



**BUREAU OF SUGAR EXPERIMENT STATIONS
QUEENSLAND, AUSTRALIA**

PROJECT No. 2025

FINAL REPORT

BENCH TESTING OF NEW NITROGEN PRODUCTS
FOR POTENTIAL AMMONIA VOLATILISATION -

When broadcast onto soil or sugarcane trash

(N-GOLD"A", N-GOLD"B")

by

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CONTENTS

1.0	SUMMARY	1
2.0	INTRODUCTION	1
3.0	METHOD	1
4.0	RESULTS	2
5.0	DISCUSSION	3
6.0	CONCLUSION	3
7.0	REFERENCES	4

1.0 SUMMARY

N-Gold"A" and N-Gold"B" are granulated products containing urea and calcium oxide with 42.4 and 43.2 % N and 1.5 and 1.3 % Ca respectively. When broadcast onto soil or a green cane trash blanket, ammonia volatilisation losses were not different to those from prilled or granulated urea when tested in the laboratory. These products produced a more alkaline solution than urea and, in theory, this would slightly increase the ammonia volatilisation losses, but this did not happen in this experiment.

N-Gold"A" and N-Gold"B", when analysed for N content in 0.5 g samples, showed more variation than for prilled or granulated urea. This variation is unlikely to cause any deleterious effects when used as a fertiliser but could have implications for quality control.

2.0 INTRODUCTION

N-Gold"A" and N-Gold"B" are new granulated urea products manufactured at Gibson Island. The products both have calcium oxide in the formulation, which makes a 10% solution of the products more alkaline (pH 8.5) than a 10% solution of granulated urea (pH 7.8). It is therefore likely that the use of these products, as a surface applied fertiliser to soil or green cane trash, would lead to increased ammonia volatilisation compared to granulated urea.

The Australian sugar industry is looking for nitrogen fertilisers which can be surface applied, be cost competitive, and reduce ammonia volatilisation losses. Granulated urea is currently the preferred form of nitrogen because of its low cost per unit of nitrogen. Urea has the disability that ammonia volatilisation losses can be as high as 40% of that applied, under conditions favourable for volatilisation losses (Denmead *et al* 1990, Freney *et al* 1991, Freney *et al* 1992). Other loss processes such as leaching and denitrification, also significantly reduce the efficiency of nitrogen fertiliser processes by the crop. These two new products would be similar to urea with regard to these loss processes.

N-Gold"A" and N-Gold"B" were compared to granulated and prilled urea by the technique of bench-testing for potential ammonia volatilisation (Chapman *et al* 1994).

3.0 METHOD

Air dry soil was placed into 24 PVC cylinders, 15 cm diameter by 20 cm high, with sealable lids. The soil was top-soil of a non-calcic brown from the Mackay Sugar Experiment Station. Texture was sandy loam, pH(H₂O) 5.0, cation exchange capacity 12.9 me%, organic C 1.1%, water content at field capacity 20% w/w. Soil was wet to field capacity. Fresh cane trash (30% moisture) was coarsely chopped and applied to half the cylinders. Four fertiliser treatments, N-Gold"A", N-Gold"B" prilled and granulated urea supplying 160 kg N/ha were applied to the trash and soil surface, with 3 replicates per treatment. Simulated rainfall of 0.5 mm was applied to moisten the fertiliser and the sealable lids were attached. Air was passed over the trash or soil surface to remove the volatilising ammonia which was caught in acid traps containing 400 mL of 0.5M H₂SO₄.

Needles 0.45 mm (26 gauge) were fixed to the outlets from the cylinders to equalise the airflow to each cylinder and give a uniform bubble pattern in each acid trap (see Appendix 1 for summary of methods). Traps were changed at days 2, 5, 7, 9 and 12 days and the NH₃ analysed by automatic colorimeter by the indophenol blue method. When the traps were changed on days 2, 5, 7 and 9 the cylinders were opened and 0.5 mm of rainfall was simulated to moisten the soil or trash surface and promote ammonia volatilisation. The NH₃ recovered at each sampling was accumulated to give the total lost from each cylinder and these data were analysed for variance. Three samples of each fertiliser (0.5g) were analysed to determine the uniformity of N content.

4.0 RESULTS

The ammonia volatilised over time is presented in Table 1 and Figure 1. Applying the fertiliser onto trash instead of soil increased the ammonia volatilised from 10 to 27 kg N/ha at 12 days after fertilising. The variation in the amount of ammonia volatilised from each fertiliser was not statistically significant ($P \geq 0.05$) at any time. There were no significant ($P \geq 0.05$) interactions between fertiliser and application method.

TABLE 1 Ammonia volatilised, accumulated over time, from fertilisers when applied at 160 kg N/ha to the surface of trash and soil (no trash)

TREATMENT	DAY 2	DAY 5	DAY 7	DAY 9	DAY 12
	-----kg N/ ha-----				
Trash	1.3 <i>a</i>	19 <i>a</i>	25 <i>a</i>	26 <i>a</i>	27 <i>a</i>
No trash	0.9 <i>b</i>	7 <i>b</i>	9 <i>b</i>	10 <i>b</i>	10 <i>b</i>
Error	0.3	2	5	5	5
Granulated urea	2 <i>a</i>	14 <i>a</i>	16 <i>a</i>	18 <i>a</i>	18 <i>a</i>
N-Gold"A"	1 <i>a</i>	12 <i>a</i>	20 <i>a</i>	22 <i>a</i>	22 <i>a</i>
N-Gold"B"	1 <i>a</i>	14 <i>a</i>	17 <i>a</i>	18 <i>a</i>	18 <i>a</i>
Prilled urea	1 <i>a</i>	12 <i>a</i>	14 <i>a</i>	15 <i>a</i>	15 <i>a</i>
Error	0.4	2	5	5	5

ab - Means are different ($P \geq 0.05$) if followed by different letters.

The particle size of N-Gold"A" and N-Gold"B" in the samples provided was more variable than prilled or granulated urea. Analysis of samples for total N also showed a higher coefficient of variation for N-Gold"A" and N-Gold"B" than for prilled or granulated urea (Table 2)

TABLE 2 Analyses of 0.5g samples of fertilisers for N content and variation.

	N-Gold"A"	N-Gold"B"	Prilled urea	Granulated urea
	----- N % -----			
	36.6*	38.7*	42.0	43.6
	38.8*	38.6*	42.0	43.9
	42.2*	40.8*	42.6	44.4
Mean	39.2	39.4	42.3	43.9
Coefficient of variation	7.1	3.0	0.7	0.9

* These analyses were from the products as supplied and were not adjusted for moisture content.

5.0 DISCUSSION

The amount of NH₃ volatilised from surface applied fertiliser is influenced by alkalinity in the vicinity of a granule of fertiliser. As a solution of N-Gold"A" and N-Gold"B" is more alkaline than a solution of urea, then surface broadcast N-Gold"A" or N-Gold"B" could have higher ammonia volatilisation losses. This was not demonstrated in this experiment. The higher coefficient of variation in the N content of N-Gold"A" and N-Gold"B" than urea is unlikely to affect the former products as a fertiliser. However, the variation could have implications for quality control.

6.0 CONCLUSION

N-Gold"A" and N-Gold"B" had the same rate of NH₃ volatilisation as prilled and granulated urea when broadcast onto soil or green cane trash.

7.0 REFERENCES

- Chapman L S, Haysom M B C, Royal A J and Makepeace P (1994) Bench testing of nitrogen products for potential volatilisation, BSES publication
- Denmead O T, Freney J R, Jackson A V, Smith J W T, Saffigna P G, Wood A W and Chapman L S (1990). Volatilisation of ammonia from urea and ammonium sulfate applied to sugarcane trash in north Queensland. Proceedings of the Sugar Cane Technologists Conference.
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- Freney J R, Denmead O T, Wood A W, Saffigna P G, Chapman L S, Ham G J, Hurney A P and Stewart R L (1992). Factors controlling ammonia loss from trash covered sugarcane fields fertilised with urea. Fertiliser Research, **31**, 341-349.

APPENDIX 1

BENCH TEST NO. 12

20/09/95

POTS: 3.5 kg soil
20 g trash at 30% moisture
700 mL water applied to bring soil to field capacity

TREATMENTS USED:		Product (g/plot)	kg N/ha
1	Prilled urea/trash	0.615	160
2	Prilled urea/no trash	0.615	160
3	N-Gold"A"/trash	0.667	160
4	N-Gold"A"/no trash	0.667	160
5	N-Gold"B"/trash	0.655	160
6	N-Gold"B"/no trash	0.655	160
7	Granulated urea/trash	0.615	160
8	Granulated urea/no trash	0.615	160

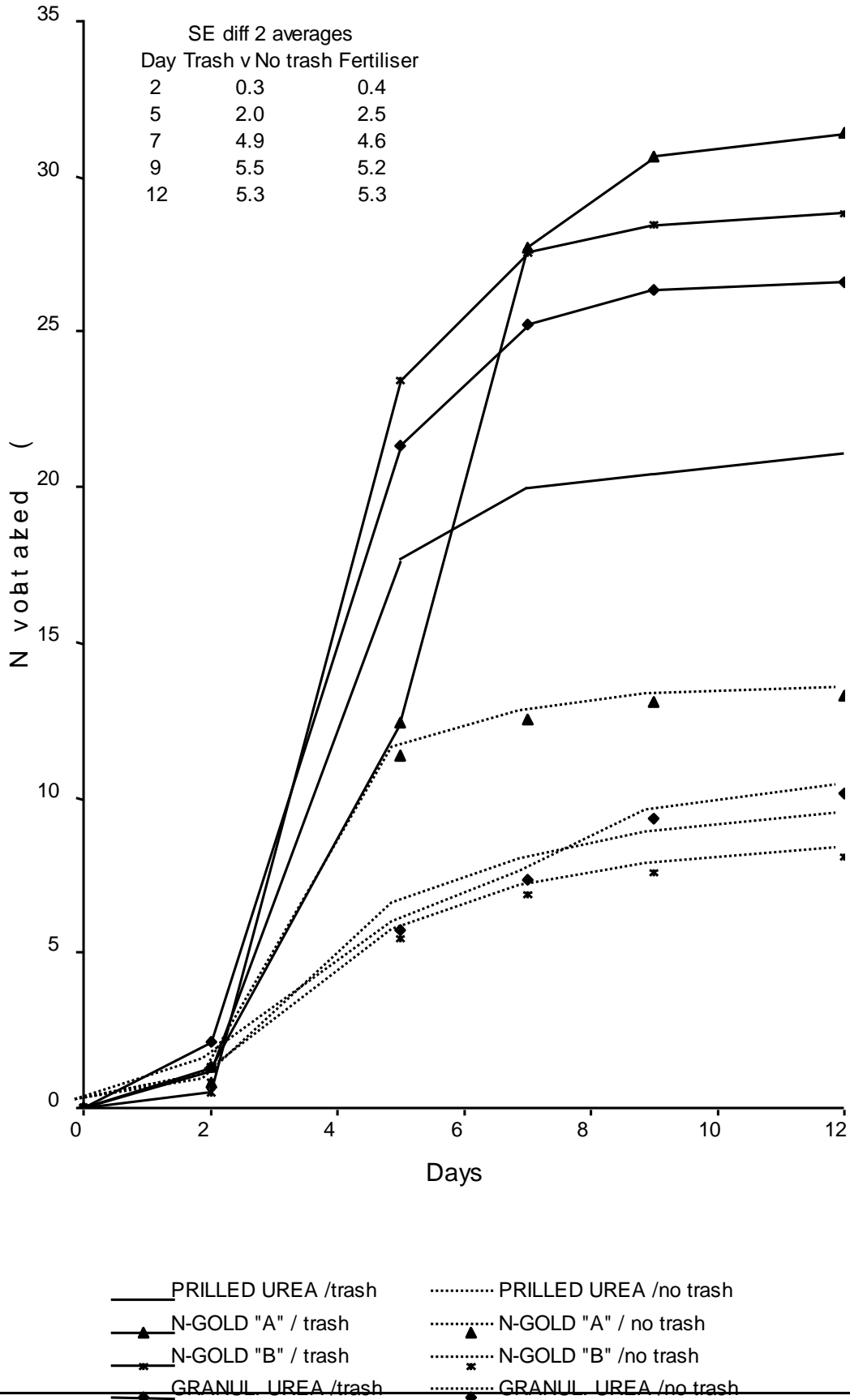
PLOT AREA: 176.8 cm²
AIRFLOW: 5 L/min
SIMULATED RAIN: 0.5 mm per event (8.8g/plot)
ACID TRAPS: 400 mL of 0.5M Sulfuric acid diluted to 500 mL
NEEDLE SIZE: 0.45 mm (26 gauge)
TEMPERATURE: Glasshouse range (Min. 15 - 22°C, Max. 35 - 38°C)
COMMENCED: Day 0 20-Sep
Day 2 22-Sep
Day 5 25-Sep
Day 7 27-Sep
Day 9 29-Sep
Day 12 2-Oct

BENCH PLAN:

4-2	4-1	3-3	6-1
6-2	3-2	4-3	7-2
3-1	8-2	5-3	1-1
5-1	7-3	1-3	1-2
6-3	8-3	2-3	5-2
7-1	2-2	2-1	8-1

0 - 0 = treatment, replication

Figure 1. Accumulated ammonia volatilized from fertiliser treatments applied to green cane trash or soil at 160 kg N/ha.



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**FINAL REPORT ON BENCH TESTING OF NEW
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ONTO SOIL OR SUGARCANE TRASH (N-GOLD"A",
N-GOLD"B")**

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AS PER ATTACHED LIST

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13 MAY 1996**