



Amending Soil with Combinations of Biochar and Manure: Impacts on Soil Properties, Barley Yield, and Nutrient Uptake



Ryan Hangs and Jeff Schoenau

Department of Soil Science, University of Saskatchewan, Saskatoon, SK

INTRODUCTION

- The utility of biochar to improve numerous soil physical, chemical, and biological properties (e.g., bulk density, cation-exchange capacity, pH, microbial community activity, etc.) is well known.
- However, previous research has concentrated on tropical soils (old and highly-weathered, acid pH, low organic matter content and fertility), while the influence of biochar application on the relatively young and fertile soils of Saskatchewan is largely unknown.

OBJECTIVE

- Examine the effects of two willow (*Salix*) biochar amendments on soil nitrogen (N) and phosphorus (P) supply and barley growth and nutrient uptake with, and without, the addition of animal manures.

MATERIALS & METHODS

- A split-plot experimental design was used in field trials to grow barley (*Hordeum vulgare* L.; cv. Austenson) on two contrasting soils: Orthic Brown Chernozem (Ardill Association; Class 4) and Orthic Humic Vertisol (Melfort Association; Class 1).
- Whole plots: 100 kg N/ha as solid cattle or liquid hog manure. Split-plots: 8 Mg C/ha as willow 'chunky' or 'powder' biochar (produced using slow and fast pyrolysis, respectively).
- Variables measured included: soil pH, EC, and bulk density; PRS™-probe N and P supply rates; and barley yield and N uptake.

RESULTS

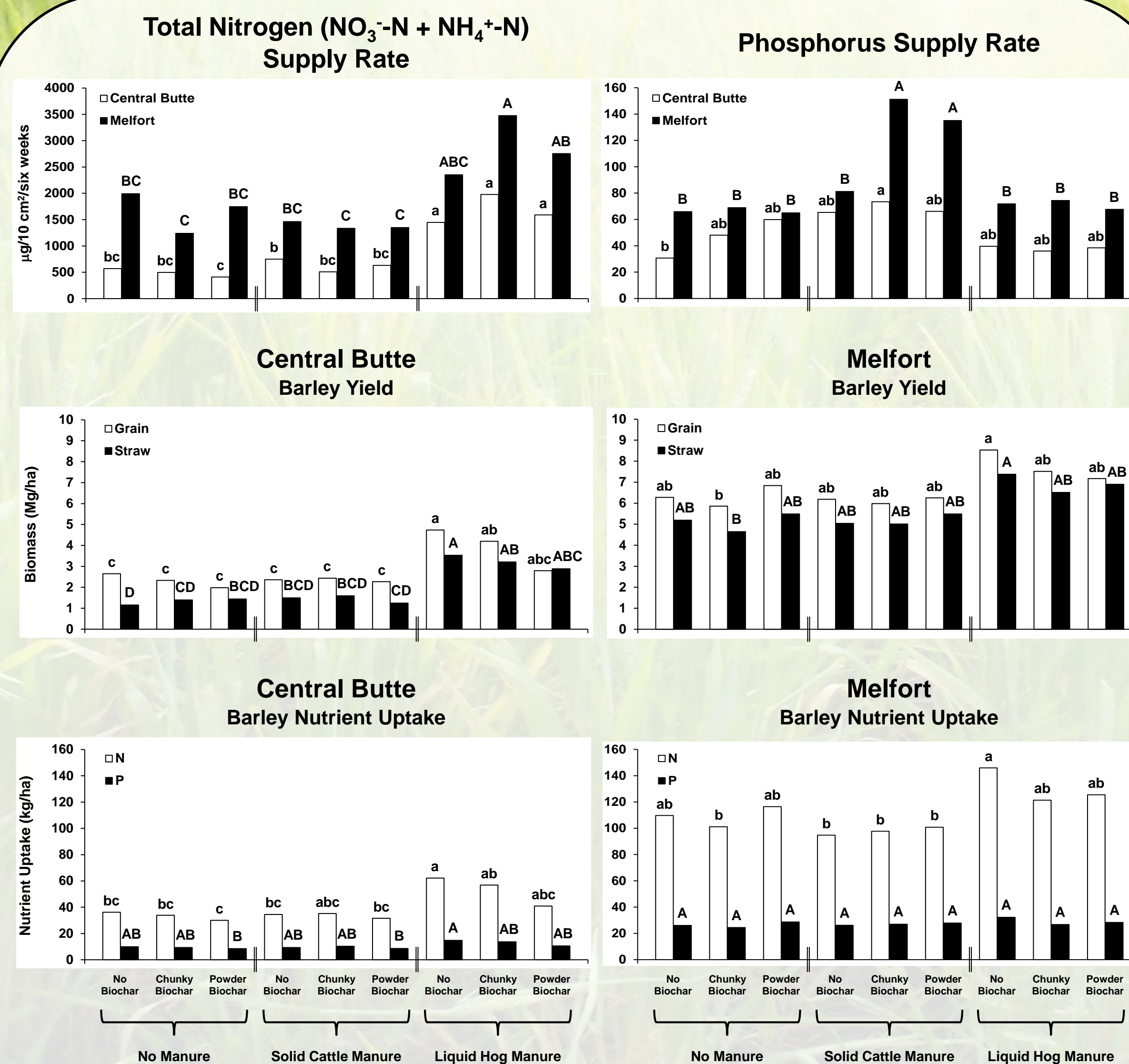


Figure 1. Mean ($n = 4$) cumulative PRS™-probe total N and P supply rates, barley biomass, and barley nutrient uptake (grain + straw) following willow 'chunky' and 'powder' biochar additions (8 Mg C/ha), with and without N (100 kg N/ha) added via solid cattle manure or liquid hog manure. For each site, columns with the same letter (and case) are not significantly different ($P > 0.05$) using LSD.

DISCUSSION

- The larger N and P supply rates of the Melfort soil, with or without the addition of biochar and manure, reflect greater mineralization, and explains the greater barley yield and nutrient uptake compared to the Central Butte soil.
- The largest soil N and P supplies were found in the liquid hog manure and solid cattle manure amended soils, respectively, reflecting their relative differences in content of N and P.
- Both chunky and powder biochars significantly increased the soil P supply in the solid cattle manure amended soil at Melfort, suggesting that biochar may enhance P release from solid cattle manure.
- Although the liquid hog manure amendment produced the highest yields, the lack of effects from added biochars on barley yield and nutrient uptake is attributed to the good inherent nutrient retention capacities already present in these two soils.

CONCLUSION

- Biochar amendments had little impact on enhancing nutrient availability and yield in the application year in these two soils, except increasing soil P supply in combination with cattle manure. Residual effects in subsequent years deserve attention.

ACKNOWLEDGEMENTS

- Thanks to the Saskatchewan Agriculture Development Fund and NSERC for funding; Western Ag Innovations Inc. for the PRS™-probes; D. Leach and K. Strukoff (AAFC) for their tremendous field support; E. Powell (SRC) for the biochars; and H. Ahmed, S. Anderson, B. Ewen, C. Fatteicher, B. Ferhatoglu, E. Hildebrand, N. Howse, G. Kar, T. King, M. Miheguli, L. Schoenau, W. Soomro, W. Stock, and R. Urton for their logistical support.