

Stand Establishment Systems and Water Quality

Issues related to dissolved organic carbon (DOC) and total dissolved nitrogen (TDN)

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OBJECTIVES

1. Compare dissolved organic carbon (DOC) losses between water seeded (conventional tillage) and drill seeded (conventional tillage) stand establishment methods.
2. Compare total dissolved nitrogen (TDN) losses between water seeded (conventional tillage) and drill seeded (conventional tillage) stand establishment methods.

BACKGROUND

Periodic increases in DOC concentration have been observed in the Sacramento River. The Sacramento River is a main drinking water source for the Sacramento metropolitan area. When DOC concentrations get too high, then harmful by-products (e.g. trihalomethanes) can form during the chlorination process during drinking water disinfection. There is some evidence to suggest that rice fields could be the source of this extra DOC. As the rice straw that is incorporated into the soil after harvest decomposes, it releases DOC into the rice field water, which can then be exported to the Sacramento River.

The total dissolved nitrogen is a total of the nitrate, ammonium, and dissolved organic nitrogen in rice field outflows. The total amount of nitrogen lost can have agronomic, economic, and environmental impacts. It is unknown how different stand establishment practices can affect TDN losses.

MATERIALS AND METHODS

Different stand establishment practices (water seeding vs. drill seeding) have different timings of water management (filling, flushing, draining, etc.), which can then affect water quality. Two treatments (water seeded-conventional tillage and drill seeded-conventional tillage) at the Rice Cultural Systems site at the Rice Experiment Station were selected to determine water quality impacts between stand establishment practices. Water samples are collected throughout the growing season and winter flooding, when outflow is occurring. Water was also collected from the source water, which was the same for all plots. Samples are analyzed for:

Dissolved organic carbon, dissolved inorganic carbon, total dissolved carbon
Nitrate, ammonium, dissolved organic nitrogen, total dissolved nitrogen
Dissolved phosphorus, dissolved potassium
Sediment, total carbon, total nitrogen, total phosphorus
Turbidity (clarity of water), total dissolved solids (how much salt is in the water)

Preliminary results on DOC and TDN are reported here.

Dissolved Organic Carbon

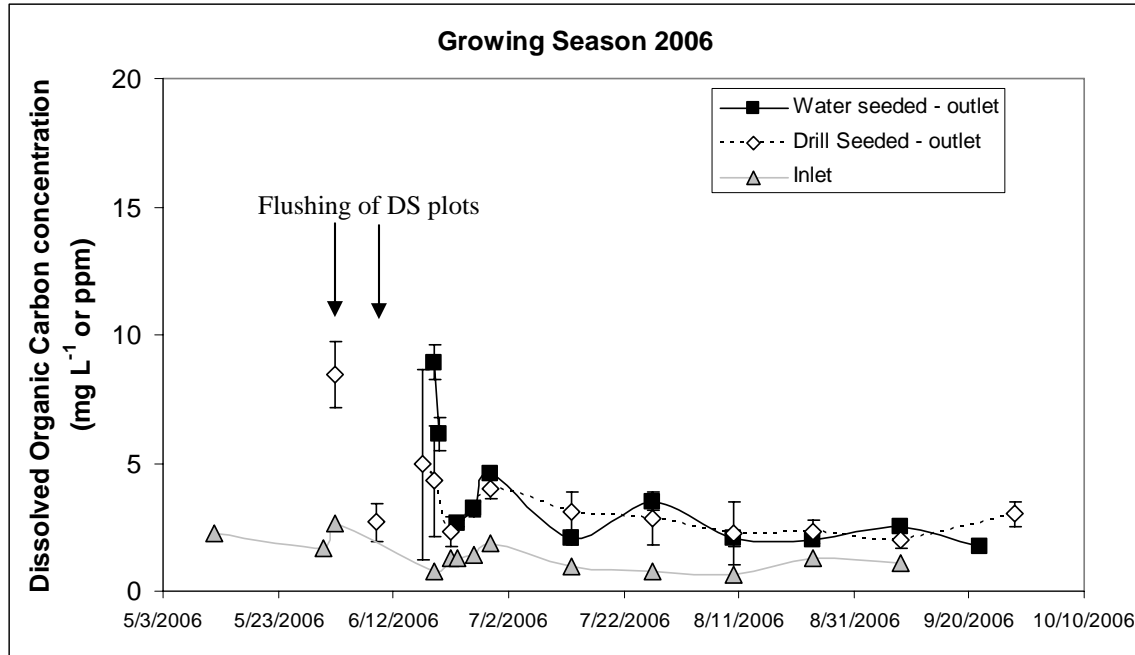


Figure 1. Dissolved organic carbon concentrations during the 2006 rice growing season.

- DOC concentrations were the highest (8 to 10 ppm) from either treatment when water was first released as outflow.
- No major differences in DOC concentration were observed between treatments
- Rice fields do contribute DOC to surface waters, as inlet waters usually had about 1 to 2 ppm less DOC than the outlet waters.

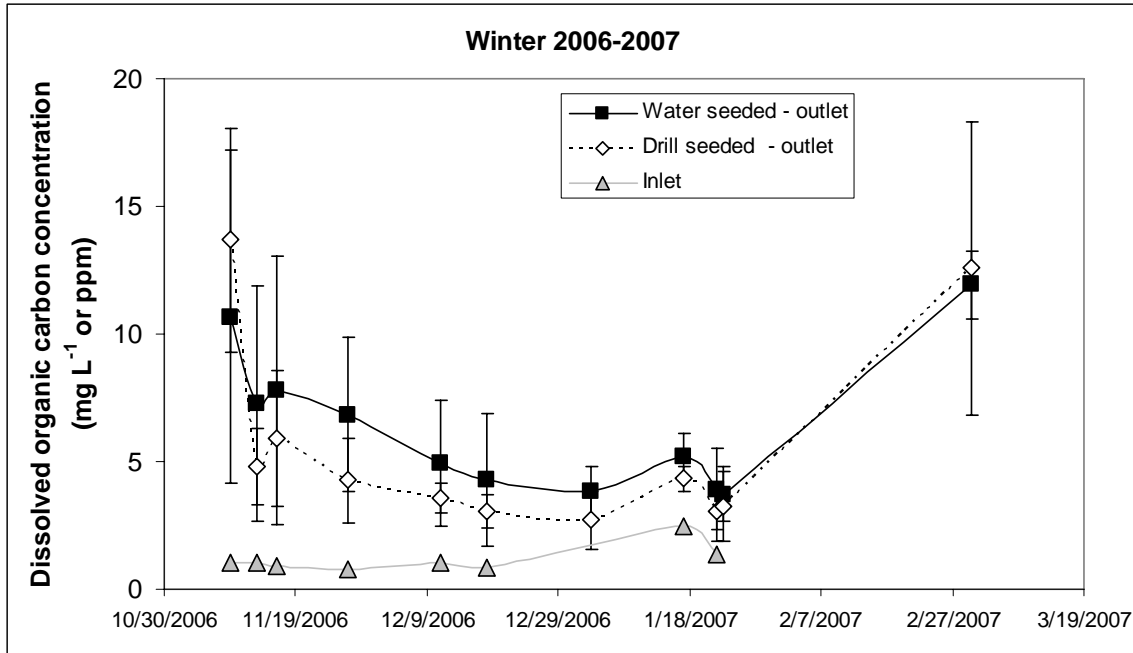


Figure 2. Dissolved organic carbon concentrations during winter of 2006-07.

- Average DOC concentrations were similar between the two treatments during the winter flooding, with the highest concentrations at the beginning of outflow.
- Again, DOC concentrations in outlet waters were greater than DOC from inlet waters.
- DOC concentrations appeared to increase again when the boards were pulled to drain the field.
- DOC concentrations in the winter appeared to have higher DOC concentrations than during the growing season.

Total Dissolved Nitrogen

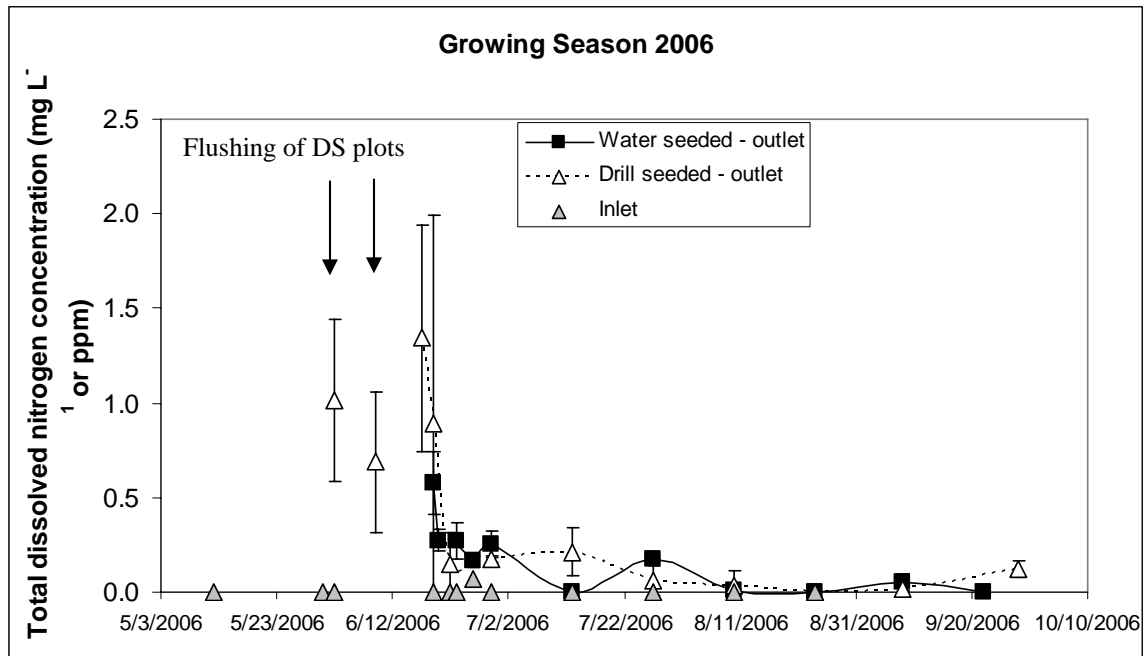


Figure 3. Total dissolved nitrogen (the sum of nitrate, ammonium, and organic nitrogen) concentrations during the 2006 rice growing season.

- TDN concentrations were higher for the drill seeded treatments during the beginning of outflow (flushing and maintenance flow) compared to TDN concentrations at the beginning of outflow in the water seeded treatments.
- After the initial outflow, TDN concentrations were similar between treatments and very low (<0.3 ppm).
- TDN losses during early season flushing of drill seeded plots may represent a significant loss of N (water flow rates are needed to determine how much total N was lost).
- TDN concentrations in the inlet were typically less than 0.05 ppm.

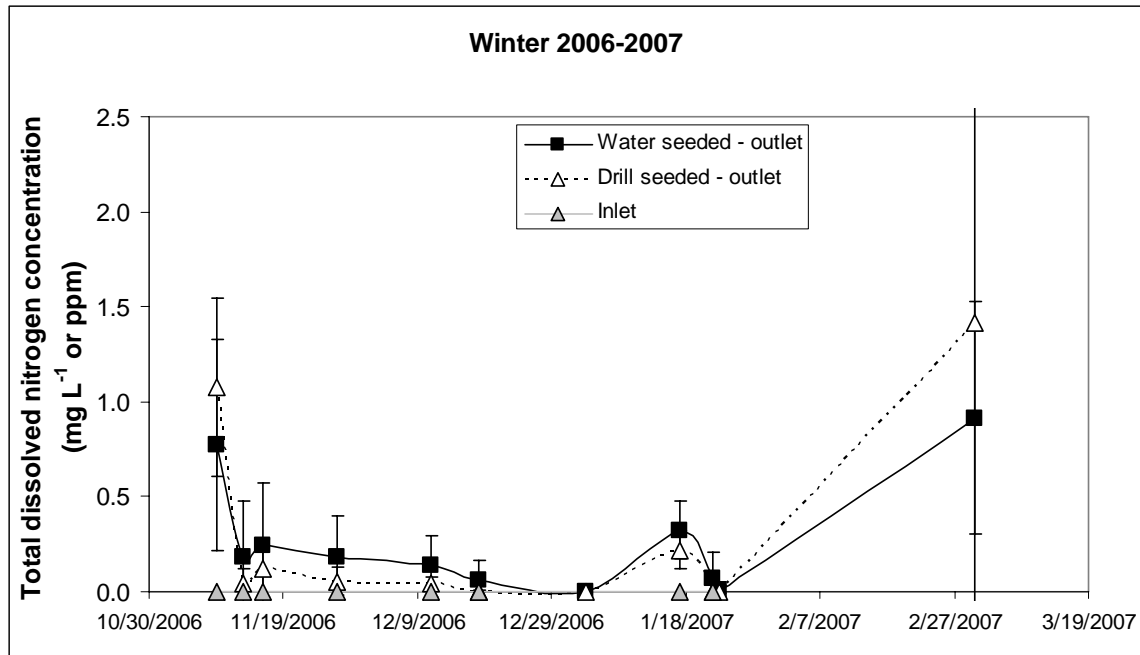


Figure 4. Total dissolved nitrogen (the sum of nitrate, ammonium, and organic nitrogen) concentrations during the winter of 2006-07.

- TDN concentrations were similar between the two treatments.
- TDN concentrations in the inlet waters were typically less than 0.05 ppm.
- TDN concentrations were the highest at the beginning of outflow (early November) and at the final drain.

FUTURE RESEARCH

Future research will be to:

1. Calculate total losses of carbon, nitrogen, phosphorus, potassium, and sediment from each stand establishment, and
2. Determine seasonal variation in water quality indicators (e.g. turbidity and dissolved solids) and carbon, sediment, and nutrient concentrations from water seeded and drill seeded stand establishments.