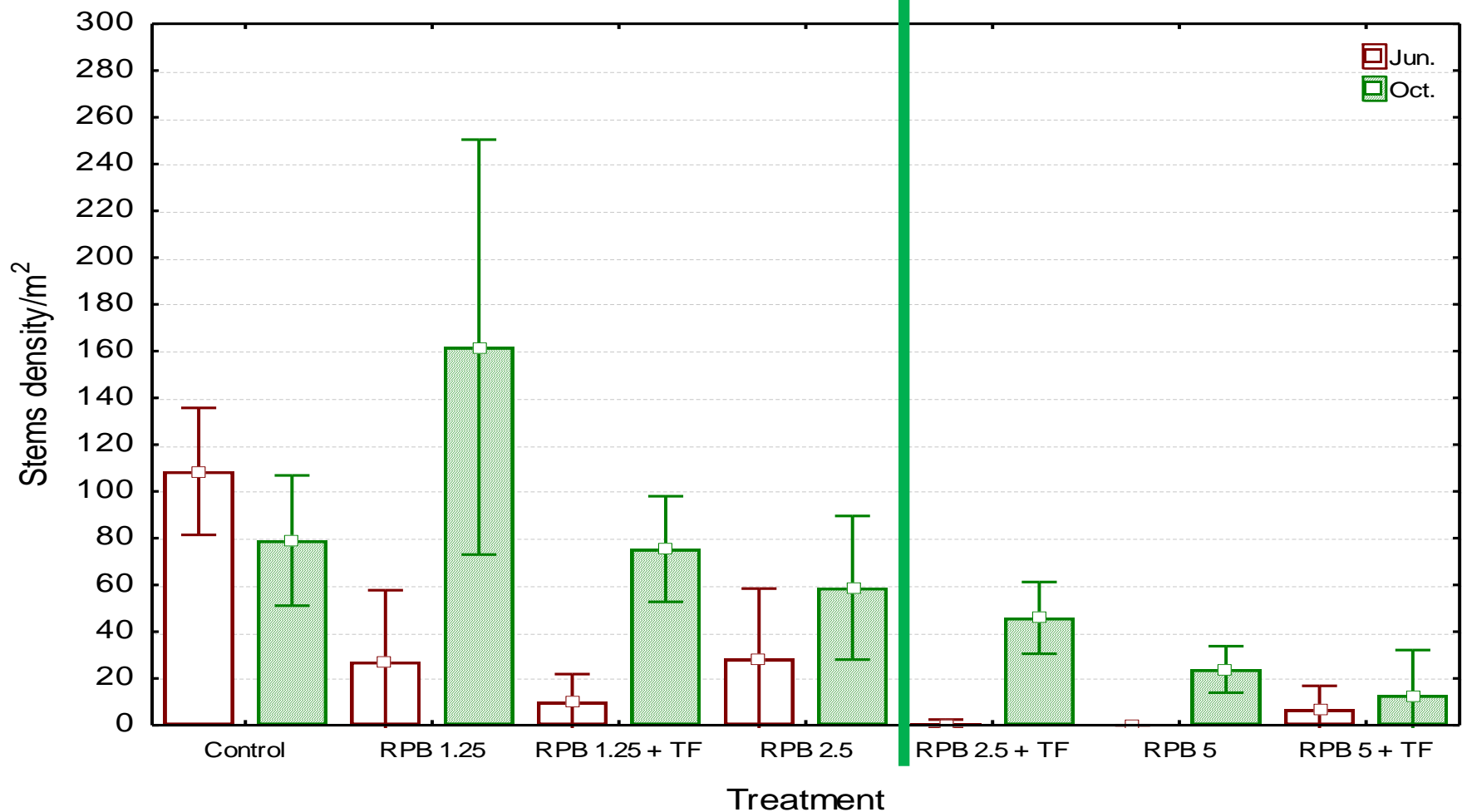


Stem Height

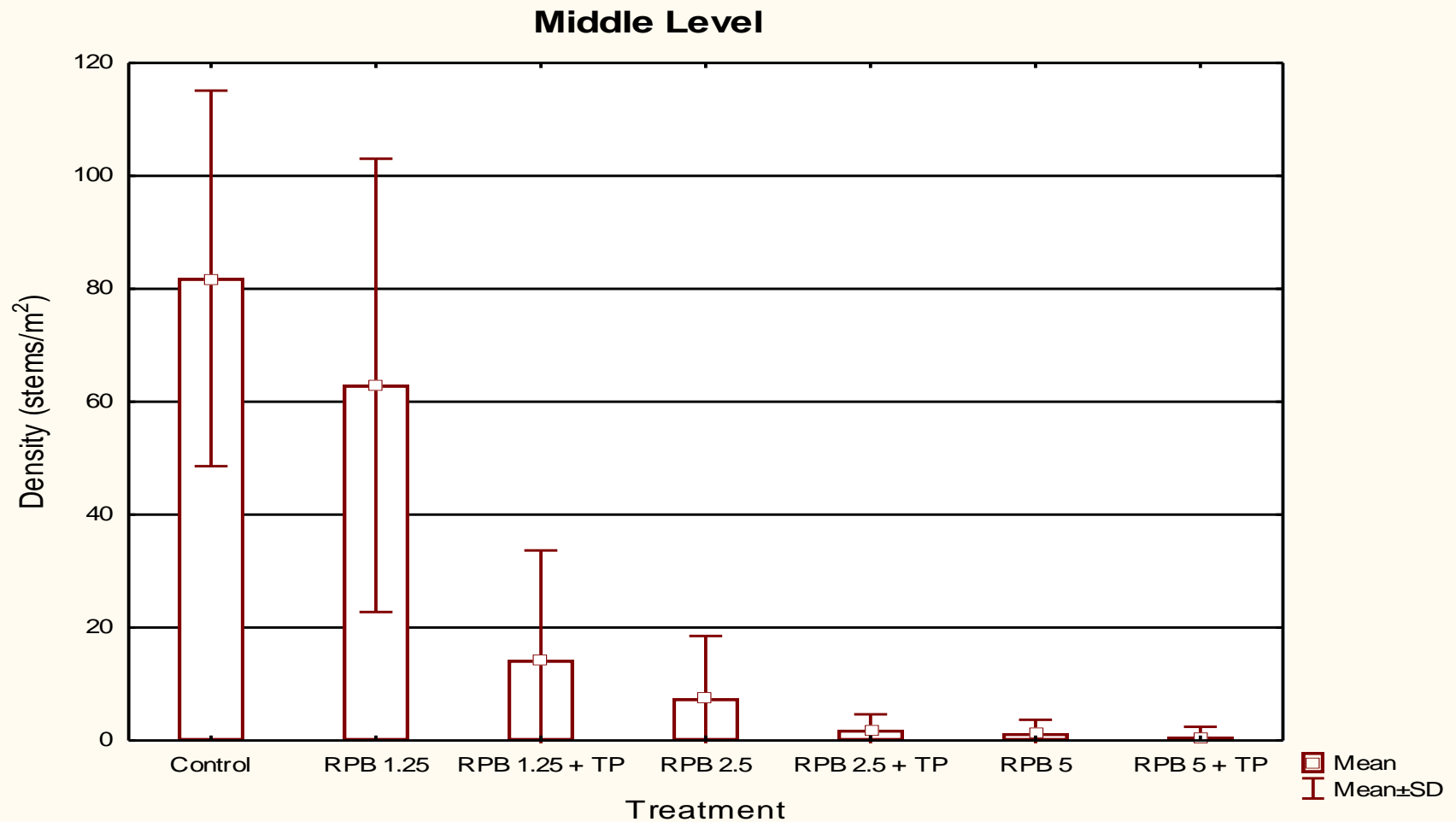


Comparison between June and October

Witham 4th

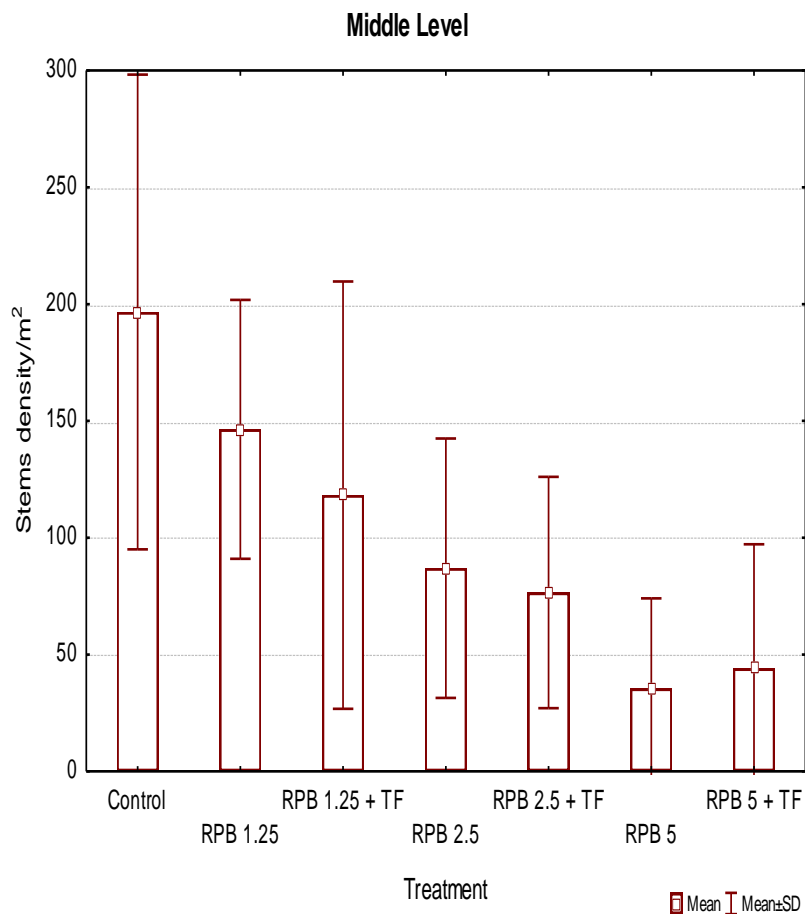


Middle Level – June 2014

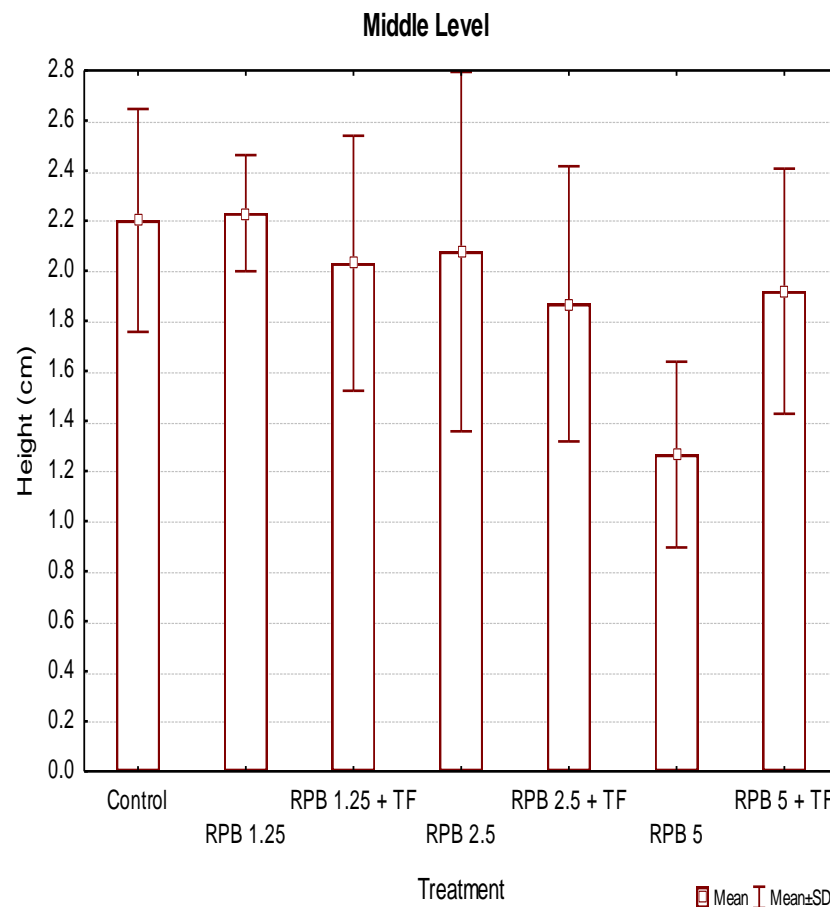


Middle Level One Year After treatment

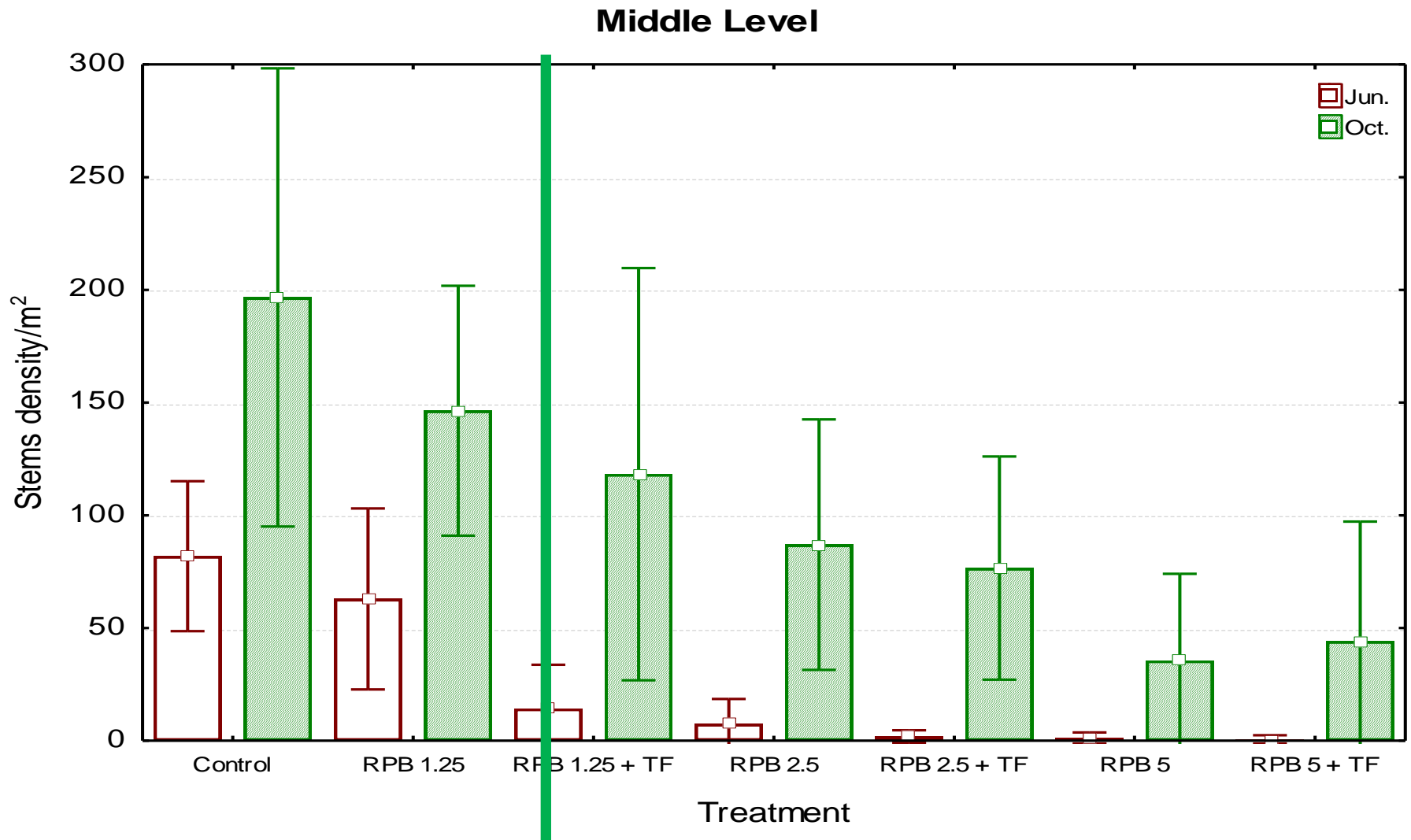
Stem Density



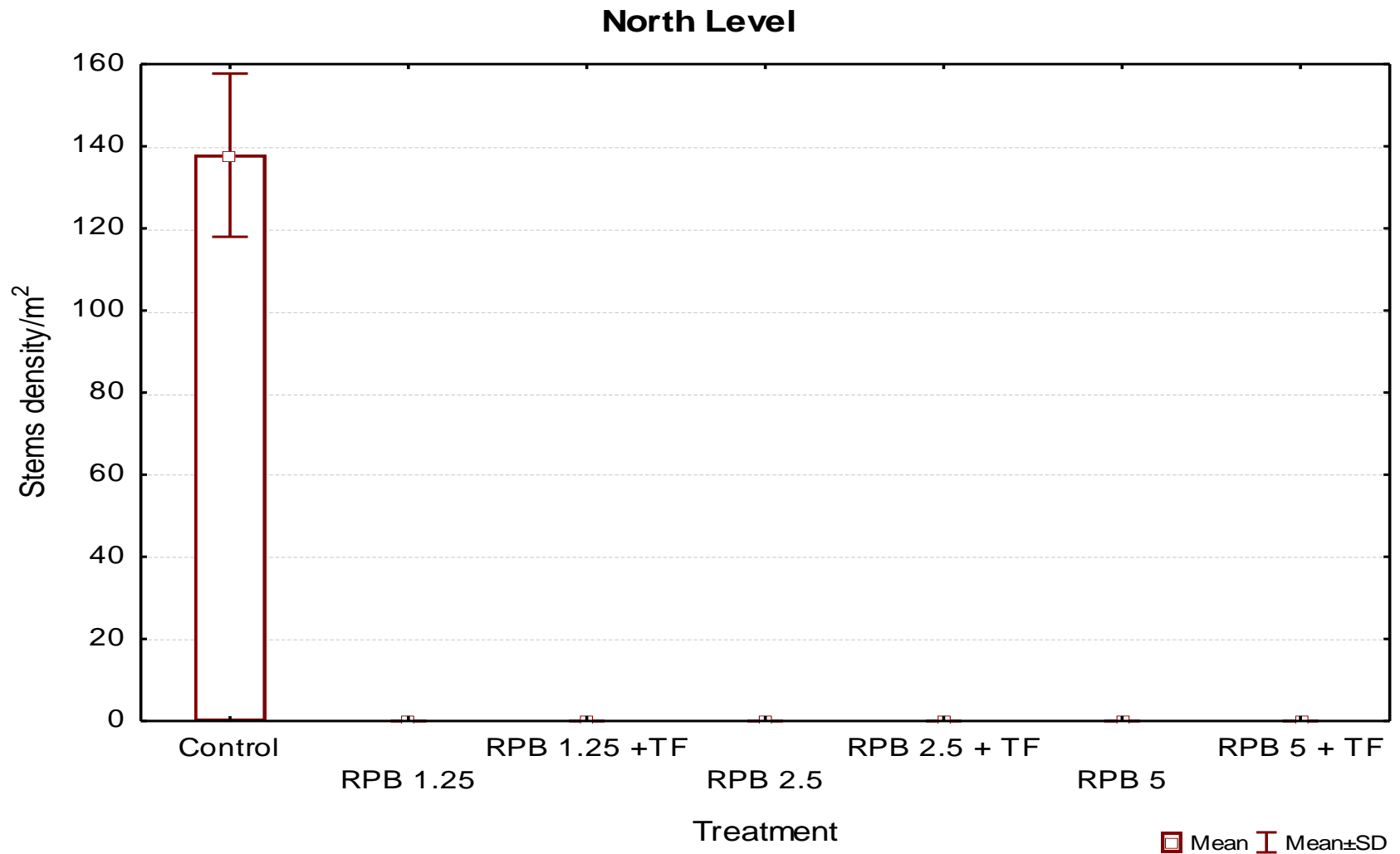
Stem Height



Stem density June and October



North Level - 1 year after treatment



Plot Differences

Witham 4th

- North facing slope
- Steep slope
- Water level well below treated zone = terrestrial



Middle Level

- South facing slope
- Shallower slope
- Reeds in water at toe of bank



North Level

- North west facing Slope
- All reeds in water when treated



Summary

- Half rate applications are no different to full rate applications (not significant)
- Quarter rate applications do not give adequate control (not significantly different to untreated control)
- Results are different at 8 months and 12 months after treatment
- Seedling recruitment in late summer means that repeat applications are required for complete control
- Unknown seed bank persistence time?

Recommendations

- Spray from Mid August to Mid November
- Can use half rate glyphosate and Full rate TopFilm
- Long term control better when standing in water
- Seedling recruitment requires retreatment annually

European Aquatic Herbicide Situation

- **No** herbicides for submerged aquatic weed control
- **No** Algaecides
- **Glyphosate** (95 products approved) for control of:
 - Water lilies
 - Emergent reeds and rushes
 - Lemna species
 - Bankside species
- **2,4-D amine** (2 products)

Glyphosate formulations

- Most approved products based on the original Roundup formulation
- Herbicide Risk Approach
 - Use the safest product for you and the environment
 - Biactive (European) formulations have much lower aquatic ecotox profiles, usually more than 125 times less toxic to fish (8 mg/L *c.f.* > 1,000 mg/L)
 - Newer products contain a combination of two surfactants with better safety profile
 - **Approximately 5 of 95 products should remain approved for aquatic use**

Environmental Quality Standard (EQS)

- The EU have requested an EQS for glyphosate as a specific pollutant as part of the Water Framework Directive
- Set the level at the lowest effect level in the literature,
 - 196 $\mu\text{g/L}$ Long term mean (annual average)
 - 398 $\mu\text{g/L}$ Short term 95th %tile (spot check)

Why might this cause problems?

- Normal application rates result in potential concentration of 216 $\mu\text{g/L}$ in water 1 m deep at 6 L/Ha
- Therefore a small problem with long term, but no problem with short term...
- Ignores:
 - Spray on to target plant not water surface (interception rate)
 - Retention on target leaf
- Most applications at 5 L/Ha = 180 $\mu\text{g/L}$, so within limits
- **Political Problem** with an EQS that does not have any effect.....

What's The Purpose of the EQS?

- Reduce pesticide load to water
- Take steps to comply with the spirit of the EQS
 - Reduce maximum dose rates
 - possible
 - Reduce application frequency
 - possible
 - Use an alternative product
 - Not possible in EU

Reduce dose rates

- **Use less product**
 - Loss of efficacy
 - Off-label use
 - Resistance
- **Use adjuvants**
 - Increase efficacy of low doses
 - Modify uptake or retention on leaf
 - Stick herbicides to submerged plants

Caution.....

- EU has national adjuvant database system
 - Registration required for product in each of 28 countries
- Only country to have registered adjuvants for aquatic weed control in EU is UK
 - Most European adjuvants are incorporated into the formulations
 - Most American adjuvants are tank mixed

More Caution...

- Application rates of adjuvants for sub-surface weed control are usually much higher than for emergent or terrestrial weeds
- Application rates of adjuvants to submerged weeds often exceed or are close to observed LC_{50} values
 - No safety margin of 10 x Predicted Environmental Concentration (PEC)
- Decomposition rates of adjuvants and hydrolytic decomposition products less well (or not at all) studied
 - Long term accumulation

What are we (they) looking for?

- **Green Adjuvants (OECD)**
- **Manufacturing Approach**
 - Renewable raw materials
 - Renewable energy
- **Environmental Impact Approach**
 - If they have a low human and environmental impact,
 - If they do not increase active ingredient environmental mobility and/or toxicity to humans and non-target organisms,
 - If they do not increase the exposure to these active substances
 - And if they lower the impact of formulated pesticides by enhancing the performance of active ingredients, thus potentially lowering the required dosage of active ingredients.

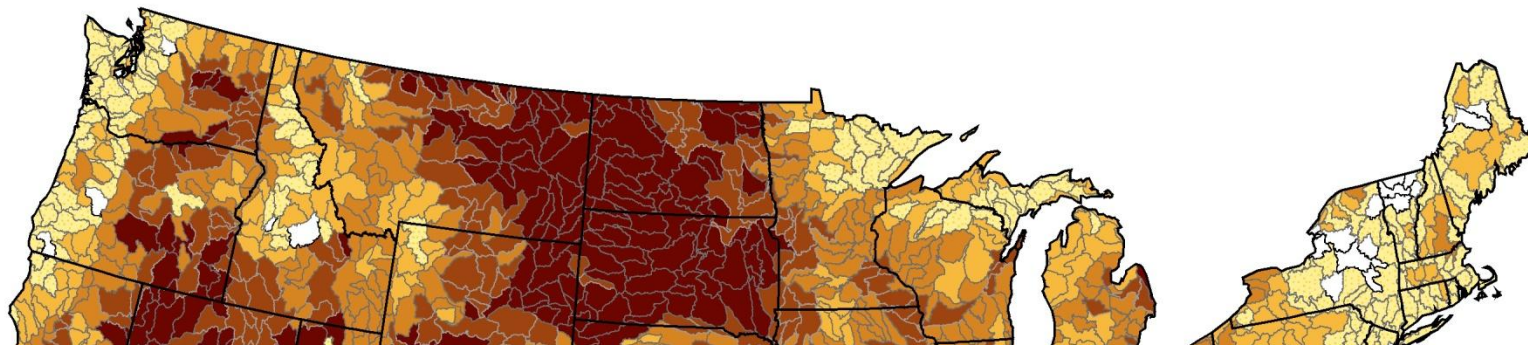
Lack of Research

- Only 10 papers retrieved by Web of Science on adjuvant* AND aquatic AND weed AND control
- But 3,340 from Google Scholar (or about 50 useful ones)
- And only 5 from Scopus
- **166 from APIRS**
 - These are the ones I need to read
- 1,572 papers on aquatic weed control and herbicides in Web of Science (948 on APIRS)
 - 0.63% or 17.5%

The Hippocratic Oath for adjuvants

- Do No Harm
- Answer to the question:
 - Very Good Idea
 - Current Bad Practice

Percentage of Intermittent Stream Length by Watershed

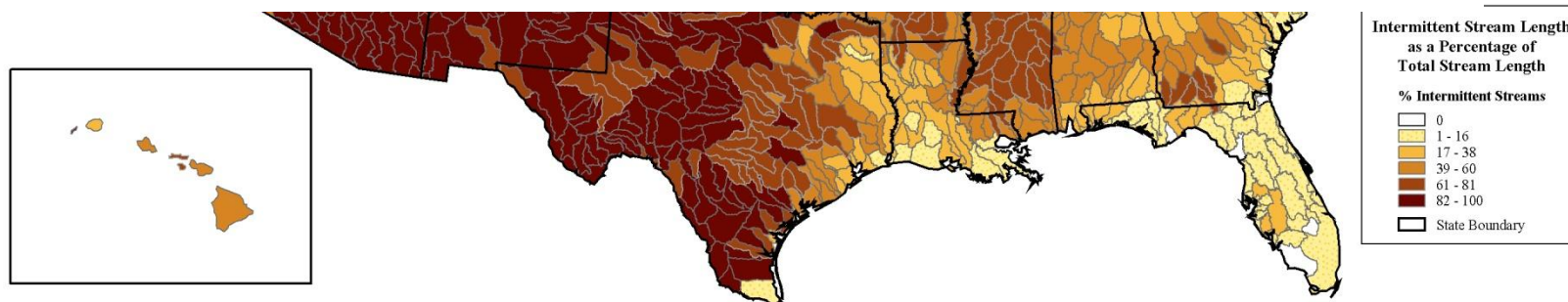


5,484,159 km total stream length

43,300 km² total stream area

131,619 km² Riparian buffer strip

46,496 km² Total water surface area (excl Great Lakes)



Legend: This map shows the percentage of intermittent and ephemeral streams, relative to total stream length, within each watershed. This analysis highlights the regional pattern of intermittent and ephemeral stream occurrences in the United States, excluding Alaska, where NHD data are not available. In the 49 states there are 5,484,159 total kilometers of linear streams, of which 59% (3,212,641 km) are intermittent and ephemeral. Based on data from the National Hydrography Dataset at medium resolution. The value ranges in the key were devised to reveal underlying groupings and patterns in the data displayed on the map. One mile is equal to 1.61 kilometers.

Source Data:

- NHD from Reach Address Database (RAD) v2.0 at 1:100,000 scale using 8 digit HUC watersheds.
- Intermittent and ephemeral streams grouped together.

Caveat:

- NHD data generally does not capture streams under one mile in length.

“The critical ability to enhance management programs and to continue to develop new control methods is steadily being eroded through lack of long term funding arrangements, and unless these are reversed a life sustaining heritage – the nations priceless water resources – will be severely or irreparably degraded and lost”

Legend: This map shows the percentage of intermittent and ephemeral stream occurrences in the United States, excluding Alaska, where NHD data are not available. In the 49 states there are 5,484,159 total kilometers of linear streams, of which 59% (3,212,666) are intermittent and ephemeral streams. Based on data from the National Hydrography Dataset at medium resolution. The value ranges in the key were devised to reveal underlying groupings and patterns in the data displayed on the map. One mile is equal to 1.61 kilometers.

CAST Commentary: benefits of controlling nuisance aquatic plants and algae in the United States
Getsinger *et al.* (2014)



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Source Data:

NHD from Reach Address Database (RAD) v2.0 at 1:100,000 scale
- NHD data generally does not capture streams under 0.5 miles in length
- IUC watersheds
- ephemeral streams grouped together.

Caveat:

- NHD data generally does not capture streams under 0.5 miles in length

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