

## **A new anhydrous ammonia distributor**

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### **Introduction**

In answer to a request in 1989 for engineering research project ideas, the Australian Cotton Growers Research Association nominated a major problem of "striping" and the resultant lost production in cotton crops. Discussions with local cotton growers and with Incitec (the sole manufacturers of anhydrous ammonia ( $\text{NH}_3$ ) in Australia) continued to support the belief that  $\text{NH}_3$  metering and distribution equipment was inaccurate (up to 30% too high at high rates of application had been reported on a number of occasions on recently calibrated meters). Clear evidence was also visible of "striping", particularly in the Macquarie Valley, NSW. Unfortunately, attempts by the  $\text{NH}_3$  equipment companies in the past 40 years (eg. Shell, John Blue and Continental) in the USA and Europe to overcome these problems have not been successful.

The Agricultural Engineering Research Unit, based at Trangie ARC, undertook a research program to ensure an even and adequate (but not excessive) supply of  $\text{NH}_3$  to the crop in conditions which allow full utilisation by the crop. By so doing, this would either reduce or eliminate the presence of "striping" in cotton. The research program was initiated in 1989 to (i) determine the level and cause of variability in  $\text{NH}_3$  flow and distribution from the outlets of rigs, and (ii) modify the  $\text{NH}_3$  application systems to ensure even flow and distribution.

### **Prototype development**

A total of 20 experiments have been run since 1989 to address the area of distribution variation. Of these experiments, the latest two conducted in the laboratory have compared 10 different metering and distribution systems, comprised of current commercial metering systems fitted with their commercial distribution/ manifolds systems and the same metering systems fitted with a range of prototype manifold distributors or other attachments developed during the previous experimental phase (see Table 1).

The NH<sub>3</sub> metering and distribution systems were set-up to simulate a conventional 8-row system. The NH<sub>3</sub> distributed down each of the 8 hoses emanating from the manifolds was collected in individual collection drums (specifically designed for these experiments). The flow rate could then be determined for each hose from measurements of the height increase in the water level in each drum (mm) caused by the flow of NH<sub>3</sub> during a 60 sec interval. These different combinations were tested at a flow rate of 2000 lbs/hr NH<sub>3</sub> for a period of 60 seconds.

The prototype manifold distribution device "C" developed as part of this research program proved to be the most successful during laboratory experiments. These laboratory experiments found that variation (measured as coefficient of variation) of flow from the 8 manifold outlets was less than 5% of the mean distributed flow, compared to around 15-20% from the current commercial manifolds offered by Continental and John Blue.

#### **Field verification**

Two experiments were subsequently established to determine whether the better distribution pattern from prototype manifold "C" could be achieved in the field and whether this may have any impact on the appearance of "striping" and/or cotton crop growth and yield.

The first experiment was sited on field 4 at **Darling Farms, Bourke**, NSW owned by the Buster Farming Partnership. The treatment variables were nitrogen rate (100, 150 and 200 kg N/ha) as main plots and manifold type (Continental RPR and Trangie "new") arranged as a split-plot design with three replications. Each main plot area consisted of 4 passes (32 rows). The treatments were imposed on August 7-8, 1995, using Big N as "gas".

The second experiment was sited on field 11 at **Burratippi, Trangie**, NSW owned by Agriland Pty Ltd. The treatment variables were nitrogen rate (120, 180 and 120+60 kg N/ha) as main plots and manifold type (Continental RPR and Trangie "new") arranged as a split-plot design with three replications as defined above. The cotton crop (Variety Sicala V2) was planted in early November with a stand established on November 26, 1995. The nitrogen treatments were then imposed on December 8-9, 1995, using Big N as "cold-flo".

A single row picker was used to harvest 60 m and 40 m sections at Agriland and Darling Farms respectively from each sampling row to determine seed cotton yield.

The results from the first field experiment (see Fig 1b) show that there is no apparent yield benefit (6.166 t/ha with new manifold compared with 6.167 t/ha with RPR manifold. This difference was not statistically different at  $P < 0.05$ . No visual effect of "striping" was observed at any time during crop growth in either manifold treatment area and this lack of yield effect is therefore not surprising. However, there was less variation in row yield within each pass when the new manifold was used (3.85% vs 5.84% - see Fig 2). This shows a trend towards more even crop growth within each pass of the new manifold as a result of more even nitrogen application.

The results from the second field experiment (see Fig 1a) show that there is an overall yield benefit of around 2% (4.785 t/ha with new manifold compared with 4.669 t/ha with RPR manifold. This difference is however not statistically different at  $P < 0.05$ . At the higher rate of nitrogen application (180 kg N/ha either in single or split application), a 4.87% yield increase (N.S.) was measured (4.953 t/ha with new manifold compared with 4.724 t/ha with RPR manifold).

A visual effect of "striping" was observed in all the passes performed using the Continental RPR manifold system but only during the final weeks of crop growth. No "striping" was observed in any of the passes performed with the new manifold. There was also less variation (significant at  $P < 0.1$ ) in row yield within each pass when the new manifold was used (5.39% vs 5.96%) again suggesting that crop growth was more even within each pass of the new manifold as a result of more even nitrogen application.

The inability to manage for timeliness and other factors in these two experiments may well have overridden any yield advantages which may have accrued due to the use of the new distributor. It was clear from observations at defoliation and picking at the Trangie site that the areas which had  $\text{NH}_3$  applied with the new distributor were later and more even in growth and colour and contained more green leaf and bolls. This effect was also observed at the Bourke site but in areas outside the experimental plot.

In addition to the experimental plot, the new manifold was also used to apply  $\text{NH}_3$  to over 1000 acres of a total area of 5000 acres sown to cotton on this property, requiring 72 hours of use in the field. This area was the only area on the property (outside the experimental area) which did not show "striping". The areas where the current commercial system was used required subsequent treatment with water-run urea.

**Conclusions**

Both the laboratory and field experiments provide positive indications that improved distribution performance can be achieved with the new distributor. This is provided both by the lack of "striping" in the fields and the reduced yield variation within treatment passes. Whilst overall yields and yield variations were not significantly different from each other, the data suggests that there may be yield advantages and that there is potentially large savings to be realised through less management and additional nitrogen requirements.

NSW Agriculture is currently negotiating with a number of local and overseas companies in an attempt to commercialise the new distributor. It is hoped that it will be available to Australian cotton growers early in 1997.

**Acknowledgments**

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Table 1 : Details of the various metering and distribution systems and their relative distribution variation

Description	Mean Coefficient of Variation (%) <sup>*</sup>	T-test group
John Blue A-3910 Nitrolator fitted with John Blue manifold, linked by a 500 mm long x 25 mm ID vertical stainless steel tube	28.93	A
John Blue A-3910 Nitrolator fitted with John Blue manifold	21.74	B
Continental Metermatic C-4100 fitted with the multiple outlet C-4100 RPR manifold	15.92	C
Continental Metermatic C-4100 fitted with an 8 outlet prototype manifold "B" linked via the C-4103 single 1" outlet and 90 degree elbow by a 500 mm long x 25 mm ID vertical stainless steel tube	11.00	D
Continental Metermatic C-4100 fitted with an 8 outlet prototype manifold "A"	9.24	E
John Blue A-3910 Nitrolator fitted with an 8 outlet prototype manifold "A"	8.88	E
John Blue A-3910 Nitrolator fitted with an 8 outlet prototype manifold "A" linked by a 500 mm long x 25 mm ID vertical stainless steel tube	7.22	F
Continental Metermatic C-4100 fitted with an 8 outlet manifold "A" linked via the C-4103 single 1" single outlet and 90 degree elbow by a 500 mm long x 25 mm ID vertical stainless steel tube	5.35	G
John Blue A-3910 Nitrolator fitted with an 8 outlet prototype manifold "C"	4.42	G
John Blue A-3910 Nitrolator fitted with an 8 outlet prototype manifold "C" linked by a 500 mm long x 25 mm ID vertical stainless steel tube	3.55	H

\* Means with the same letter are not significantly different

Fig 1a : Comparative seed cotton yields (t/ha) at 3 different N rates (120, 180 and 120+60 kg/ha as Big N "cold-flo") applied using the Continental "RPR" and Trangie "NEW" distribution manifolds at Agriland, Trangie

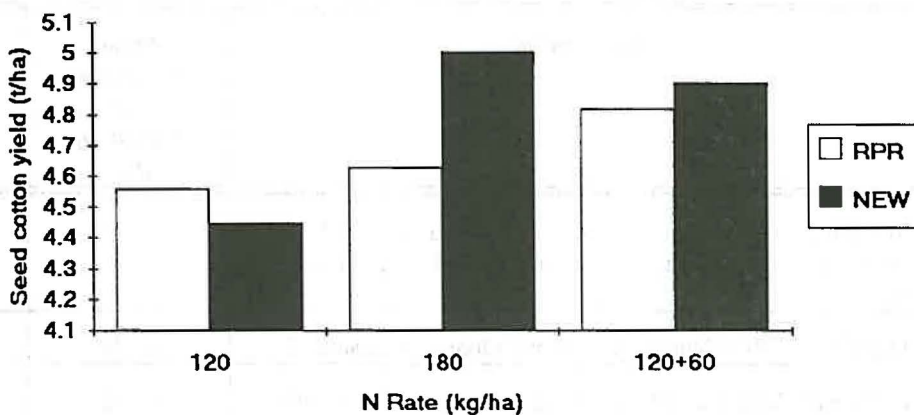


Fig 1b : Comparative seed cotton yields (t/ha) at 3 different N rates (100, 150 and 200 kg/ha as Big N "gas") applied using the Continental "RPR" and Trangie "NEW" distribution manifolds at Darling Farms, Bourke

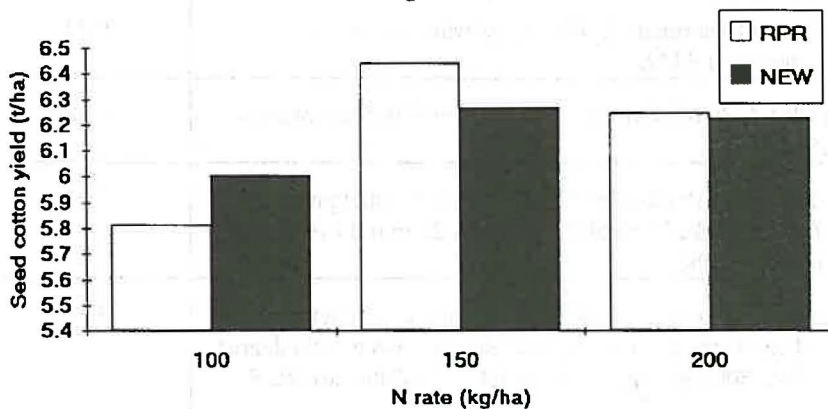


Fig. 2 : Comparative coefficients of variation (%) in seed cotton yield between rows within each machine pass for the Continental "RPR" and Trangie "NEW" manifolds at Agriland, Trangie and Darling Farms, Bourke

