

How do agronomic management practices affect potential soil nitrogen mineralization?

A meta-analysis

Navreet K. Mahal, Fernando E. Miguez and Michael J. Castellano

Department of Agronomy, Iowa State University, Ames, IA (50011)

IOWA STATE UNIVERSITY
Department of Agronomy



INTRODUCTION

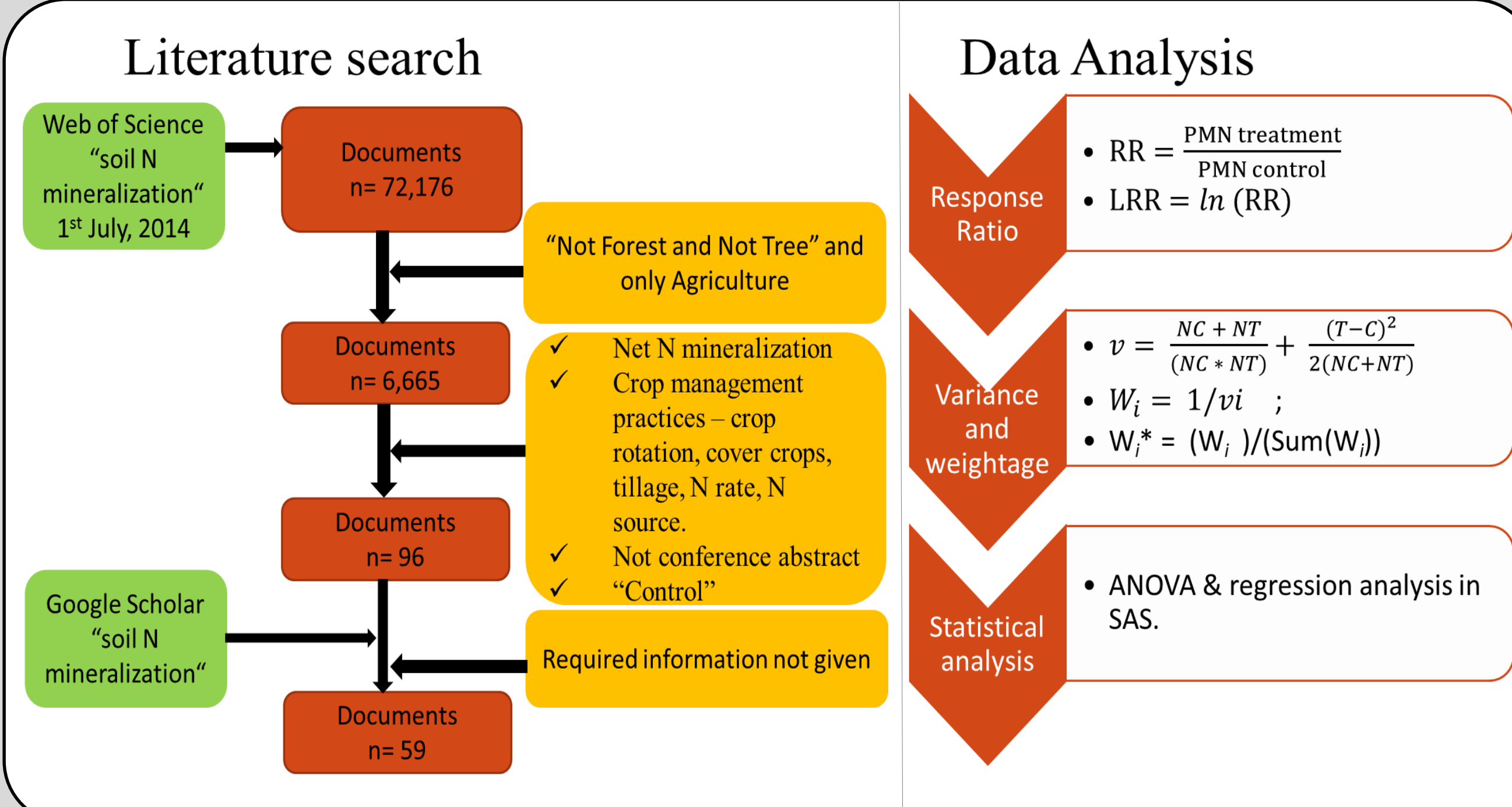
Potential Mineralizable Nitrogen (PMN) is the fraction of organic nitrogen (N) converted to inorganic forms.

- PMN is estimated by aerobic and anaerobic methods by determining net change in soil inorganic N pool size over time.
- PMN has been positively related to crop yield and proposed as an indicator of soil health.
- In fertile soils, mineralized N from soil organic matter is the dominant source of N for plant uptake even when N fertilizer is applied.
- Importantly, PMN has been indirectly managed through agronomic practices such as tillage and crop rotations, however, the overall effect remains unknown.

OBJECTIVE

Examine the effect of various conservation agriculture practices on PMN.

METHODOLOGY



HYPOTHESES

Hypotheses

- **Fertilizer:** inorganic fertilizer will increase PMN due to higher crop residue input and manure increases the soil organic matter
- **Tillage:** will increase PMN due to higher soil-residue contact and soil aeration
- **Cropping system diversity:** higher crop diversity will increase PMN due to different properties and amount of residue, nutrient status of the soil and different management strategies
- **Cover crops:** will increase PMN due to additional crop residue inputs

Evaluations:

Tillage: Chisel plow/no-till and moldboard plow/no till

Fertilizer: Inorganic fertilizer/no fertilizer, manure/no manure, compost/no-compost and inorganic + manure/no fertilizer

Crop sequence: Two crops/continuous cropping system, corn-soybean/continuous corn, three or more crops/continuous cropping system and three or more crops/two crops in rotation

Cover crop: Legume cover crop/no cover crop, non-legume cover crop/no cover crop and mixture of legume and non-legume cover crop/no cover crop

RESULTS

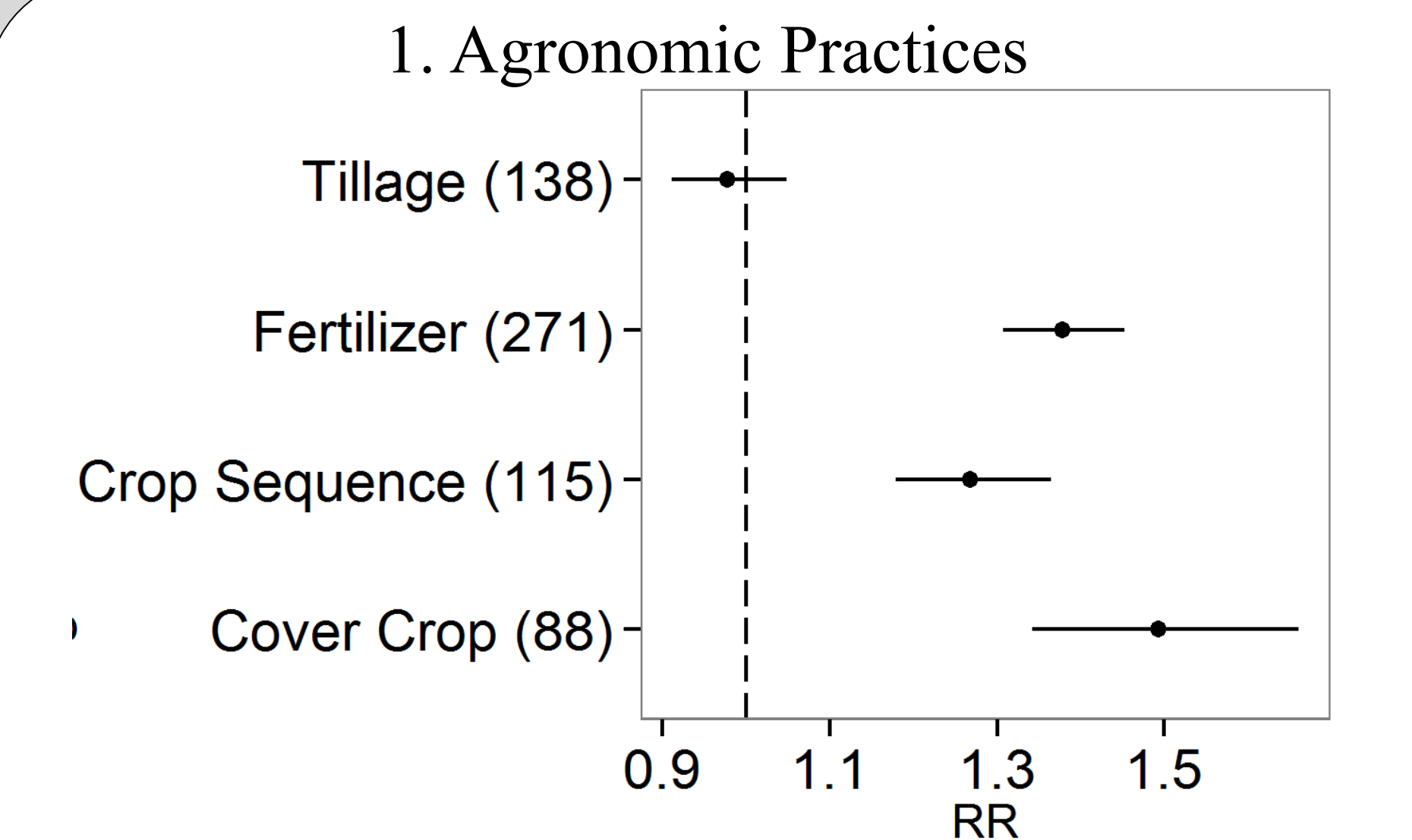


Figure 1. Mean response ratio and 95% confidence interval for four different Agronomic practices. The number of observations are displayed in parentheses.

- Tillage had no overall effect.
- Fertilizer addition increased PMN by 38%.
- Higher crop diversity increased PMN by 27%.
- Cover crops increased PMN by 49%.

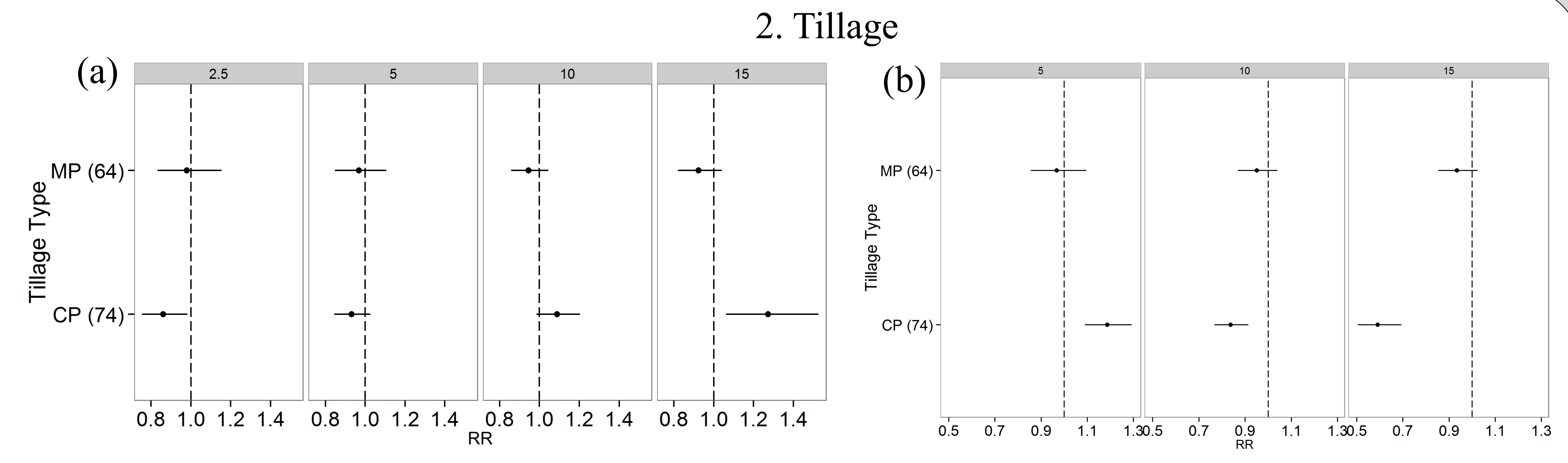


Figure 2. (a) Mean response ratio for two tillage types: chisel plow (CP) and moldboard plow (MP) at 2.5, 5, 10 and 15 cm soil depth. (b) Mean response ratio for tillage types after 5, 10 and 15 years of study.

- Moldboard plow had no effect as compared to no-till across all depths.
- In the top 2.5 cm, chisel plow was 14% lower while at 15 cm depth it was 28% higher than no-till.

- No effect of moldboard plow as compared to no-till.
- After 5 years chisel plow was 19% higher, while after 10 and 15 years it was 16 and 41% lower PMN than no-till system.

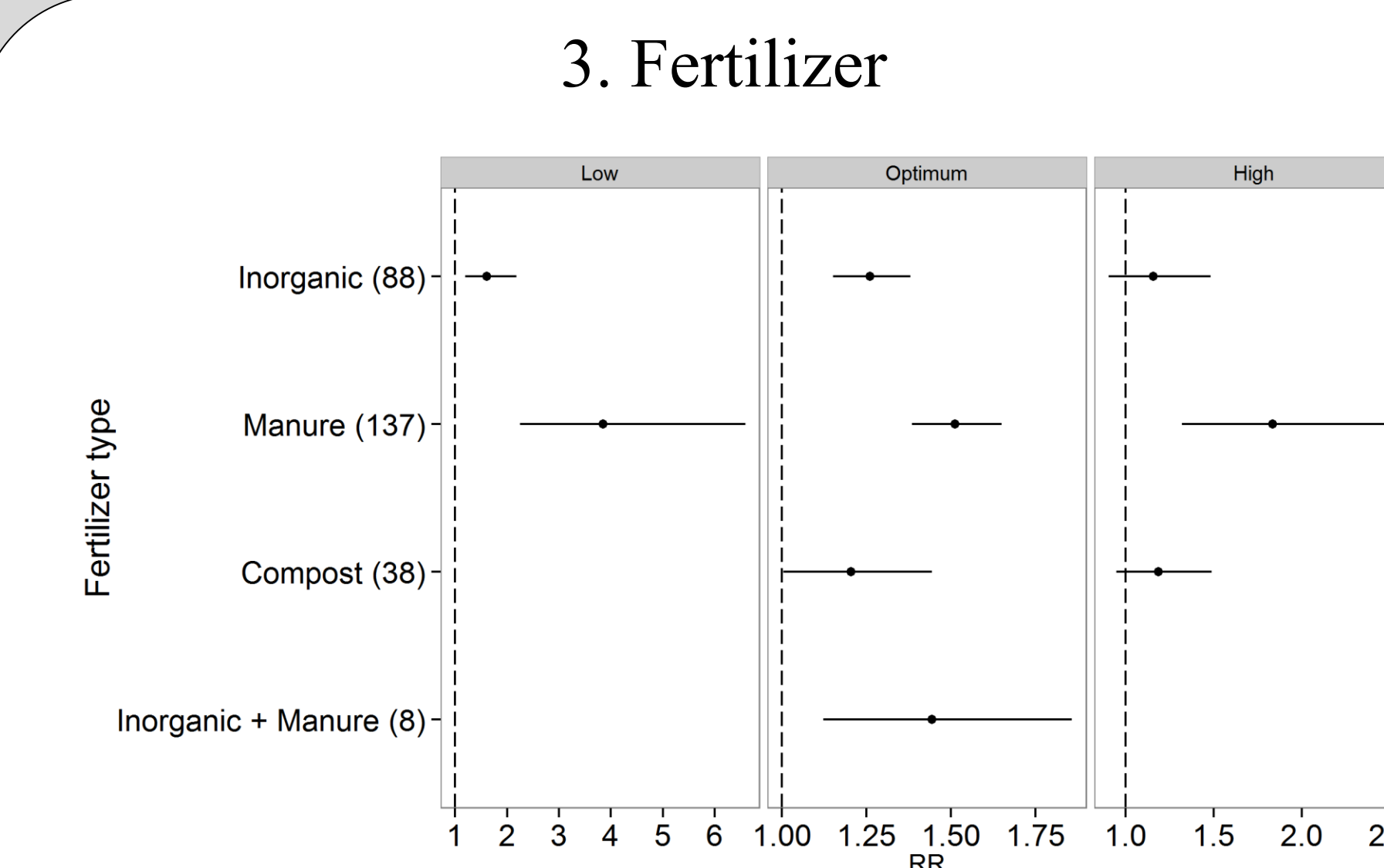


Figure 3. Mean response ratio for four fertilizer types at low, optimum and high nitrogen application rates.

- Manure & inorganic fertilizer increased PMN by 57 & 26%, respectively at optimum N rate.
- Combined application of inorganic N fertilizer and manure had a positive effect and compost had no effect on PMN.

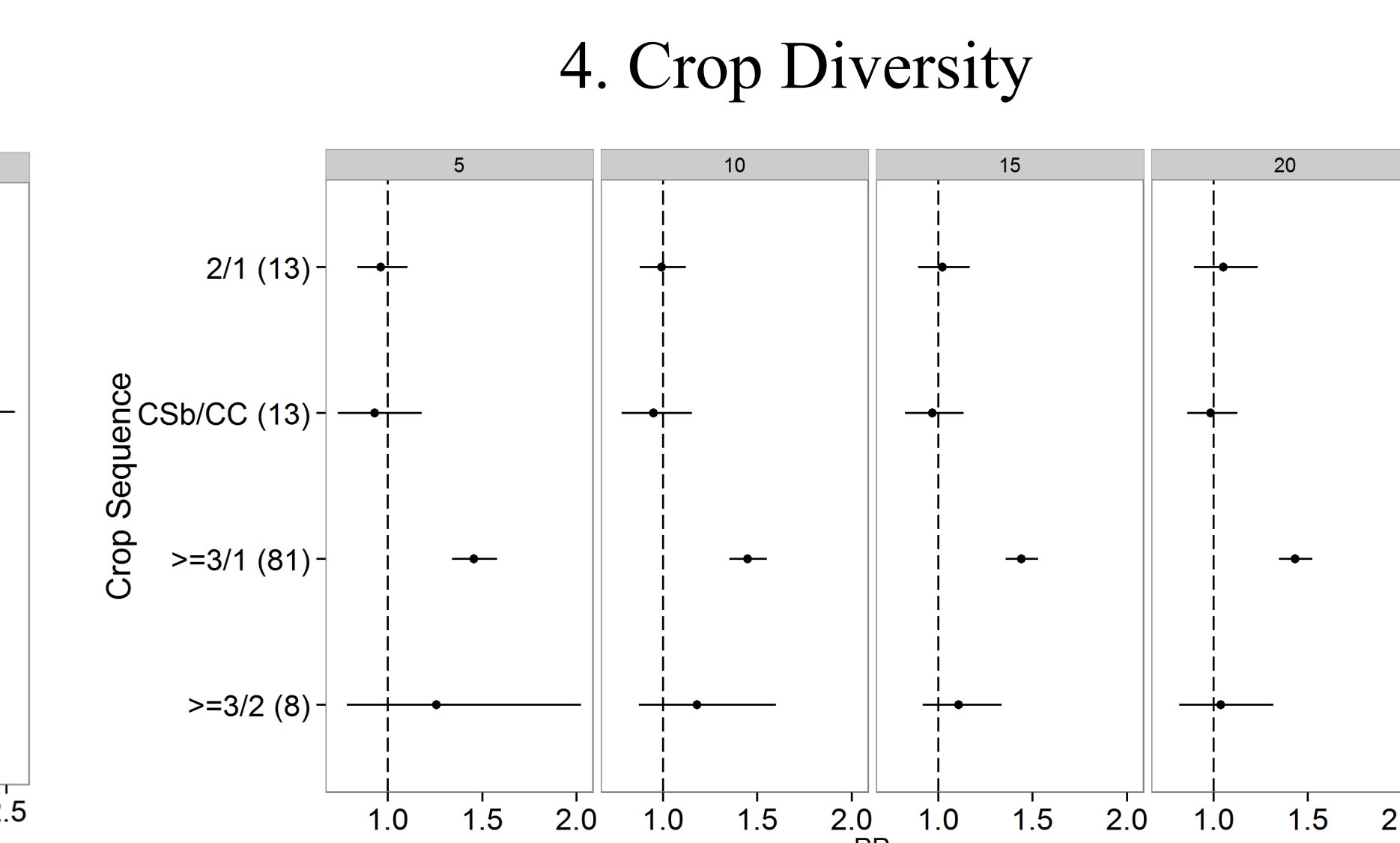


Figure 4. Mean response ratio for two crops in sequence (2/1), corn-soybean (CSb) and three or more crops ($\geq 3/1$) vs monoculture and 3 or more crops ($\geq 3/2$) vs two crops in sequence.

- Monoculture and 2 crops in rotation did not affect PMN.
- ≥ 3 crops increased PMN by 44% compared to monoculture, but had no effect when compared with two crops in rotation.
- No effect of duration of study.
- Effect of ≥ 3 crops evident from initial years.

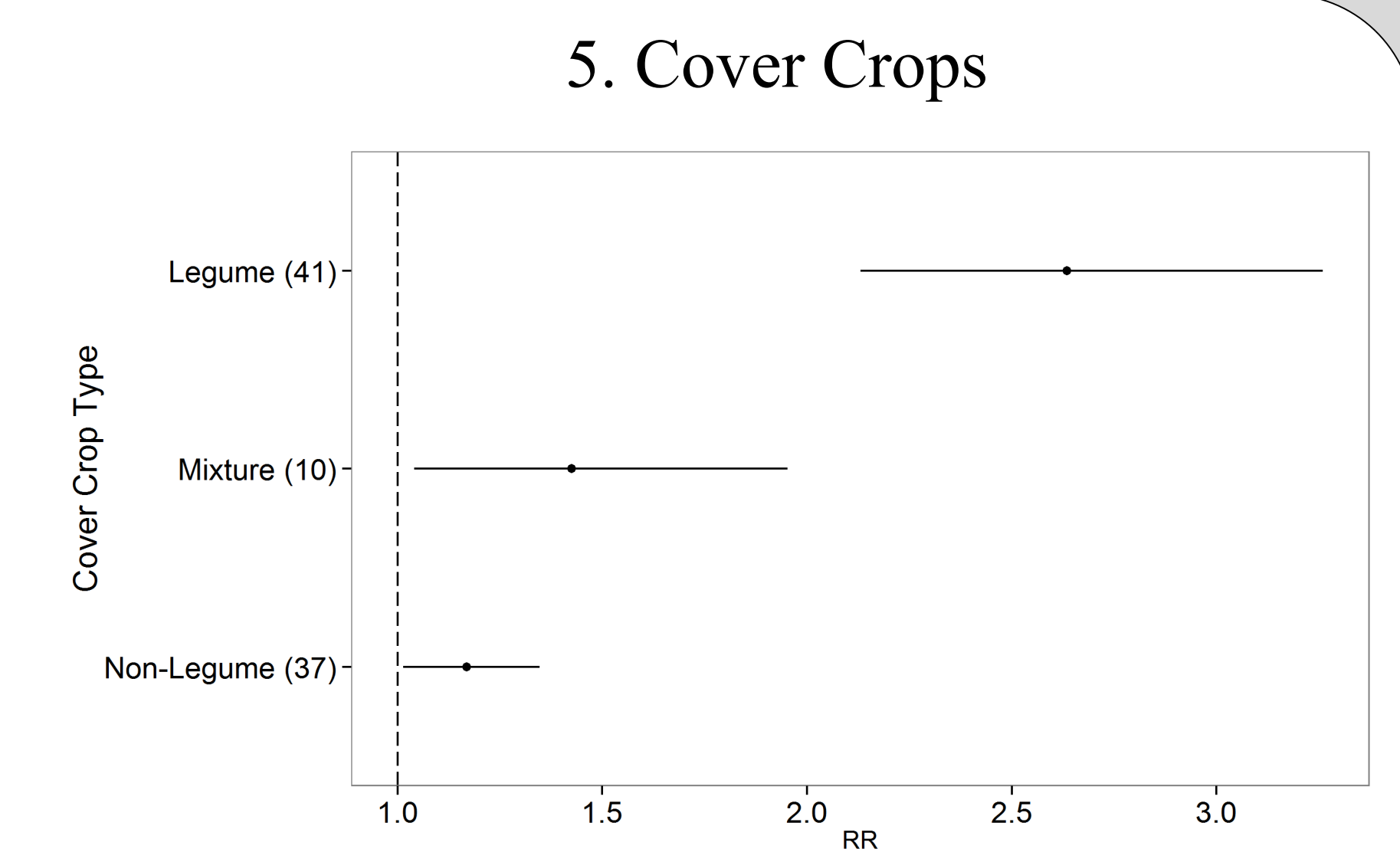


Figure 5. Mean response ratio for different cover crop types.

- Legume cover crops increased PMN by 164% as compared to no cover crop.
- Non legumes 17% higher than no cover crop.
- Mixture of legumes and non-legumes increased N mineralization by 42%.

CONCLUSION

Conservation crop management practices such as fertilizer N and manure addition, crop rotation with three or more crops, cover crops and reduced tillage can increase PMN.

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nmahal@iastate.edu ;
femiguez@iastate.edu;
castelmj@iastate.edu