N Management in Alternative Rice Systems 2004-2006

Kaden Koffler, Bruce Linquist, Jim Hill,

Cass Mutters, Chris Greer, and Chris van Kessel

Dept of Plant Sciences, UC Davis

Water management and Nitrogen

- Fairly efficient N management system developed many years ago
  - Apply most N upfront in some form of ammonium
  - Permanently flood fields
  - Topdress if necessary
- Changes in stand establishment, tillage, and/or weed management can alter N dynamics
  - Particulary early season flushes
- Aerobic-anaerobic shifts in soil from flooding-drying cycles cause N transformations to occur, which can lead to N losses
- Therefore, adjustments in N management may be necessary to achieve maximum yields in these alternative systems

Water Management and Nitrogen

- In flooded soils nitrate (NO_3) does not accumulate and ammonium (NH_4) is the primary N source.
- When a field is drained the soil becomes aerobic and soil NH_4 is *nitrified* to NO_3.
  - NH_4^+ -> NO_3^-
- When the field is reflooded the soil becomes anaerobic and NO_3 can be lost through *denitrification*.
  - nitrate (NO_3^-) -> nitrite (NO_2^-) -> nitrous oxide (N_2O) -> dinitrogen gas (N_2)

Study Rationale

- Since each system is based on different stand establishment, tillage, and weed management practices…
  - Optimal N management may be different for each system
- To determine optimal N management, an N rate trial was conducted in each system from 2004-2006
- N rates ranged from 0-200 lb N / acre, some with split applications

Field Map

<u>Systems</u>

T1 – Water-seeded, conventional

T2 – Drill-seeded, conventional

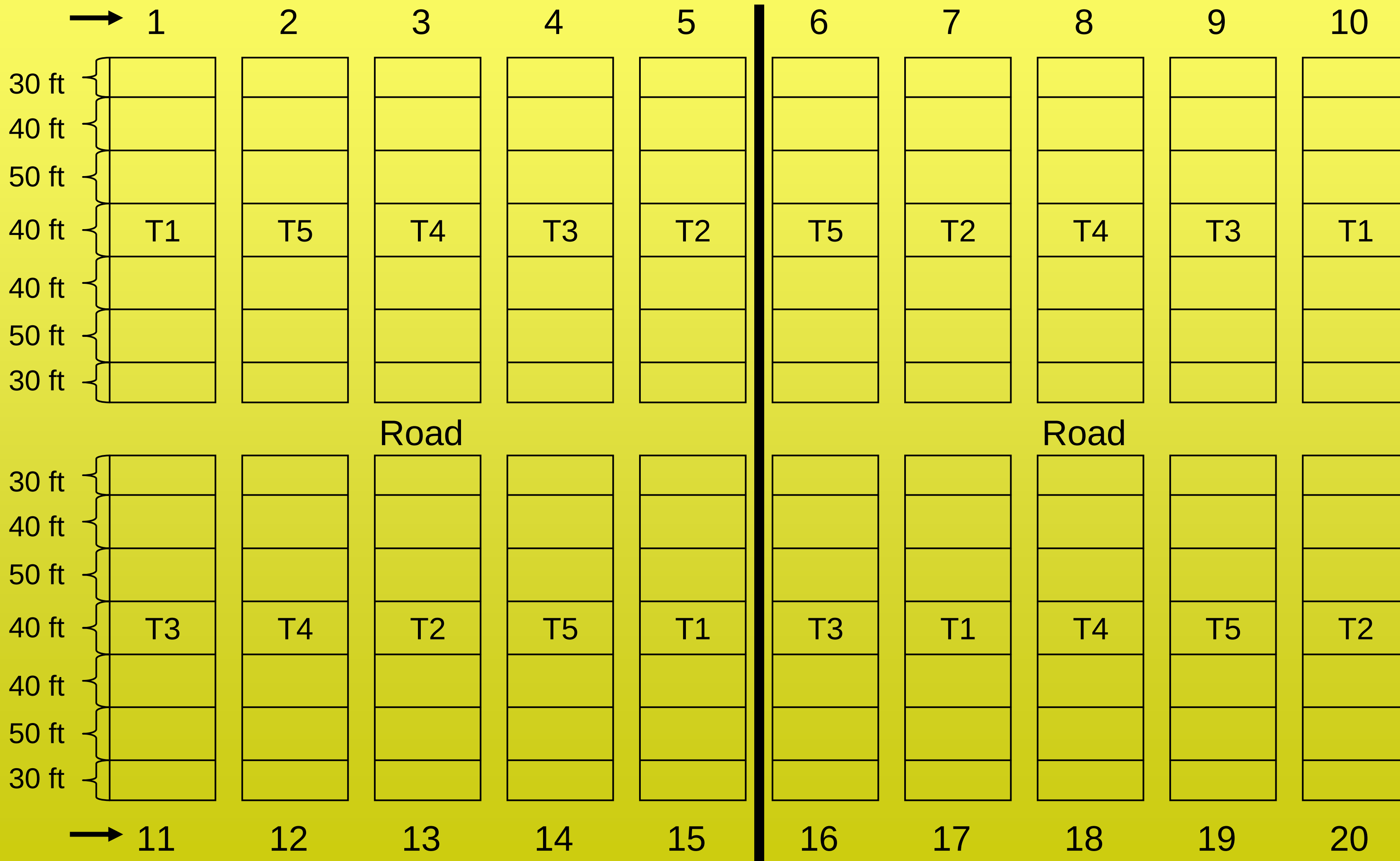
T3 – Water-seeded, stale

T4 – Water-seeded, no-till stale

T5 – Drill-seeded, no-till stale

N

Rep 1 **Rep 2**



Main Plot System

A = 150 lb / acre	B = 0 lb / acre	C = 100 lb / acre	D = 100 lb / acre (split)	E = 200 lb / acre

5 Systems x 4 Reps x 5 N rates = 100 Subplots

Range of N Rates and Time of Application

			2004				2005				2006				
Main treatment	**N sub treatment**	**Total N applied**	**Preplant Incorporated**	**Preplant Surface**	**Preflood Broadcast**	**Between MT & PI**	**Preplant Incorporated**	**Preplant Surface**	**Preflood Broadcast**	**Between MT & PI**	**Total N applied**	**Preplant Incorporated**	**Preplant Surface**	**Preflood Surface Drill Seeded**	**Between MT & PI**
1 Water seeded - conventional	**A**	**150**	150	0	0	0	150	0	0	0	**150**	150	0	0	0
	B	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0
	C	**50**	50	0	0	0	50	0	0	0	**100**	100	0	0	0
	D	**100**	100	0	0	0	100	0	0	0	**100**	50	0	0	50
	E	**200**	200	0	0	0	200	0	0	0	**200**	200	0	0	0
2 Drill seeded - conventional	**A**	**150**	50	0	100	0	50	0	100	0	**150**	50	0	100	0
	B	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0
	C	**100**	0	0	50	50	0	0	50	50	**100**	0	0	100	0
	D	**150**	50	0	50	50	0	0	150	0	**100**	50	0	50	0
	E	**150**	0	0	100	50	0	0	100	50	**200**	0	0	200	0
3 Water seeded - stale	**A**	**150**	150	0	0	0	150	0	0	0	**150**	0	150	0	0
	B	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0
	C	**50**	50	0	0	0	50	0	0	0	**100**	0	100	0	0
	D	**100**	100	0	0	0	100	0	0	0	**100**	0	50	0	50
	E	**200**	200	0	0	0	200	0	0	0	**200**	0	200	0	0
4 Water seeded - no till stale	**A**	**150**	0	0	100	50	0	0	100	50	**150**	0	100	0	50
	B	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0
	C	**100**	0	0	50	50	0	0	50	50	**100**	0	100	0	0
	D	**150**	0	50	50	50	0	0	150	0	**100**	0	50	0	50
	E	**150**	0	50	100	0	0	50	100	0	**200**	0	200	0	0
5 Drill seeded - no till stale	**A**	**150**	0	0	100	50	0	0	100	50	**150**	0	0	100	50
	B	**0**	0	0	0	0	0	0	0	0	**0**	0	0	0	0
	C	**100**	0	0	50	50	0	0	50	50	**100**	0	0	100	0
	D	**150**	0	50	50	50	0	0	150	0	**100**	0	50	50	0
	E	**150**	0	50	100	0	0	50	100	0	**200**	0	50	150	0

<u>Methods and Times of Application</u>

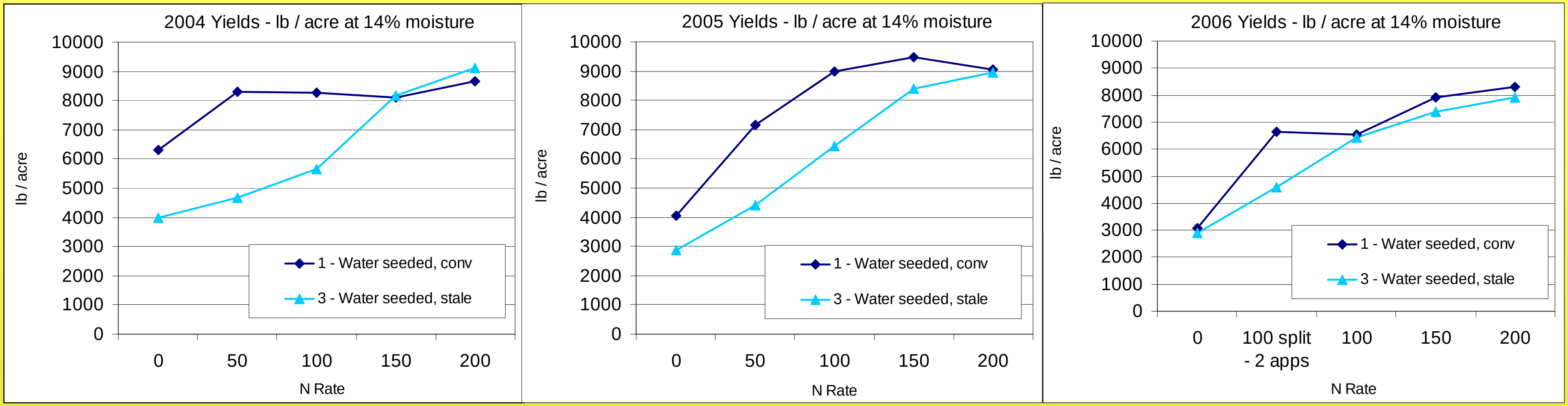
- Preplant Incorporated

- Preplant Surface

- Preflood Broadcast

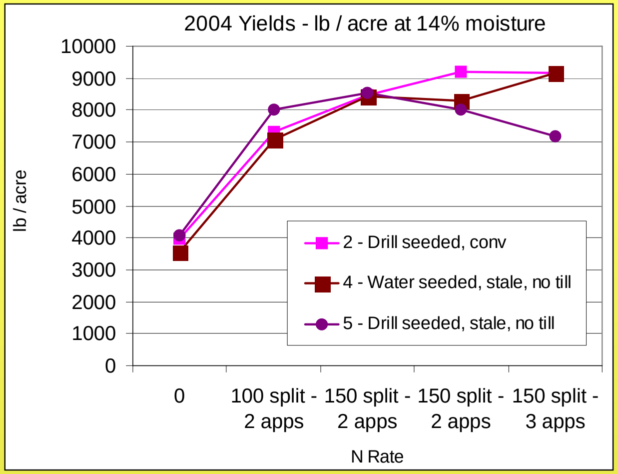
- Topdress Between MT & PI

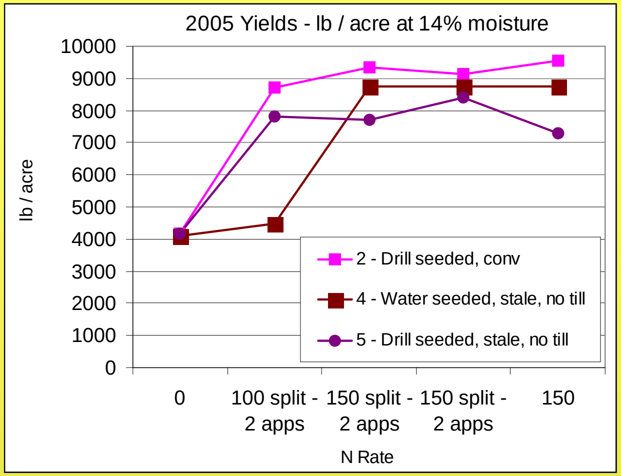
N Response – Systems 1 & 3

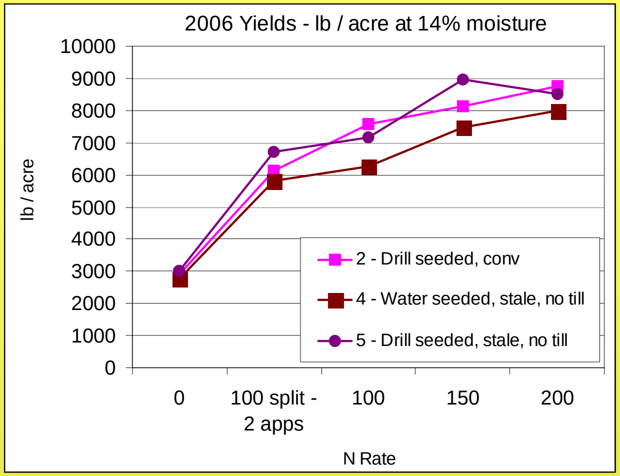


- Systems 1 & 3 have similar yield potential
- But system 3 shows a yield response up to 200 lb N / acre, whereas system 1 levels off between 100-150 lb N / acre
- This suggests flushing for stale seedbed leads to N loss

N Response – Systems 2, 4, & 5

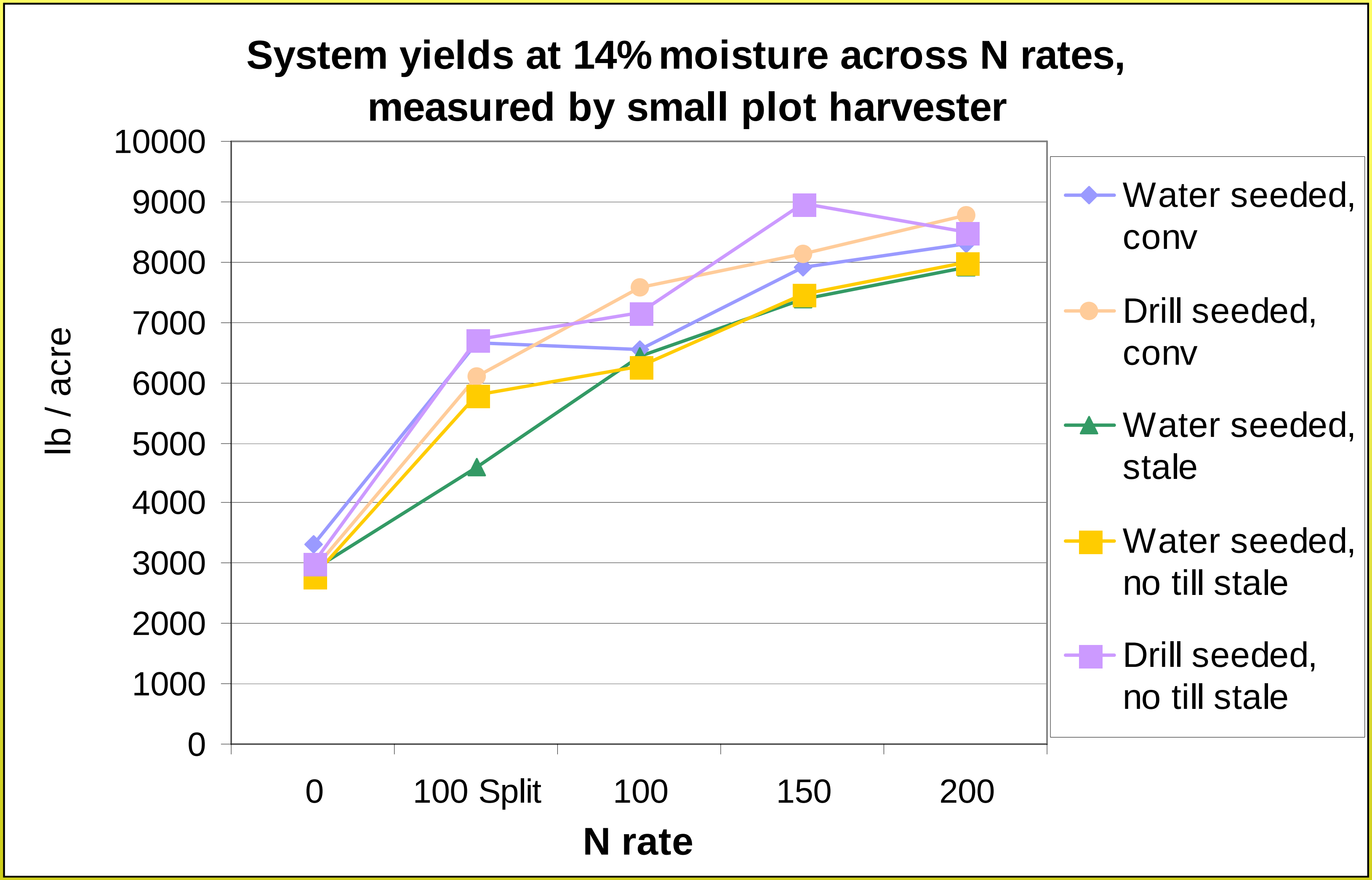






- No clear trends from effects of tillage and drill-seeding across years
- In 2005, split N applications increased yields in system 5, but had no effect on systems 2 and 4
- In 2006, splitting N application at 100 lb N / acre reduced yields compared to 100 lb N / acre applied all at once

2006 Yields



Some differences in yields at lower rates, but similar yield potential at higher rates

Take Home Messages

- All systems appear to have similar yield potential, but some require higher N rates
- Yield differences among systems can’t be entirely explained by N losses from flushing events
- Tillage and seeding method are probably interacting with early season water management to influence yield trends as well