

BUREAU OF SUGAR EXPERIMENT STATIONS  
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PROJECT REPORT

EVALUATION OF BIOSTIL DUNDER -  
AND MIXTURES WITH NITROGEN  
FERTILISERS FOR SUGARCANE NUTRITION

by

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## INTRODUCTION

Dunder is a byproduct produced at CSR's ethanol distillery in Sarina. Dunder has significant levels of essential plant nutrients: in particular potassium, but also nitrogen, phosphorus, calcium, magnesium, sulfur and trace elements.

The fertiliser potential of dunder (Usher *et al* 1979), has now been recognised by canegrowers. The use of dunder by canegrowers has increased from nil in 1979 to an estimated 76% of the assigned cane land treated in the Plane Creek and Racecourse mill areas (Chapman *et al* 1987).

The nutrient concentrations in dunder are low, hence application rates of up to 15 t/ha are required. Consequently, transport costs increase the total cost of the product significantly, and in 1987 only 60% of the total output could be recycled onto farms. The remainder was sprayed onto a disposal area at Oonooie, where water is evaporated and solids are bio-degraded (Usher *et al* 1979).

In 1989 CSR commissioned a new distillery at Sarina, which uses an advanced biostil technology. The biostil dunder from this new plant will ultimately have nutrient concentrations four times greater than those in the old dunder resulting from a reduction in water content of dunder from 90% to 60%. This reduction will improve the economics of transporting biostil dunder to more distant cane fields.

The aims of this project were:

- (a) to measure the cane and sugar yield responses from the application of biostil dunder on its own and in mixtures with nitrogen fertilisers in field trials.

to assess the suitability of these treatments for sugarcane nutrition.

These treatments relate to a possible management strategy on cane farms, ie to broadcast sufficient phosphorus fertiliser on fallow land for the crop cycle, and then use a mixture of dunder and nitrogen fertilisers to provide the total N and K requirements for each crop in a single field application.

## METHODS

### Biostil dunder

A simulated biostil dunder was produced by evaporating water from dunder in a specially constructed kettle at CSR's distillery at Sarina. The simulated biostil dunder contained 6.0, 0.5, 38.0, 9.1, 6.3 and 3.3 kg/kL of N, P, K, Ca, Mg and S respectively.

### Sites

Four trial sites on the properties on Messrs Pat Young, Walkerston; John Galea, Te Kowai; Tom Reed, Mt Chelona; and Jim Pedersen, Koumala, were selected to cover a

range of soil types. These were respectively: sandy loam (non-calcic brown), clay loam (solodic), sand (yellow gleyed podzolic) and, loam (prairie). Soil samples (0-250 mm), each of 10 cores, were collected from each site before establishment and analysed by BSES methods.

The cane crops were Q63 third ratoon, Q123 third ratoon, H56-752 first ratoon, and Q136 first ratoon respectively. The previous crop on Mr Galea's trial site was harvested green, but at all other sites the previous crops were burnt before harvest.

#### Treatments

Treatments included a control (no biostil dunder), biostil dunder, biostil dunder plus urea or nitram mixtures and biostil dunder plus urea or nitram banded separately.

The biostil dunder and the biostil under nitrogen mixtures (urea and nitram readily dissolved in biostil dunder) were poured onto the interrow, while the urea or nitram were broadcast on the cane row.

Dunder was applied at 2.5 kL/ha (3 t/ha = 95 kg K/ha), urea and nitram at 160 kg N/ha. A basal application of superphosphate (30 kg P/ha) was applied to all plots.

Trials were established between late July and early August 1988, except Reed's trial (December 1988), within eight weeks of the previous harvest. Treatments were replicated four times at each site.

#### Yield estimates

Cane yields were estimated at harvest in 1989 when each crop was approximately 12 months old. Harvest weights were recorded by special truck mounted weighing machine in two of four replicates after cutting with a commercial cane harvester. Samples of six stalks of cane were collected from each plot, crushed by a small mill, and the juice analysed for ccs content. Sugar yield was estimated as the product of ccs (minus 1.5 units) by cane yield.

#### Leaf samples

Third leaf samples were collected from Reed's trial 3, 5, 7, 9 and 13 weeks after fertilising, commencing on 23rd December, 1988. Five leaf blades (20 cm of the mid section with the mid-rib removed) were collected from each plot and then combined to give one sample per treatment at each time of sampling. The samples were analysed for total N, P, K, Ca, Mg and S.

## RESULTS AND DISCUSSION

### Yield

In Young's, Galea's and Reed's trials, but not in Pedersen's, the treatments significantly ( $P < .05$ ) improved cane yields (Table 1). In this latter trial yield variances were high, consequently yield increases from treatments were not significant. The mean yields in Galea's trial were low, probably due to waterlogging rather than trash conservation.

The increases in cane yield from biostil dunder were small. However, cane yield responses were highest where the soil potassium levels were lowest (Table 2) which is consistent with the role of dunder as mainly a source of K.

The level of cane yield responses, of six and seven tonnes/ha respectively from Young's and Pedersen's trials, were similar to those reported by Chapman (1982) for ratoon trials at Mackay fertilised with potassium chloride. Bieske (1979) compared 120 kg K ha<sup>-1</sup> as potassium chloride with the same amounts of K from dunder at Fairymead. Both sources of K gave equal yield responses of tonnes of cane per hectare. In all treatments which included nitrogen fertilisers, the responses in cane yield improved.

In all trials biostil-dunder/nitram mixtures gave equal or higher yields than biostil-dunder/ urea mixtures. This result is consistent with NH<sub>3</sub> volatilisation losses which can occur from urea when it is spread on soil or trash (Denmead et al 1990). Usually no such losses occur from nitram. More work would be required to substantiate the proposition that the mixture of biostil dunder with urea reduced NH<sub>3</sub> volatilisation losses.

In three out of four trials treatments with the nitrogen fertilisers applied on the cane row and the biostil dunder applied in the interrow, gave better cane yields than treatments with biostil-dunder/nitrogen mixtures applied in the interrow. Nitram when banded in the row had very little advantage in cane yield over urea. This result is opposite to that which could be expected as the NH<sub>3</sub> volatilisation losses from urea should disadvantage it compared to nitram.

The differences in yields between biostil dunder and nitrogen fertilisers, applied separately and biostil-dunder/nitrogen mixtures are probably due to the different placements of the N fertilisers rather than to some problem with the dunder/nitrogen mixtures. This aspect will be discussed further in the next section on leaf assays.

Soil tests at establishment (Table 2) indicated that all nutrients except potassium were at suitable levels for normal growth of cane.

There were no significant CCS responses to treatments, thus the sugar yield results show the same pattern as those for cane yield.

## Leaf assays

The assays of third leaf samples from Reed's trial are plotted against time of sampling in Figures 1 - 6. Except for some nitrogen data, the concentrations of nutrients in third leaves were generally higher than critical values - thus indicating normal growth.

The treatments, with the N fertilisers banded on the cane row had much higher concentrations of N in the leaves three and five weeks after application than the other treatments. It is probable that the early uptake of nitrogen by banding N fertilisers in the cane row has led to a better use efficiency of N - hence the higher final yields of cane in these treatments. It was only in Young's trial that the N banded in the cane row treatments were not the highest yielding, and at this site the reduced soil moisture following application may have been a contributing factor.

The K nutrition for all treatments in Reed's trial appeared satisfactory by the leaf assay evidence (Figure 3). This is supported by the cane yield data, for no increase in yield occurred from the biostil dunder treatment compared to the control.

## CONCLUSIONS

The K in biostil dunder is in solution and thus available to cane plants. However, biostil dunder alone did not produce a significant ( $P < .05$ ) cane yield response in any of the trials, probably because adequate K was present before the dunder applications. In two trials non significant ( $P > .05$ ) cane yield responses (six and seven tonnes of cane per hectare) were equal to the significant ( $P < .05$ ) responses from normal dunder recorded by Bieske (1979). In two of the trials no cane yield responses occurred.

The mixing of nitrogen fertilisers with biostil dunder could be considered as an option in a fertilising program for cane growers, either following burnt or green cane harvesting. However, further evaluation of the effect of applying the biostil nitrogen mixture to the row rather than the interrow should be considered, for row application could be preferable. Only the interrow application was evaluated in this program.

Biostil dunder nitram mixtures may be slightly superior to biostil dunder urea mixtures, but economics would have to be considered. These data have indicated that N fertilisers may be more effective when applied to the row rather than to the interrow. It is suggested that the row placement of dunder may also be better than the interrow placement which is currently used, and this should also be evaluated.

## ACKNOWLEDGMENTS

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TABLE 1 - Effect of biostil dunder/fertiliser treatments on cane and sugar yields, and ccs.

Trial Site Cane (t/ha) TREATMENTS	YOUNG	GALEA	REED	PEDERSEN
C	71	33	64	85
D	77	31	66	92
D + U (R)	96	37	75	96
D + N (IR)	98	37	69	114
D (IR), U (R)	92	54	79	117
D (IR), N (R)	95	53	80	117
l. s. d. (P = .05)	13	13	9	n. s.
CCS (-1.5 units)				
C	14.0	15.6	15.2	15.6
D	14.0	15.0	14.6	15.1
D + U (IR)	13.6	14.7	14.8	15.6
D + N (IR)	13.1	15.0	15.2	14.4
D (IR), U (R)	13.9	15.3	14.5	15.6
D (IR), N (R)	14.0	14.8	14.7	15.0
l. s. d. (P = .05)	n. s.	n. s.	n. s.	n. s.
Sugar_ (t/ha)				
C	10.0	5.7	9.7	13.3
D	10.9	4.6	9.6	13.9
D + U (IR)	13.1	5.4	11.2	15.0
D + N (1R)	12.9	5.5	10.5	16.4
D (R), U (R)	12.7	8.3	11.6	18.3
D (R), N (R)	13.6	7.9	11.8	17.6
l. s. d. (P = .05)	2.4	2.5	1.5	n. s.

C	==	control (no biostil dunder)
D	==	biostil dunder (2.5 kL/ha)
N	==	nitram (160 kg N/ha)
U	==	urea (160 kg N/ha) banded on
(R) (OR)	==	row poured on interrow
l. s. d.	==	least
n. s.	==	significant difference not
	==	significant (P > .05)

TABLE 2 - Mean soil assays at the commencement of the trials

SITE	PH (H <sub>2</sub> O)	SEC	P mg/kg	Ca me%	Mg me%	Na me%	K me%
YOUNG	5.46	.02	122	2.12	1.46	.10	.13
GALEA	5.81	.02	160	1.98	0.46	.07	.15
REED	6.95	.02	116	2.18	0.62	.03	.25
PEDERSEN	5.53	.01	19	4.75	1.71	.07	.11