



# Key Findings and Recommendations from the National Biosolids Research Program

Key findings and recommendations on nutrient issues

Mike Bell on behalf of the NBRP team

7 December, 2007





## Nutrient work in the NBRP

- ❖ Not a key focus of the program in most states
- ❖ Strong interest in Qld, and to a lesser extent WA
- ❖ Main focus on nitrogen (N) and phosphorus (P).
- ❖ Focus on appropriateness of NLBAR calculation, the need for a PLBAR (??) and the fate of applied nutrients.





## Biosolids application rate generally based on N loading

- ❑ Application rates specific to biosolids type/quality and crop N demand
- ❑ Determined by the NLBAR calculation (NSWEPA 1997)

$$\text{NLBAR (t/ha)} = \text{Crop N reqt (kg/ha)} / \text{Available N in biosolids (kg/t)}$$

$$\text{Available N} = (\text{NH}_4\text{-N}/5) + \text{Oxidised N} + (\text{Organic N} * \text{Mineral}^n \text{ factor})$$

Mineralization factor = 15% (anaerobic biosolids) to 25% (aerobic biosolids) of the total organic N



## Key issues

- No account of soil N status – ie. what proportion of crop N can be supplied by background fertility**

Farmers modify N fertilizer rates by preplant soil testing. Why not for biosolids?

- N mineralisation factor for organic N (15% for anaerobically- digested dwc and 25% for aerobically-digested dwc)**

How valid is this under warm, moist subtropical conditions? How much does it vary with management?

- Volatilisation losses of 80% of  $\text{NH}_4\text{-N}$  in biosolids at application**

How valid is this given the requirement for rapid incorporation?



# Starting soil N

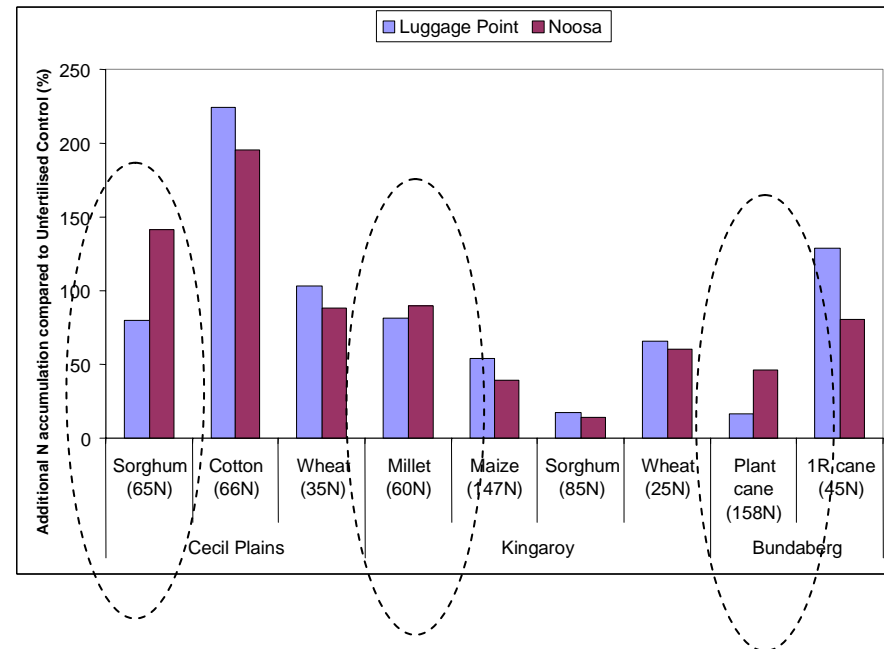
❑ Crop N requirement was assessed at 150 -180 kg N/ha.

❑ In the year after application, most crops reached that target.

(CP sorghum 150-200, Kin millet 140-150, Bbg sugar 180-200 kg N/ha)

❑ N supplied from biosolids was as low as 15% of that target, and averaged 50%.

❑ Even if other assumptions are right, this means excess mineral N will be left behind.

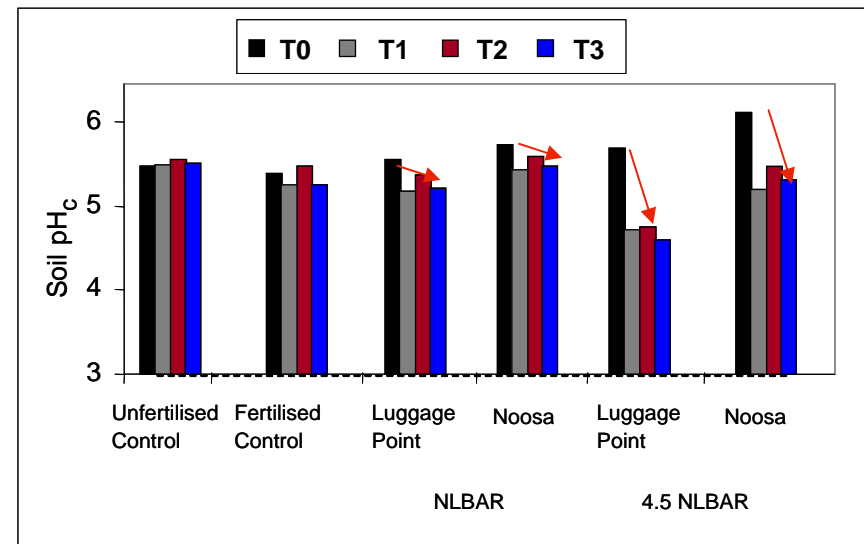
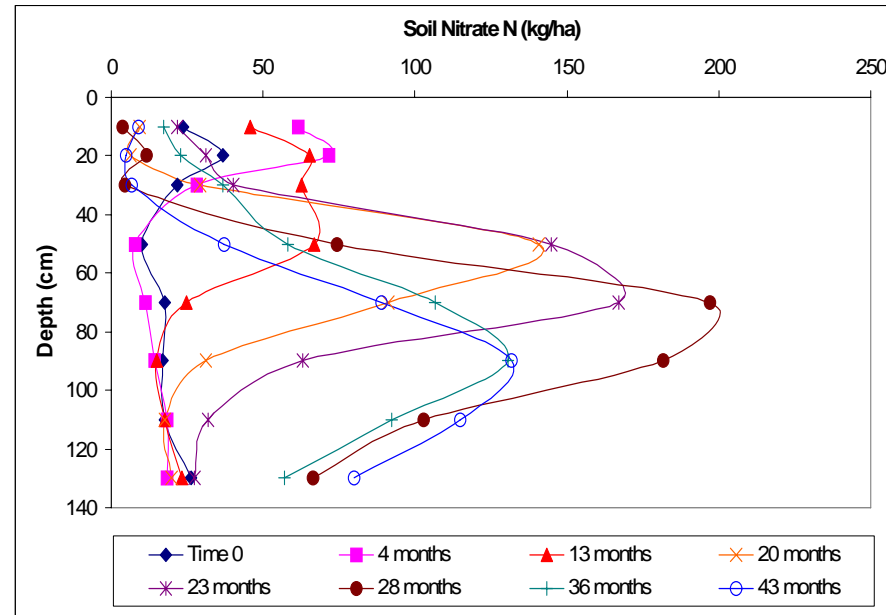


1. Application rates need to be modified for starting soil N and mineralization factors
2. This becomes complicated if applications are well in advance of planting.
3. Local agribusiness/consultants can help



# Excess mineral N can leach, and profiles will acidify

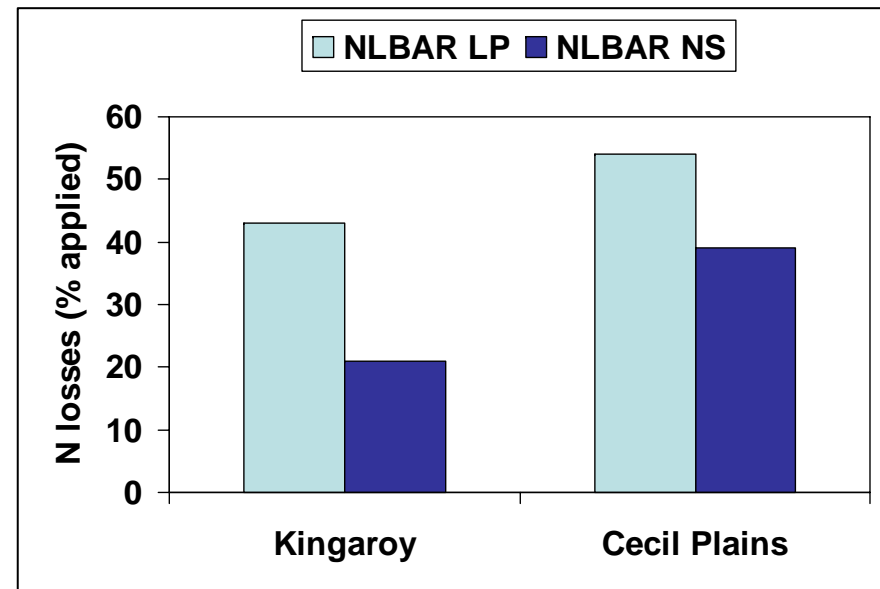
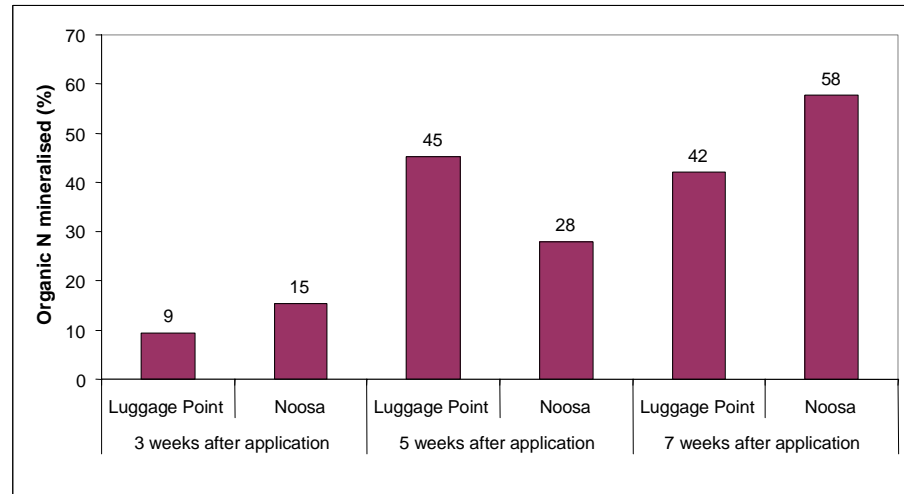
- ❑ Leaching of  $\text{NO}_3\text{-N}$  to groundwater is already a big issue, especially in GBR catchments.
- ❑ The acidification resulting from  $\text{NO}_3\text{-N}$  leaching can be substantial
- ❑ This acidification will increase the food safety risks posed by increased Cd bio-availability





# Mineralisation of organic N (field)

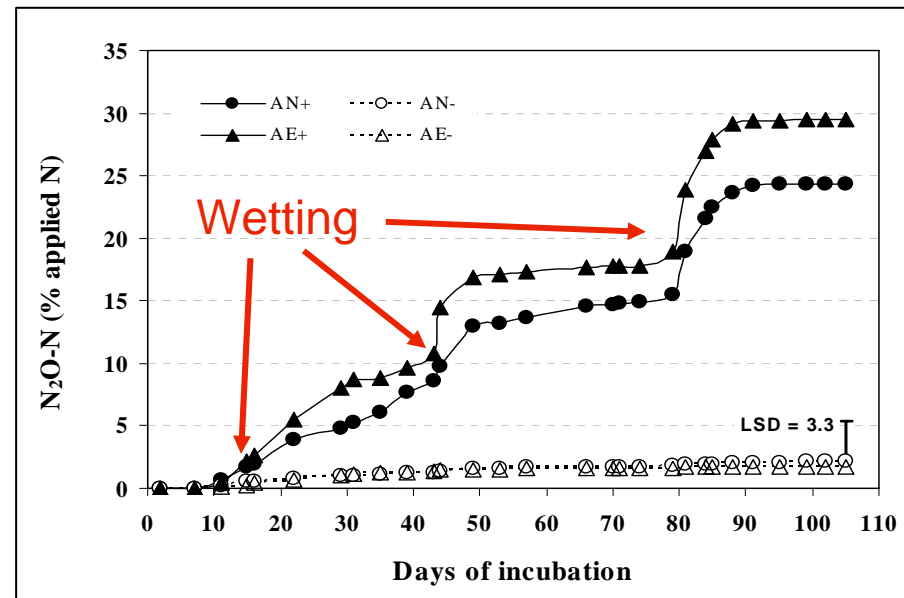
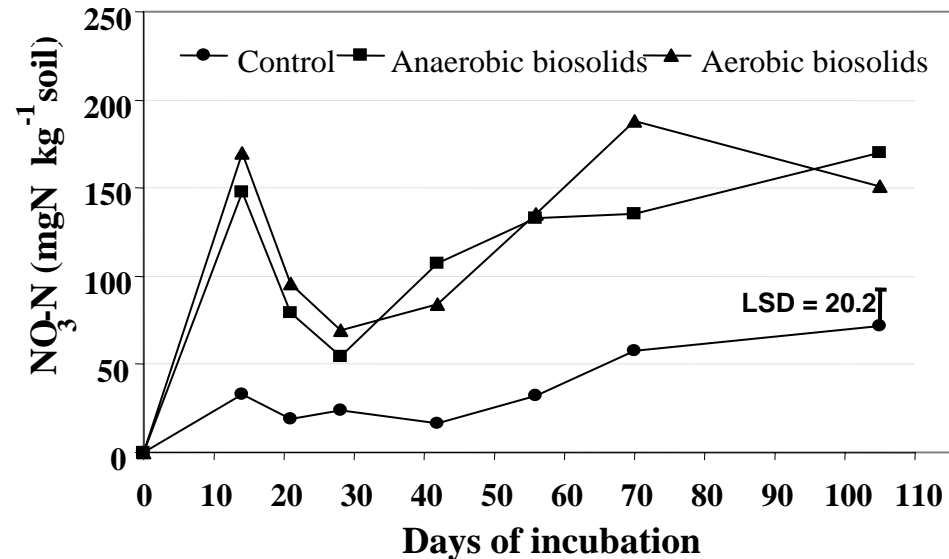
- ❑ Currently assumed 15% (anaerobic) – 25% (aerobic) of organic N will mineralise in the first crop year.
- ❑ Our measurements suggests rates are much greater
- ❑ Large apparent losses of N from the field studies could be related to this.





# Link between N mineralisation and losses ? (lab studies)

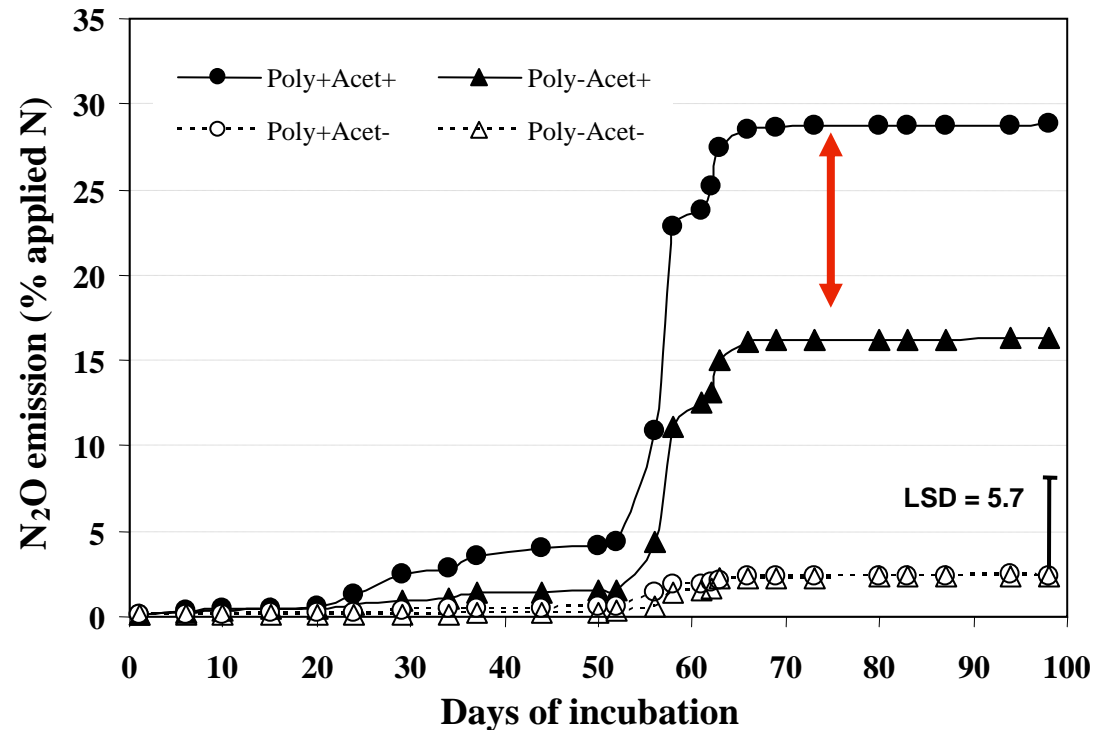
- ❑ Denitrification requires high concentrations of  $\text{NO}_3\text{-N}$
- ❑ Very high  $\text{NO}_3\text{-N}$  concentrations were observed in soil as organic N was mineralized
- ❑ Laboratory studies suggest denitrification losses can be very high





# Impact of polymers, other treatment processes?

- The presence of polymer added during dewatering increases gaseous losses
- Apparent mineralization rates in dried materials are at least as great, if not greater than, that in dwc.
- N content and mineralization rates are much lower in vermicast biosolids.



Treatment	Total N %	Ammonium – N mg/kg soil		
		Before incubation	After incubation	Difference
DWC before heat	6.8	11182	20524	9342
DWC after heat	6.7	6326	20810	14484



## Conclusions - NLBAR

- Calculation needs to include inherent soil mineral N status
- More work needs to be done on N mineralisation rates. What are they in the field, and how do they vary with climatic factors and biosolids product?
- Can management practices be modified to account for the rapid mineralisation of N and prevent losses?





# P loadings at NLBAR

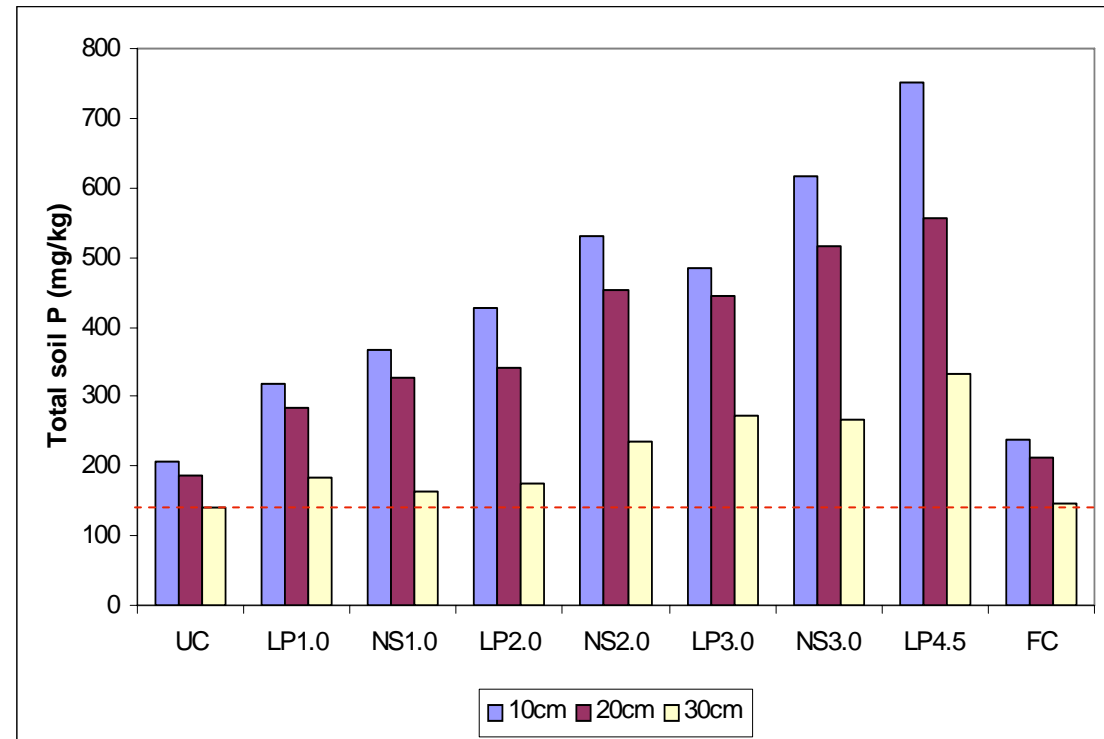
- Biosolids are not a balanced fertiliser
- In the aerobic dwc, the N and P loadings were quite similar
- Crop P requirements are only 10-20% of that for N.
- Large surplus P applications are being made. What is the fate of that P?

	Luggage Point dwc		Noosa dwc	
	NLBAR	4.5 NLBAR	NLBAR	4.5 NLBAR
	Kingaroy			
Dry weight (t/ha)	25	112.5	10	45
Nitrogen (kg/ha)	1433	6446	567	2552
Phosphorus (kg/ha)	558	2509	428	1926
	Bundaberg			
Dry weight (t/ha)	20	90	14	-
Nitrogen (kg/ha)	1127	5072	814	-
Phosphorus (kg/ha)	486	2187	546	-
	Cecil Plains			
Dry weight (t/ha)	20	90	14	63
Nitrogen (kg/ha)	1174	5283	846	3808
Phosphorus (kg/ha)	504	2268	522	2350
	Lowood			
Dry weight (t/ha)	16	72	12	54
Nitrogen (kg/ha)	997	4486	733	3299
Phosphorus (kg/ha)	562	2529	510	2296



# Fate of applied P

- In heavy clay soils P does not move down the profile
- In sandy soils with low P fixing capacity, there is a real risk of P leaching.
- Many of the sugarcane soils in coastal Qld are already (over)loaded with P.
- In this instance, biosolids applications based on a PLBAR would be warranted.
- Could be developed from intensive livestock industry guidelines.





## Conclusions - nutrients

- The nutrients in biosolids can be beneficially reused in broadacre cropping.**
- A key issue for sustainable reuse practices will be using these nutrients efficiently, preventing off farm movement.**
- There are significant knowledge gaps surrounding ways to improve the efficiency of biosolids N use.**
- There is a good case for developing a PLBAR for acidic sandy soils with low capacity to fix P.**
- There is a strong case to develop a combined approach to nutrient management in land application of biosolids and organic wastes from industries (eg. intensive livestock, sugar mill muds etc).**



# ACKNOWLEDGEMENTS



Australian Government  
Australian Centre for  
International Agricultural Research



## Contact

Dr Michael Bell

Principal Agronomist

Phone +61 7 4160 0730

Email [mike.bell@dpi.qld.gov.au](mailto:mike.bell@dpi.qld.gov.au)

or

Mr Glenn Barry

Principal Chemist

Phone +61 7 3896 9306

Email [glenn.barry@nrw.qld.gov.au](mailto:glenn.barry@nrw.qld.gov.au)

Thank You

