DAIRY MANURES AND SLURRIES: CHARACTERISTICS AND EVALUATING CURRENT PRACTICE

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CHANGING FARM PRACTICES

SOLID SEPERATION

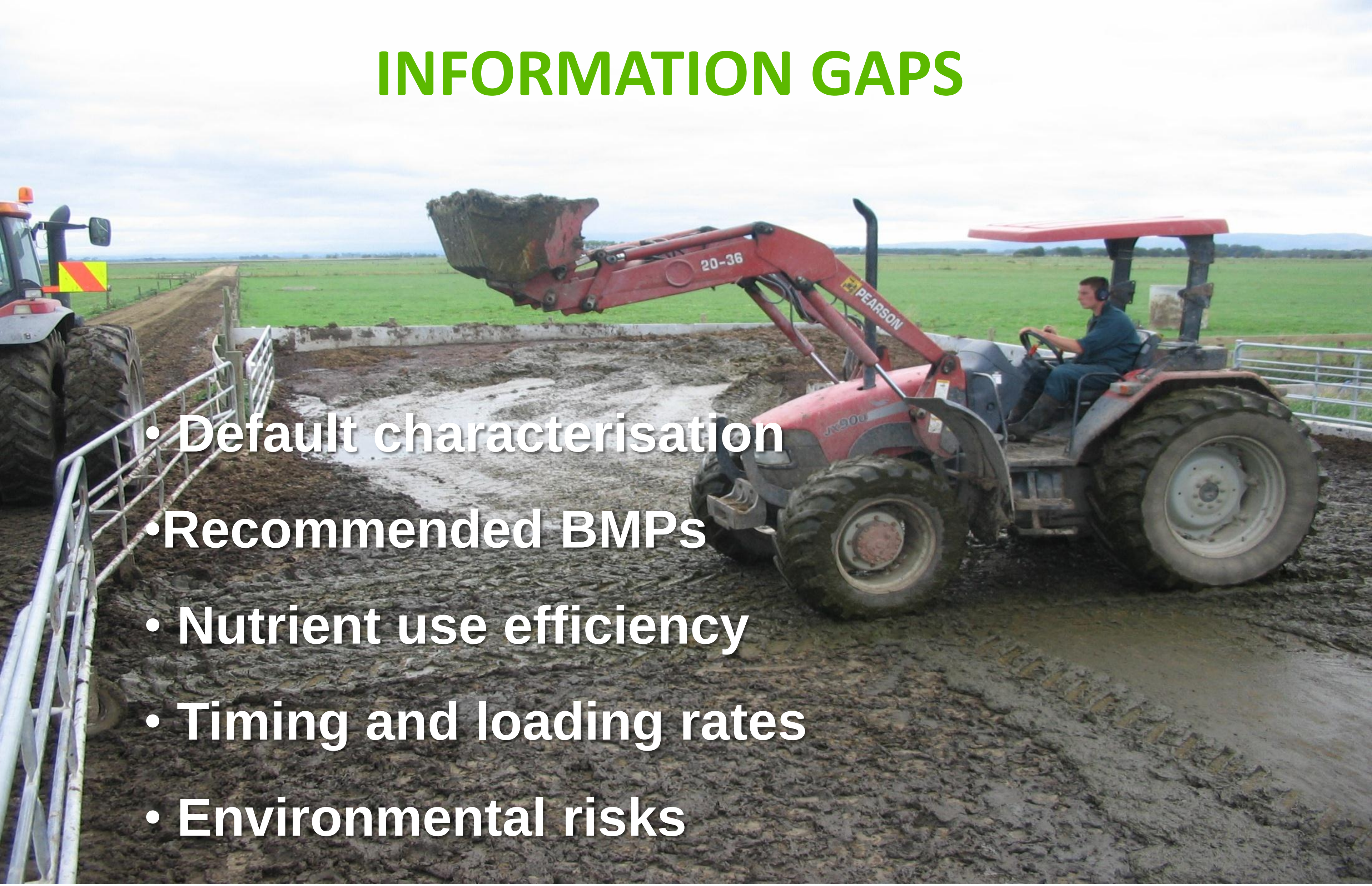
- **Pond storage of FDE now a common practice**
  - Changes in regulatory policy
  - Dairy industry COP for FDE
  - Uptake of Pond Storage Calculator
- **Small irrigation nozzles require cleaner liquid**

CHANGING FARM PRACTICES

OFF-PASTURE SYSTEMS

- **Greater capture of animal excreta**
- **Greater use of animal feed inputs**

INFORMATION GAPS



- Default characterisation
- Recommended BMPs
- Nutrient use efficiency
- Timing and loading rates
- Environmental risks

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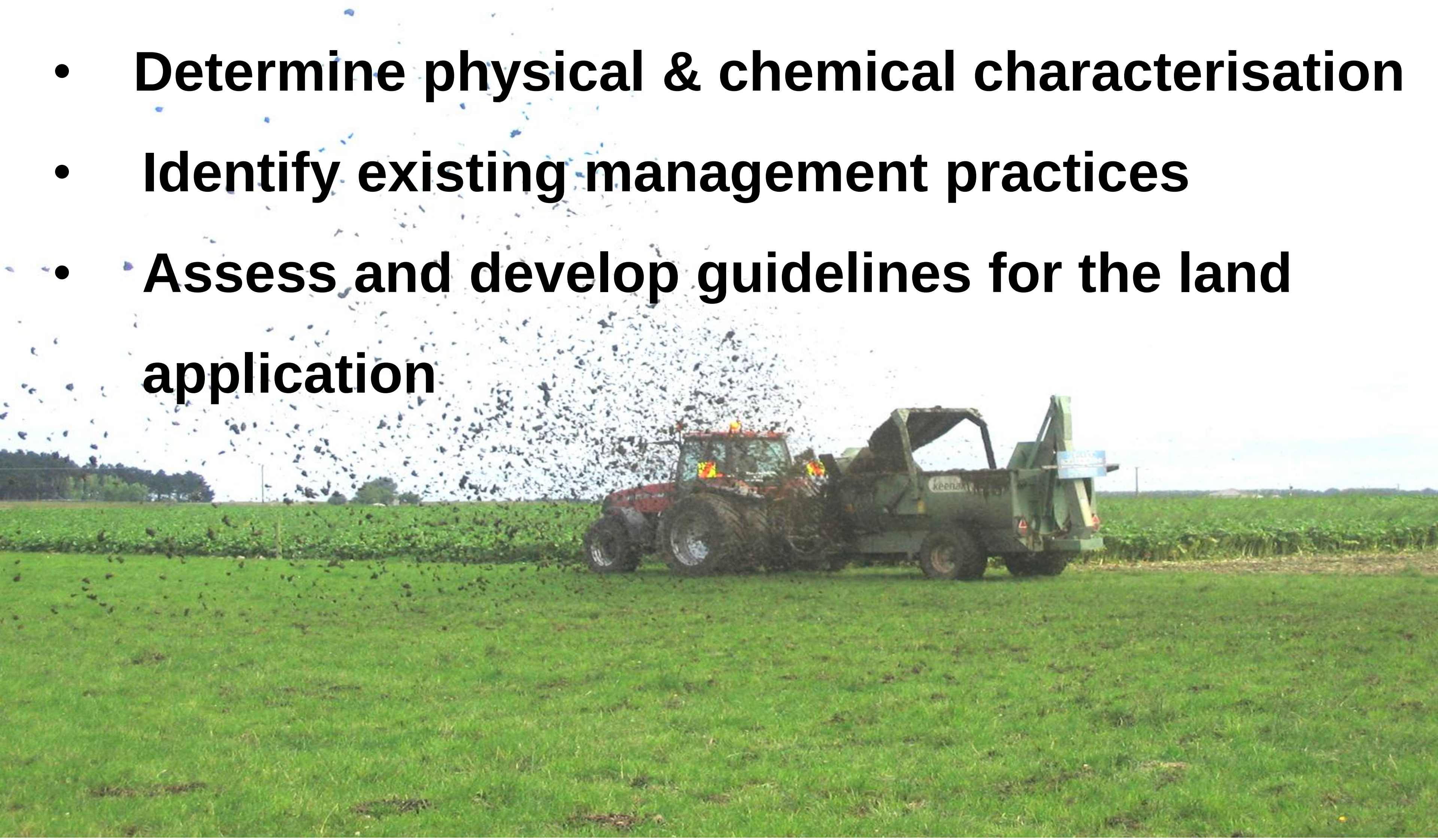
PROJECT'S OBJECTIVES

- Determine physical & chemical characterisation
- Identify existing management practices
- Assess and develop guidelines for the land application



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METHODOLOGY

16 land application case studies

- Effluent collected in transects (measure volume or weight)
- Application depth (mm) and rate (m^3/ha)
- Determine nutrient loading (kg/ha)
- Spreading distribution pattern
- Uniformity (DU_{UQ})

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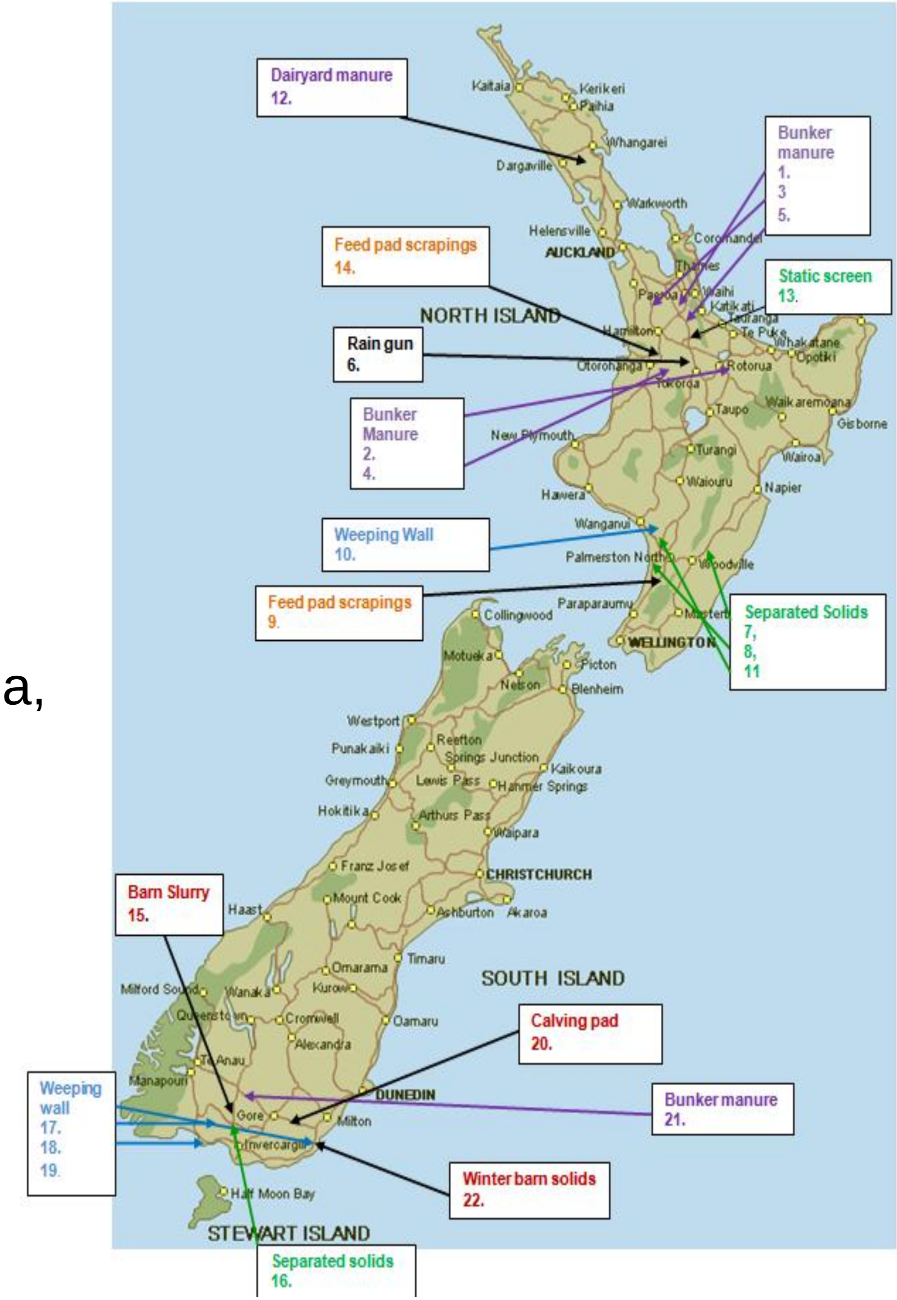
Sampling sites and system type

22 sites

7 regions
(Northland, Waikato, Bay of Plenty, Manawatu, Wairarapa, Otago, Southland)

8 generic systems

24 manure or slurry products



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GUIDELINES ON EFFLUENT CLASSIFICATION

Total solids (%)							
0	5	10	15	20	25	30	35
Liquid		Semi-liquid		Semi-solid		Solids	
Pump & Piping		Auger	Tractor scraper/loader				
Tanker			Muck spreader				
Sprinkler							

Source: NZAEI, 1984

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MANURE SYSTEMS

Raw manure systems

Carbon-rich systems

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MANURE SYSTEMS……

MANURE CHARACTERISTICS (mean values)

Manure system	% DM	Total N kg/t	Mineral N kg/t	Total P kg/t	K kg/t	Carbon %
Barn slurry [1]	8	3.2	1.4	0.8	4.2	3
Static screen [2]	11	2.3	-	0.4	0.7	-
Mechanical	25	3.6	0.2	0.6	1.0	10
Weeping wall	23	2.4	0.3	0.6	0.9	5
Feed pad	26	5.9	0.4	1.3	7.7	8
HerdHomes®	23	5.6	1.6	1.4	6.7	10
Carbon pads	38	3.7	0.5	1.1	5.3	15

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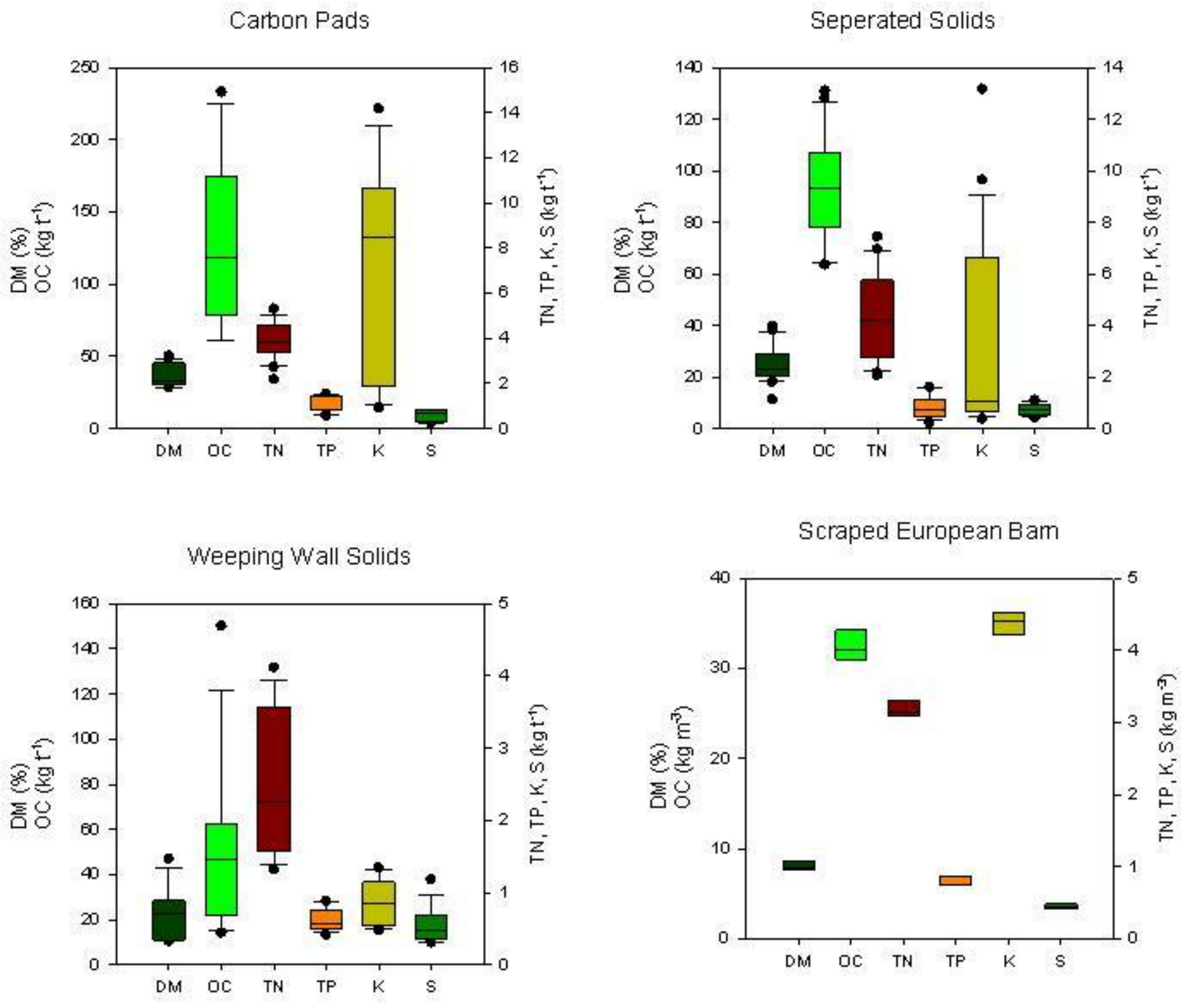
[1] kg/m^3

[2] Data supplied by Murray McEwan,
GEA Farm Technologies NZ Ltd, Cambridge

NUTRIENT VARIABILITY IN DAIRY SOLIDS



Weeping wall

Manawatu case study

%	FDE	Solids	Liquid
DM	1.8	21	0.3
Total N	0.07	0.26	0.03
Mineral-N	0.03	0.01	0.02
Total P	0.02	0.05	0.01
Potassium	0.06	0.08	0.04
Carbon	0.6	3.7	0.1
Min-N/TN	44	1	67
N:K ratio	1.3:1	3.4:1	0.6:1

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Mechanical solid separation

Manawatu example

%	FDE	Solids	Liquid
DM	0.6	22	0.3
Total N	0.02	0.24	0.02
Mineral-N	0.01	<0.01	0.01
Total P	0.009	0.055	0.007
Potassium	0.04	0.08	0.05
Carbon	0.2	8.8	0.1
Min-N/TN	53	1	81
N:K ratio	0.5:1	3.2:1	0.4:1

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HerdHomes® shelters (pooled data)

%	Liquid	Solids	Slurry
DM	1.8	23.1	11.0
Total N	0.09	0.56	0.43
Mineral-N	0.06	0.16	0.17
Total P	0.01	0.14	0.10
Potassium	0.41	0.67	0.64
Min-N/TN	62	28	39
N:K ratio	0.2	0.7	0.9

DELIVERY SYSTEMS

Three different spreading systems were evaluated:

1) slurry tankers

2) muck spreaders

3) tip truck approach with tractor fitted back blade for spreading

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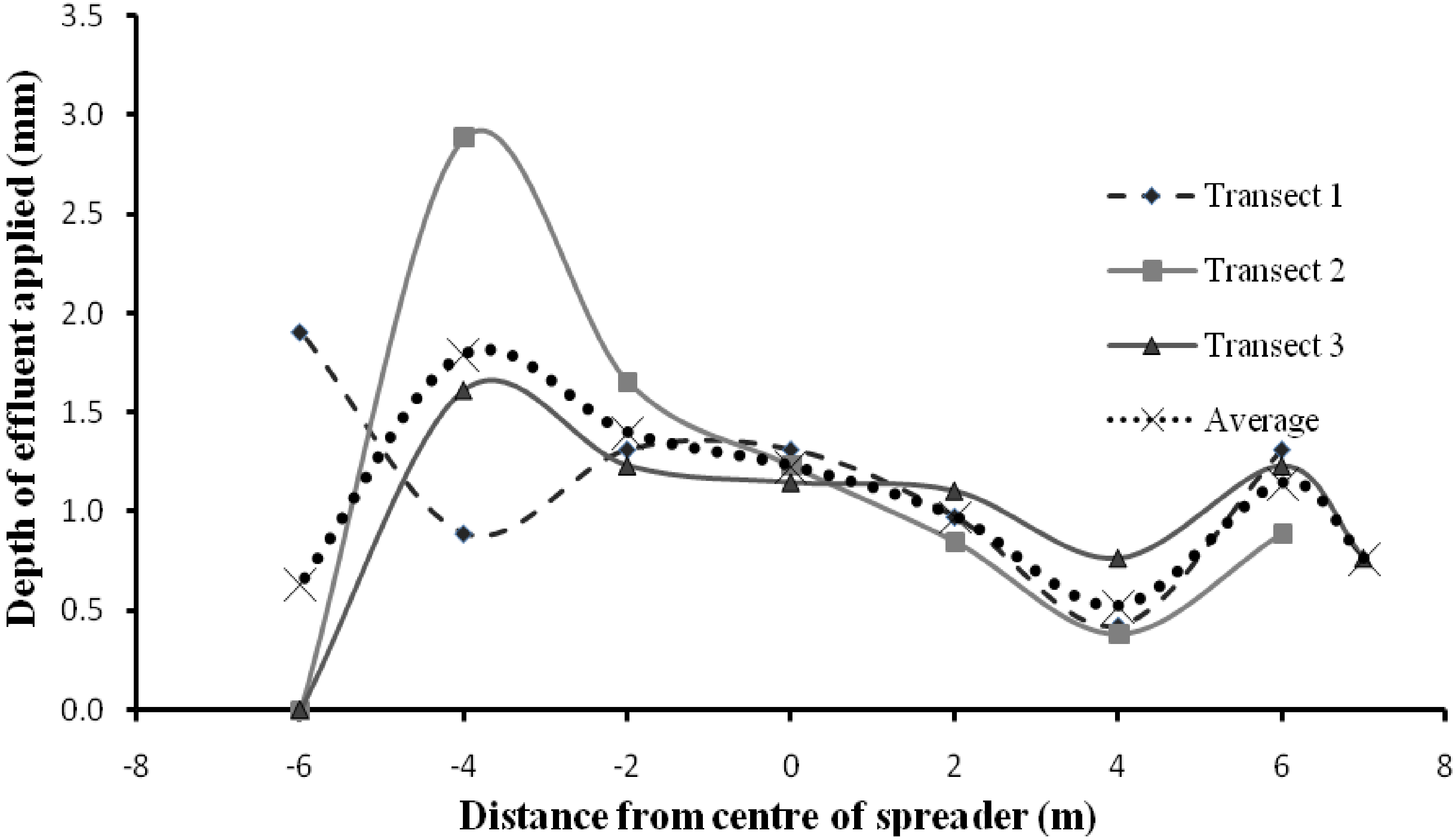
SPREADING UNIFORMITY
eg., THREE PASSES FROM SAME SYSTEM



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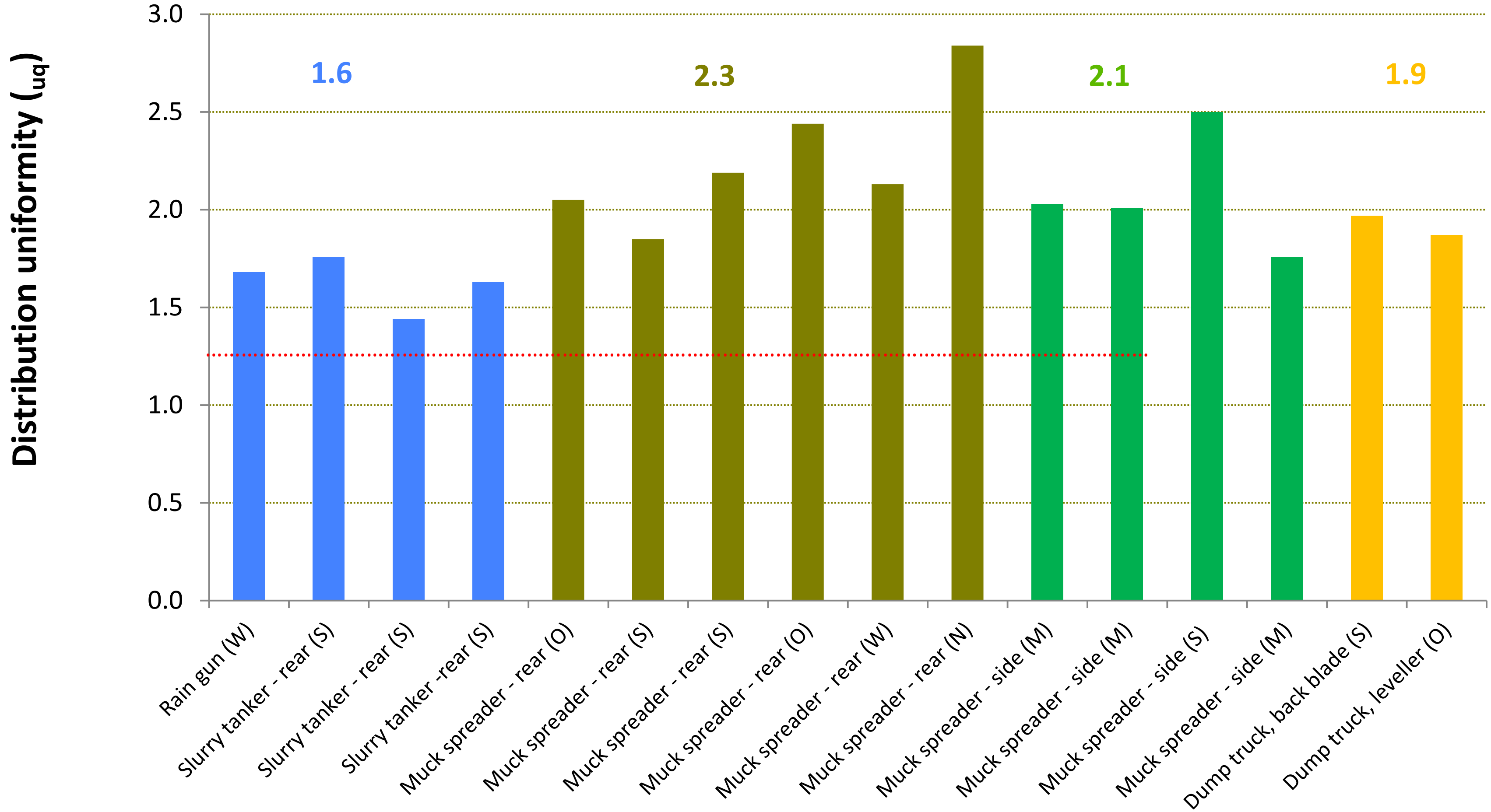
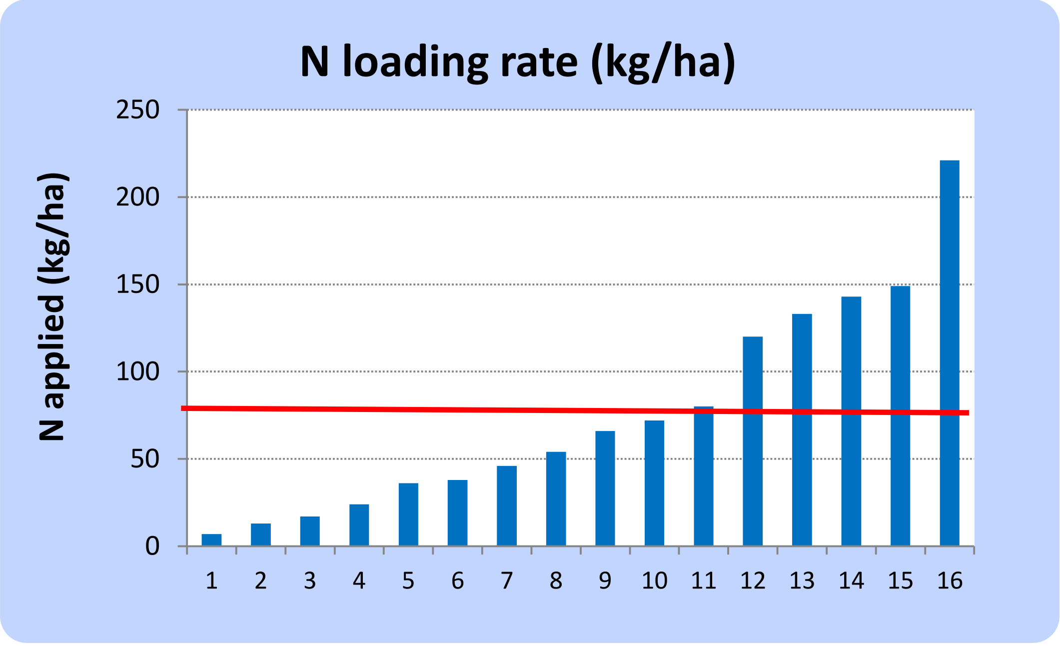
SPREADING UNIFORMITY FOR DIFFERENT SPREADING SYSTEMS



DU_{uq} of < 1.25 should be achieved for all liquid effluent application systems (COP)

NITROGEN LOADING RATES

- **Mean N loading rate of 80 kg N/ha**
- **15/16 cases studies <150 kg N/ha (mean)**
- **One case study applied c. 220kg N/ha to maize**
    - Crop N loading dependant upon yield and residual soil N supply

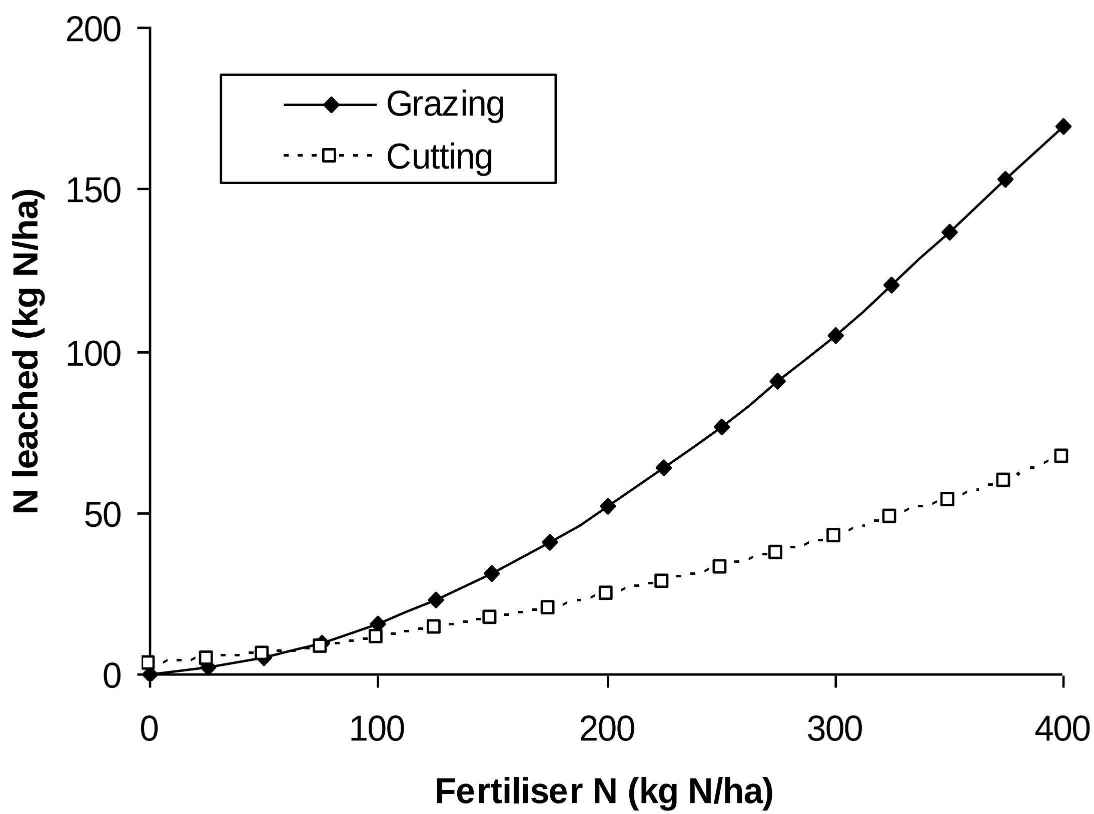


NITROGEN LOADING RATES

- **Relationship between N loading rate & leaching loss**
- **RC’s use max. N loading rates of 150 or 200 kg N/ha/yr**

  for dairy effluen

- **High K loading rates, particularly in slurries**



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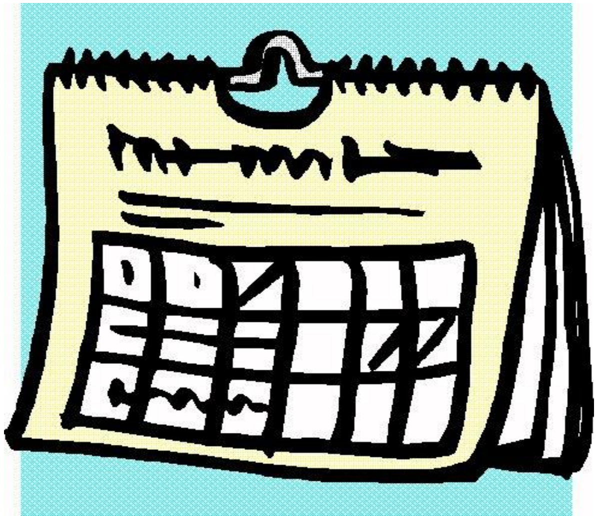
KNOW WHAT IS BEING APPLIED

- **Laboratory analysis** (most accurate but costly and time delays)
- **Rapid testing** (further development required, NH_4 ok)
- **Default values** (quick & easy, may not represent system)
- **OVERSEER® nutrient budget** (estimates loading but not conc.)


TIMING CONUNDRUM

Season	Risk	Mitigation
Summer/early autumn	N volatisation	Timing with weather, N form
Autumn	N leaching	DCD, N form
Winter/early spring	P & N runoff	Storage
Late spring	Optimum window	

Stored slurry (NH_4) > risk of N leaching than manure (Org N)



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MATCHING FDE APPLICATION TO SOIL & LANDSCAPE RISK

Category	**A**	**B**	**C**	**D**	**E**
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rate	Sloping land (>7°) or land with hump & hollow drainage	Well drained flat land (<7°)	Other well drained but very stony[x] flat land (<7°)
Application depth (mm)	< SWD*	< SWD	< SWD	< 50% of PAW#	≤ 10 mm & < 50% of PAW#
Instantaneous application rate (mm/hr)	N/A**	N/A**	< soil infiltration rate	N/A	N/A
Average application rate (mm/hr)	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate	< soil infiltration rate
Storage requirement	Apply only when SWD exists	Apply only when SWD exists	Apply only when SWD exists	24 hours drainage post saturation	24 hours drainage post saturation
Maximum N load	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr
Risk	High	High	High	Low	Low

Best management practice dependant on soil properties

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FRAMEWORK FOR EFFLUENT SOLIDS

Category	A	B	C	D
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rate	Sloping land (>7°) or land with hump & hollow drainage	Well drained flat land (<7°)
Application volume - slurry	< 50m^3/ha	< 50m^3/ha	< 50m^3/ha	< 50m^3/ha
Application volume - solids	<3 t DM/ha	<3 t DM/ha	<3 t DM/ha	<3 t DM/ha
Soil moisture at application - slurry	Application depth <SWD	Application depth <SWD	Application depth <SWD	Avoid saturation: field capacity or drier
Soil moisture at application - solids	Avoid saturation: field capacity or drier	Avoid saturation: field capacity or drier	Avoid saturation: field capacity or drier	Avoid saturation: field capacity or drier
Maximum N load - pasture	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr
Maximum N load - crop	Crop and site dependant	Crop and site dependant	Crop and site dependant	Crop and site dependant
Tactical timing if not incorporated	> 10 days until runoff event (min 48 hrs)	> 10 days until runoff event (min 48 hrs)	> 10 days until runoff event (min 48 hrs)	> 10 days until runoff event (min 48 hrs)
Optimum time of year	Late spring	Late spring	Late spring	Late spring
Minimum soil temperature	4 ºC	4 ºC	4 ºC	4 ºC

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RECOMMENDED BEST PRACTICE

Practice	Recommendation
Characterisation	2 from: lab test, default values, Overseer nutrient budgets
Application volume	<50m^3/ha slurry, 3 t solids/ha manure
Soil moisture at application	Soil type and effluent dependant
Maximum N load (kg/ha/yr)	150 N (pasture); site/crop dependant (cropping)
Tactical timing if not incorporated	> 10 d until runoff event (min 48hrs)
Minimum soil temperature	4^o C
Optimum time of year	Late spring

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6% DM Slurry, 3000 mg N/L at 50 m^3 =150 kg N/ha

TRAILING SHOE TECHNOLOGY

- Band spread direct to soil
- Pasture sward uncontaminated
- Large reductions of NH_3 loss
- Increased N use efficiency
- Controlled loading rates and uniformity

CONCLUSIONS

- Physical & chemical characteristics differ between systems
- Population database on some systems still very small
- Spreading uniformity: generally poor.........problem?
- Slurry spreading systems more accurate than muck spreaders
- N loading generally well managed, K sometimes excessive
- Recommended rates: < 50m^3/ha slurries; 3 t solids/ha manures
- Optimum time for land application: late spring
- 10-day window required between application and surface runoff in order to minimise environmental risks

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