Comparing effects of TSP, MAP and DAP applied in bands on some key soil chemical properties in a black vertosol.

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ABSTRACT

The availability of nutrients and effect of Fertilizers on crop emergence is influenced by the chemical properties of the fertiliser. MAP, DAP and TSP were band applied and the change in soil pH, ammonium (NH_4^+) concentration and electrical conductivity (EC) of the band were measured to determine the potential effects on crop emergence. Significant differences were found between products for each of the soil chemical properties measured, suggesting that crop emergence would most significantly be affected by DAP.

KEY WORDS

Ammonium, osmotic, $EC_{(SE)}$, pH, toxic.

INTRODUCTION

Effects of NH_3 toxicity (1, 2) and osmotic pressure (7) from fertiliser applied with seed have been long been suspected to reduce germination and/or crop establishment. It is difficult to distinguish between the effects of NH_3 toxicity and osmosis because the NH_3-NH_4^+ equilibrium in the soil solution could also create an osmotic effect on seeds. Compound Fertilizers such as MAP and DAP containing NH_4^+ and other anions may therefore exert combined effects of NH_3 toxicity and osmotic pressure to affect germination and establishment whereas TSP is likely to exert an osmotic effect only. This experiment was conducted to measure differences in NH_4^+-N concentration, pH and EC in soil where MAP, DAP and TSP had been banded to assess the potential damaging effects of each product for seed-furrow placement.

MATERIALS AND METHODS

Five kg of field moist black vertosol soil collected at Formartin, Queensland was packed into trays under a rain-out shelter. Four furrows 30 to 35 mm deep and 25 mm wide were made across each tray. Fertiliser was mixed with 10 to 15 g of soil from the furrow and the soil-fertiliser mix was spread evenly along the furrow, and the furrow filled with the remaining soil. The trays were over-watered and allowed to dry until the soil moisture content was about 38 % w/w. Fertiliser products TSP (20.7 % P, 1.4 % S, 15 % Ca, salt index = 17), MAP (10 % N, 21.9 % P, 2 % S, salt index = 30) and DAP (18 % N, 20 % P, 1.7 % S, salt index = 35) were sieved to include only granules with diameters between 2.0 mm and 2.8 mm and applied at 4 P rates equivalent to 0, 5.5, 11, 22 and 44 kg/ha. Salt index is a measure of relative osmotic effect of fertiliser proposed by Rader *et al*. (5).

Soil samples were collected 2 DAS taking six 25 mm diameter vertical cores, centred over fertilised rows, to the full depth of the tray. Soil was divided into 2 sub-samples prior to chemical analysis. One sub-sample was prepared for NH_4^+-N analysis using the “field moist” procedure to avoid loss of NH_3 during drying. Soil moisture, pH and EC were measured on the other sub-sample, after oven drying at 105 ^oC. Soil cores were analysed for NH_4^+-N, pH, and EC. Electrical conductivity was measured due to its direct relationship with osmotic potential (4). EC measurements were converted to saturated extract (EC_{SE}) equivalence by adjusting for soil texture as suggested by Shaw (6).

RESULTS and DISCUSSION

Soil pH for the DAP application band was consistently higher than MAP or TSP for all rates greater than 5.5 kg/ha (Fig 1a), and as application rate increased, pH for all products declined. The rate of decline in

soil pH was greater for MAP and TSP than for DAP. DAP and MAP both increased ECse significantly more than TSP as fertiliser application rates were increased (Fig. 1b). The ECse difference between MAP and DAP was not significant. This is consistent with findings of Rader *et al.* (5) who assigned similar salt indices for MAP and DAP. Ammonium-N concentration within application bands was significantly different between different fertiliser products (Fig. 1c). The increase in soil NH_4^+-N was in proportion to the quantity of N added as fertiliser product, after adjusting for background soil NH_4^+-N concentration, DAP producing the highest concentration.

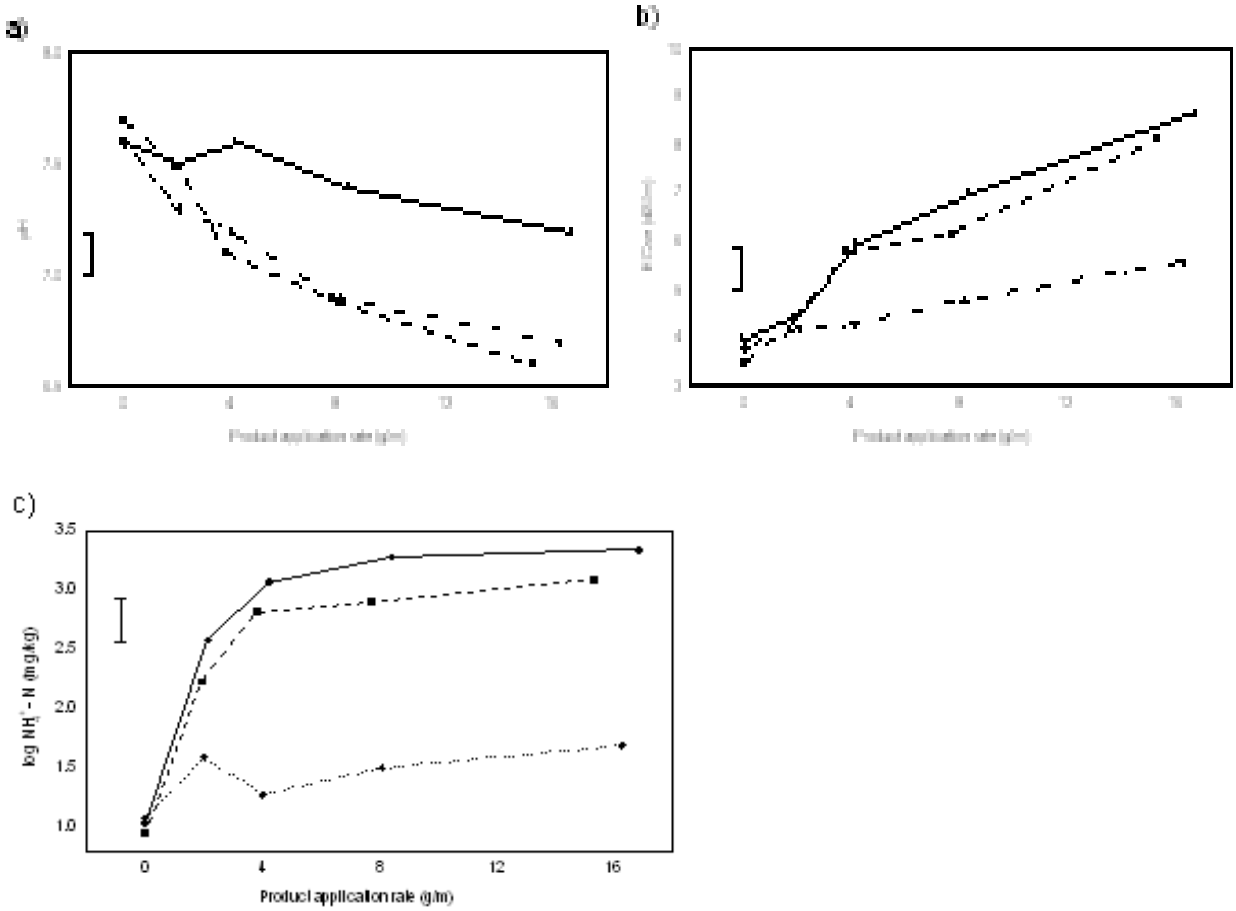

Figure 1. Soil pH (a), EC_{se} (b) and NH_4^+-N concentration (c) of fertiliser application bands 2 days after application of 4 rates of MAP (%), DAP (() and TSP (+). Error bar represents the l.s.d. (*P*=0.05) for the interaction between fertiliser product and application rate.

Ammonium-N concentration and pH of the fertiliser band were higher for DAP than for the other Fertilizers, suggesting that the NH_3-NH_4^+ equilibrium was likely to have favoured toxic NH_3 (3).

CONCLUSIONS

Differences between soil chemical properties resulting from 3 band applied Fertilizers (DAP, MAP and TSP) suggest that crop emergence would most be significantly affected by DAP as a result of the combination of NH_4^+ -N concentration and pH. Both MAP and DAP created similar higher $EC_{(SE)}$ values than TSP, suggesting that TSP would be less likely to impose osmotic stress during germination and establishment of seedlings.

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