Croplands Research Group
Greenhouse Gas Mitigation
Summary 01

How improved irrigation management can contribute to and assist in mitigation of greenhouse gas emissions from croplands

GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES

What is the issue?

(general statement of interest, define terms, relevance of practice/system/issue to particular crops, regions, resources available, etc.)

Current and expected climate change in North America and worldwide threaten food production and food security as the long-term drought in the Western USA illustrates. Furrow and flood-irrigated land in North America has been converting to center pivots and subsurface drip, which has resulted in lower application rates (Maupin et al., 2014). Much publicity has been given to the negative impacts of expanding center pivots in areas such as SE Arizona, which has led to groundwater decline and ground subsidence. Surprisingly little attention has been given to the potential positive effects that state of the art irrigation systems and management approaches can make on greenhouse gas (GHG) mitigation and/or carbon sequestration.

What are the factors controlling responses?

(review of factoring controlling responses of interest - SOC, CO_2, N_2O, CH_4)

Soil organic C remains low in warm regions such as the Southern and Western US, due to oxidation when deep to moderate tillage accompanies furrow irrigation.

Nitrous oxide emissions in surface and sprinkler-irrigated systems are mainly controlled by Nitrogen fertilizer rates, and number of splits applications (Yabaji et al., 2009).

Methane oxidation data in irrigated croplands is scarce, but levels are very low (Halvorson et al, 2012).

Efficiency of N fertilizer applications increase in the order: furrow irrigation > center pivot > subsurface drip irrigation (Bronson, 2008). Greater N use efficiency (NUE) means N fertilizer rates can be reduced, which reduces energy and GHG emissions associated with N fertilizer production and application (Kitchen et al., 2012).

Responses of crops to irrigation varies by many factors such as soil type, in-season rainfall, growing stage of crop.

What are expected responses?

(describe generalities of response and then list exceptions by region, environmental conditions, etc.; this is likely to be the largest section but it should be kept to ≤2 pages; overall summaries or specific examples from targeted research projects would be appropriate; try to use examples that are consistent across many studies)

There is great interest in the US and worldwide in variable-rate irrigation based on soil properties or canopy temperature (Andrade et al., 2015).

Center pivot and subsurface drip irrigation will accommodate cover crops, which will reduce wind and water erosion, improve soil tilth and infiltration, and in the long-term sequester C (Bronson et al., 2004).

Variable-rate of site specific N fertilizer management based on soil properties or canopy reflectance allows reduced rates of N fertilizer (Yabaji et al., 2009, Bronson et al. 2011), which in turn reduces energy and GHG emissions due to fertilizer production.

Fertigation will reduce N_2O emissions with a high number of small doses of N fertilizer application, compared to conventional N fertilizer timing practice of 1-2 split applications.

How can research help in refining mitigation estimates?

(describe current and future research needed and highlight need for international collaborations; who are partners that are and could assist in this research?)

Research gaps include:

Effect of site specific/variable rate irrigation and N fertilizer management on GHG emissions and Life cycle analysis (LCA).

Cover crop management and effect on C sequestration and GHG emissions ping in center pivot and subsurface drip irrigation systems.

Nitrous oxide emissions for various irrigation systems, especially those that allow fertigation.

Soil C sequestration studies for minimum till, eg. strip-till under center pivots and drip irrigation.

Life cycle analysis of various irrigation systems.

Synthesis / recommendations

(summarize current state of knowledge to make projections globally or regionally)

Acknowledgements

(list contributors, references, sources of additional information on the topic, etc.)

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