Comparing the effects of TSP, MAP and DAP applied in the seed furrow on establishment of 5 summer crop species.

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ABSTRACT

Safe rates of monoammonium phosphate (MAP), diammonium phosphate (DAP) and triple superphosphate (TSP) applied in the seed furrow at-sowing on crop establishment for a range of summer and winter crops are not well described. An experiment was established to measure the effect on crop establishment from the application of 5 rates of 3 phosphate fertiliser products to cotton, maize, sorghum, soybean and sunflower. Significant differences in species response to product and product rate were measured

KEY WORDS

Ammonia, fertiliser, germination, toxicity, osmotic.

INTRODUCTION

Effects of NH_3 toxicity (Allred and Ohlrogge 1964, Bennett and Adams 1970) and osmotic pressure (Young *et al.* 1968) 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^+ complex in the soil solution can also create an osmotic effect on seeds. Compound fertilisers 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 while TSP is likely to exert an osmotic effect only.

Currently, recommendations of application of fertiliser in the seed-furrow do not provide critical application rates for fertilisers that contain no N, and there is no recognition of the different chemistry in soil-fertiliser reaction zones arising from the application of a range of N fertilisers.

MATERIALS AND METHODS

Five kg of field-moist black vertosol soil collected at Formartin, Queensland was packed into trays and placed under a rain-shelter. The trays were over-watered and allowed to dry until the soil moisture content was about 38 % w/w. Four furrows 30 to 35 mm deep and 25 mm wide were made across each tray. Ten seeds were evenly spaced along each furrow and pressed lightly into the soil. Fertiliser was mixed with 10 to 15 g of soil from the furrow and the soil-fertiliser mix was spread evenly along the furrow around the seed, and the furrow filled with the remaining soil. 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 P rates equivalent to 0, 5.5, 11, 22 and 44 kg/ha. Three replicates of each treatment were allocated to trays in a completely randomised design and positioned on a bench in a rain-exclusion shelter.

Crop species tested were maize (cv. Dekalb 689), cotton (cv. Siokra V15), sorghum (cv. Pacific Seeds MR Buster), sunflower (cv. Pacific Seeds Hysun 46) and soybean (cv. Pacific Seeds Warrigal). Emerged seedlings were counted 3, 4, 5, 6, 7, 9 and 14 days after sowing (DAS). Establishment data presented is for counts at 14 DAS only.

RESULTS and DISCUSSION

Emergence of all species was greater than 75 % in nil-fertiliser controls and is high when compared with commercially acceptable levels. Establishment was reduced most severely by DAP and MAP when averaged over species and fertiliser rates (Fig. 1). Ranking of the crop species for their tolerance to co-placed fertiliser and seed was generally similar for different fertiliser products. Tolerance ranking for TSP was maize = sorghum = cotton > sunflower > soybean ($P<0.05$). Ranking for MAP was cotton = maize =sorghum > sunflower = soybean and for DAP was maize = sunflower > cotton > sorghum = soybean.

Lower tolerance of crops to seed-furrow placement of DAP than MAP or TSP is consistent with the findings of Allred and Ohlrogge (1964). Allred and Ohlrogge (1964) concluded that lower tolerance of seeds to DAP than MAP was a result of higher solubility of DAP and the presence of an easily hydrolysable secondary NH_4^+ radical liberated from DAP. All species tested, except for soybean and sunflower, were highly tolerant of TSP during germination. Species with low tolerance to TSP presumably have low tolerance to the osmotic effect of fertiliser or alternatively may be sensitive to P toxicity.

Sorghum, cotton and soybean were more tolerant of TSP and MAP than of DAP. For a similar product application rate reduction in establishment with DAP was generally greater than for MAP, suggesting that the characteristic of DAP causing germination reduction in these species was the production of NH_3 rather than osmosis.

CONCLUSIONS

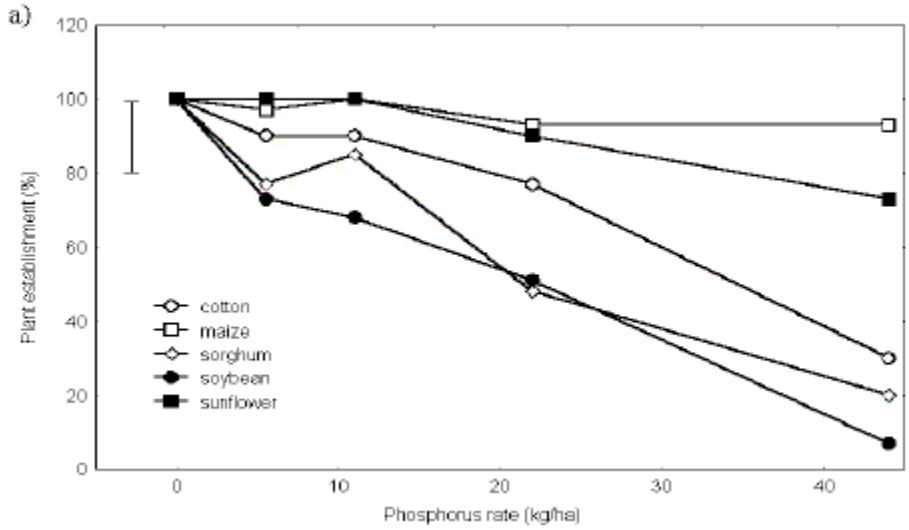
In the absence of NH_3 toxicity, osmotic pressure alone can significantly reduce crop establishment and there are significant differences between crop species in their susceptibility to toxic ammonia levels produced with DAP and MAP.

REFERENCES

1. Allred, S. E. and Ohlrogge, A. J. 1964. *Agron. J.* **56**, 309-13.

2. Bennett, A. C. and Adams, F. 1970. *Soil Sci. Soc. Am. Proc.* **34**, 259-63.

3. Young, J. A., Evans, R. A, Roundy, B. and Cluff, G. (1983). Moisture stress and seed germination, USDA, Agricultural Research Service, Reviews and Manuals, Western Series No. 36. (USDA Agricultural Research Service, Western Region.



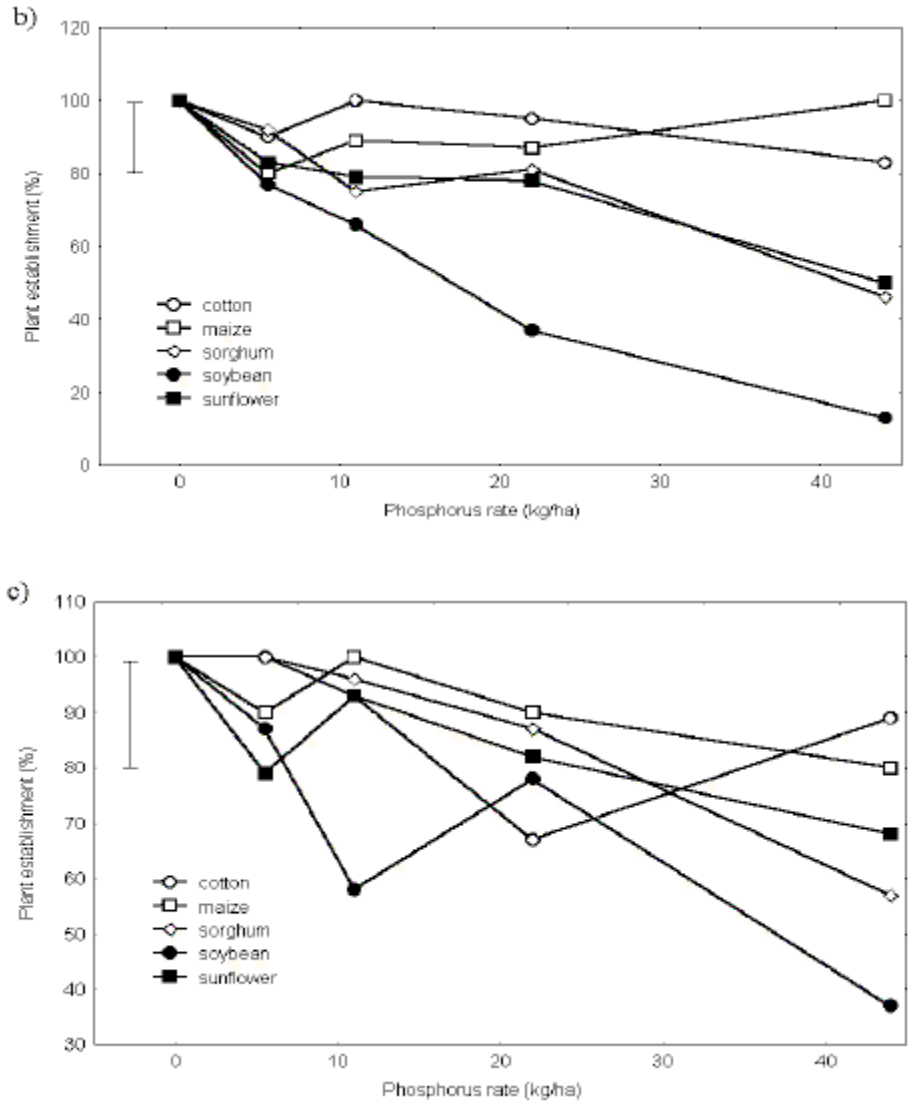


Figure 1. Relative establishment (%) of cotton, maize, sorghum, soybean and sunflower resulting from application of DAP (a), MAP (b) and TSP (c) at 5 P rates with the seed.