Effects of Irrigation, Cover Crop, and Manure on Soil Greenhouse Gas Emissions after Stover Removal in No-till Continuous Corn

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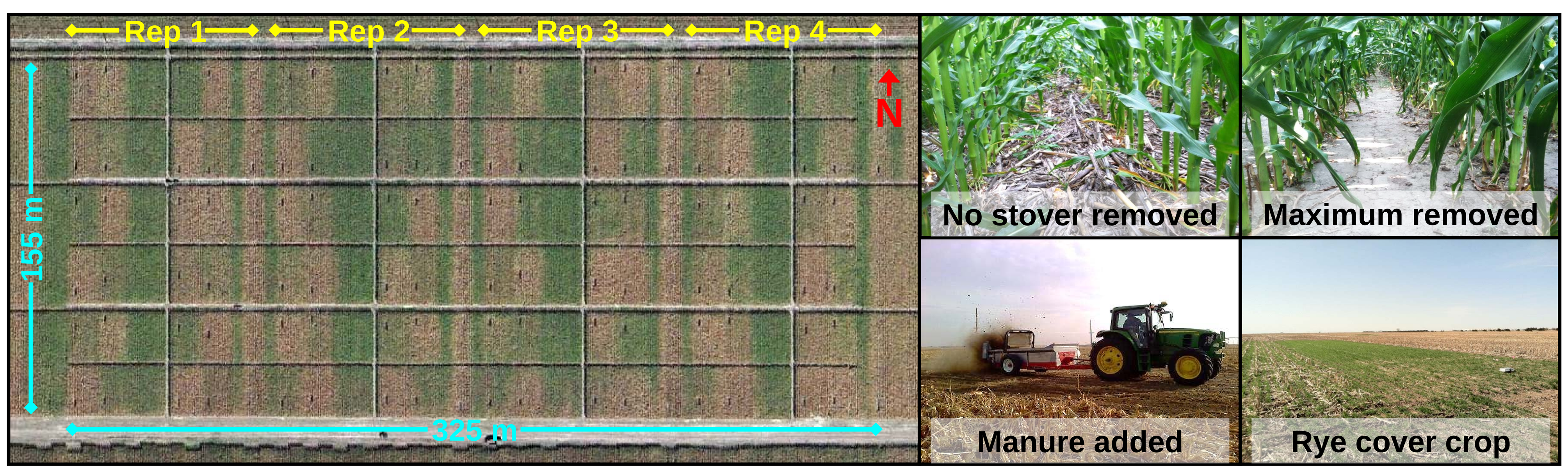
BACKGROUND & OBJECTIVE

- Corn (*Zea mays*, L.) stover is used widely for livestock co-feed and is targeted as a near-term feedstock for the developing cellulosic ethanol industry.
- High biomass production in irrigated continuous corn systems may have a greater potential to provide stover for either livestock or bioenergy end-uses.
- The impacts of corn stover removal and the use of associated amelioration practices on soil greenhouse gas (GHG) emissions are unclear.
- The objective was to determine how annual emissions of soil GHGs (carbon dioxide, CO_2; nitrous oxide, N_2O; methane, CH_4) were affected by corn stover removal and recommended amelioration practices (animal manure, winter rye (*Secale cereale,* L.) cover crop) in irrigated continuous corn for 2011-2013.

STUDY SITE & EXPERIMENTAL DESIGN

- This 5 ha irrigated no-till continuous corn site is at the University of Nebraska's South Central Agricultural Research Lab (Clay Center, NE).
- Soil is a Hastings silt loam (fine smectitic, mesic Udic Argiustoll).
- The site was established in May 2010, and full treatment (randomized complete split-split-split block; n=4 replicates) was in place by Nov 2010.



- Treatments were irrigation level (full, deficit), N rate (200, 125 kg N ha^{-1}), stover removal rate (none, maximum), and amelioration treatment (none, animal manure, winter rye cover crop).

SAMPLING METHODS

- Soil CO_2, N_2O and CH_4 fluxes were measured weekly in the growing season and monthly in the non-growing season using static vented chambers per USDA-ARS's GRACEnet (Parkin and Venterea 2010).

- Chamber headspace gases were collected over a 30 minute sampling period using a stratified sampling design (0, 10, 20, 30 min).
- Gas fluxes were calculated using linear or quadratic models (Wagner et al., 1997), and soil CO_2 and N_2O fluxes were corrected for suppression of the surface–atmosphere concentration gradient (Venterea 2010).
- Cumulative emissions were estimated by linear interpolation of fluxes between dates then summing over each year (e.g. trapezoidal integration).
- Soil GHG emissions are presented for only the 200 kg N ha^{-1} rate, 2011-13.
- Global warming impact (GWI, %) of amelioration management relative to no stover removal was calculated on a total GHG basis (Mg CO_2eq ha^{-1} yr^{-1}).

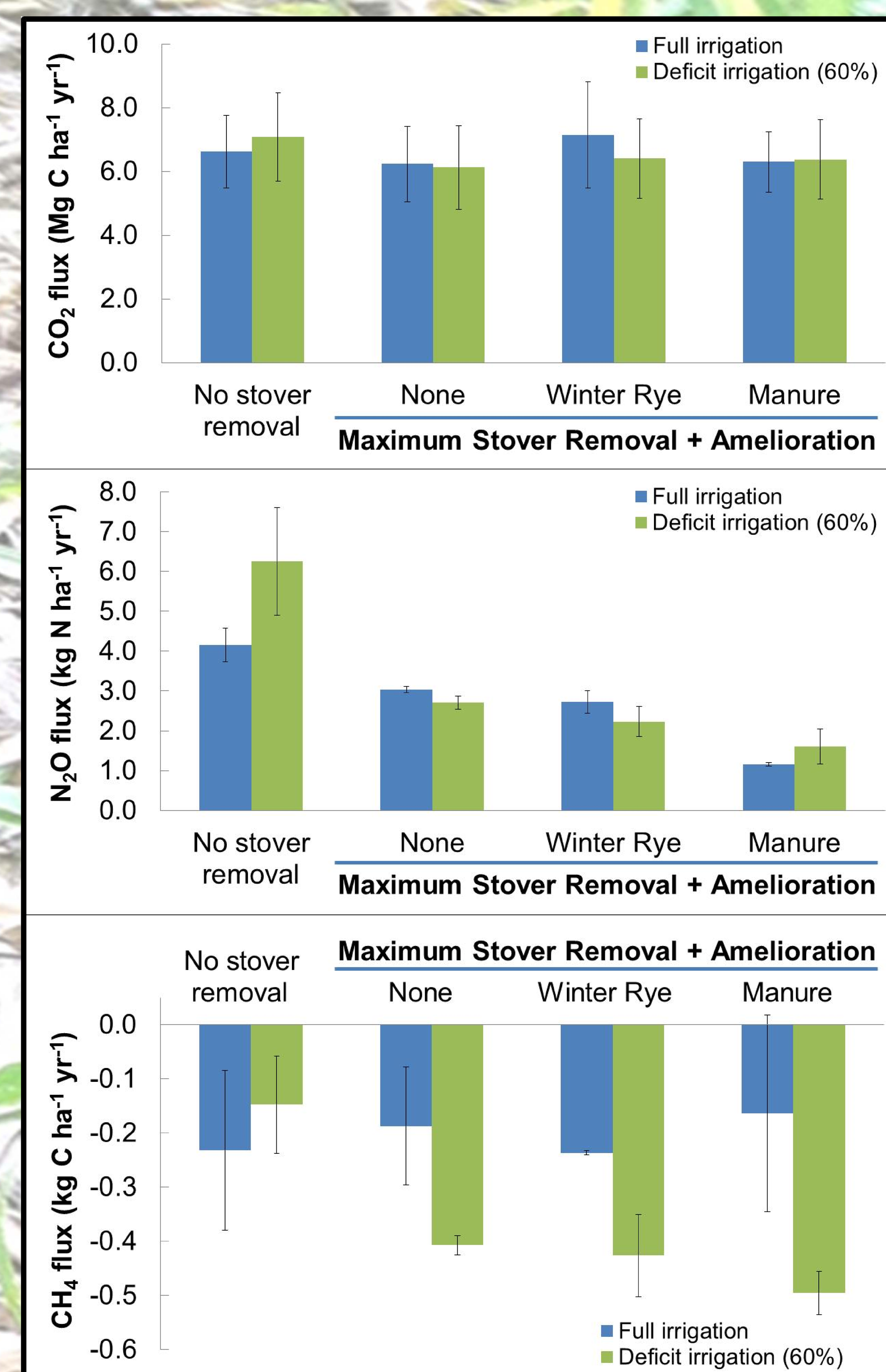


Figure 1. Mean (se) annual soil emissions of CO_2, N_2O, and CH_4 from 2011 to 2013.

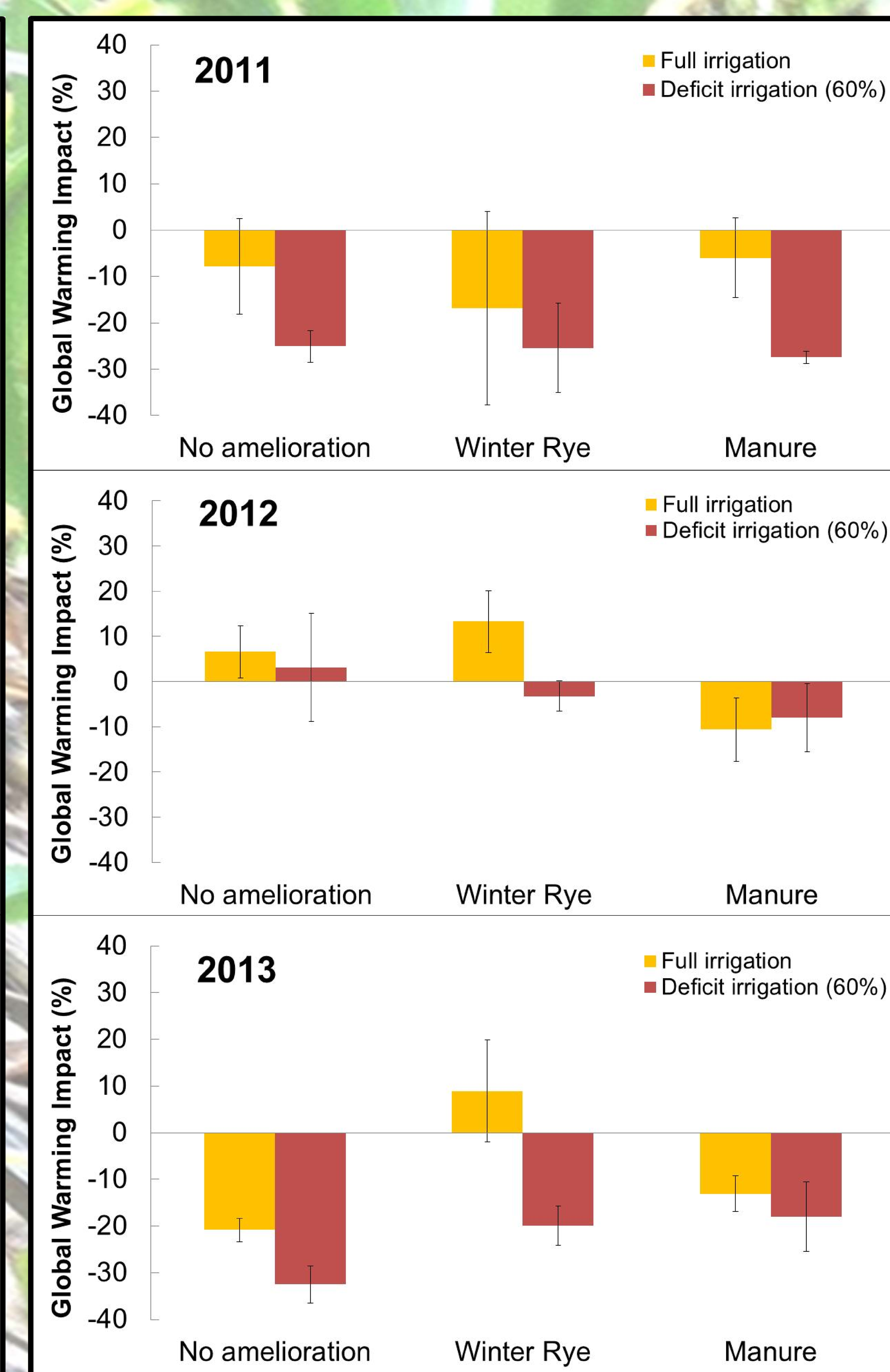


Figure 2. Mean (se) GWI (%) of amelioration after stover removal relative to no removal.

CONCLUSIONS

- Mean annual soil CO_2 emissions did not differ between irrigation treatments or for any amelioration treatment after maximum stover removal (Figure 1).
- Maximum stover removal tended to decrease soil N_2O emissions and increase soil CH_4 consumption (e.g. soils were CH_4 sinks; Figure 1).
- Maximum stover removal tended to decrease the global warming impact of direct GHG emissions from soils relative to no stover removal for all amelioration treatments, but responses varied from year to year (Figure 2).

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