FIELD-SCALE EVALUATION OF FURROW FERTIGATION USING LIQUID NITROGEN.

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Aim and objectives

On average about one third of applied nitrogen is lost which costs the cotton industry $32 million each year. Fertiliser use efficiency can be improved through site-specific application of liquid nitrogen (N) in surface irrigation systems. A field-scale fertigation trial was conducted to assess: (1) the uniformity of distribution of the fertiliser applied; and (2) the agronomic performance of furrow fertigated crop based on fertiliser N recovery. The results reported in this study will aid the development of a set of practical recommendations concerning furrow fertigation in cotton to improve use efficiency of fertiliser N.

Materials and Methods

Urea ammonium nitrate (UAN, 32% N w w^{-1}) was injected into a 50 m length of gated pipe (Fig. 1) and applied with irrigation water at a rate of 43 L ha^{-1} of fertiliser over two irrigation events conducted on 29 December 2013 and 6 February 2014 2014, respectively. Fertiliser-treated furrows were compared with control furrows (zero-fertiliser). Uniformity of distribution of fertiliser applied was determined in water during the irrigation events and in soil before and after irrigation by sampling at three locations along the furrows (100 m, 300 m and 500 m down the 600 m long furrows). Soil and water samples were subjected to determination of mineral N ($NH4^+$-N + NO_3^--N). Nitrogen recovery was determined based on Rochester (2011).

Results

Mineral N concentration in water samples ranged between 19.4 and 25.7 mg L^{-1} of N, which suggests that distribution of fertiliser applied with irrigation water was relatively uniform along the furrows. There were significant differences ($P<0.05$) in soil mineral N (SMN) between fertilised and non-fertilised furrows following irrigation. Overall, SMN at the three sampling locations reported similar ($P=0.08$) values, which suggests that distance distribution was uniform. However, SMN determined before and after fertigation showed no differences ($P>0.05$), which suggests percolation of native SMN during irrigation to depths greater than 600 mm, possibly aided by preferential flow through open cracks. There was no fertigation treatment effect ($P>0.05$) on total N recovered in cotton seeds, which is attributed to residual fertiliser N applied prior to planting. Total N in seed showed values between 3.12% and 3.52% N for both control and treatments.

FIG. 1 Fertigation unit for injecting liquid N into gated pipe for field trial.

Conclusions

Fertigation using furrow irrigation has shown promising results and it may be used as an effective means to apply N fertiliser in cotton. This is supported by satisfactory uniformity of distribution of fertiliser applied during the irrigation events, which was achieved both at distance and depth. However, greater control over the water applied to furrows is required to reduce deep percolation of native soil N. Research is being conducted to improve the understanding of the interaction between timing of fertiliser application via fertigation and timing of irrigation, and to determine potential benefits and practicalities of pre-irrigating the soil with a small amount of water to induce reduction of infiltration rate hence deep losses of native soil N, followed by fertigation.

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