Factors Influencing Absorption of Phosphorus and Zinc by Grain Crops and the Responses of Pea and Wheat to Phosphorus and Zinc Fertilisation

by

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PREFACE

I certify that the substance of this thesis has not already been submitted for any degree and is not being currently submitted for any other degree.

I certify that, to the best of my knowledge, any help received in preparing this thesis and all sources used have been acknowedged in this thesis.

Sebolele Molete

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ABSTRACT

The initial experiment was designed to compare the responses to P and Zn fertilisers of *Pisum sativum* L. var. Dundale and *Triticum aestivum* var. Sunco grown on a grey clay of low P status. P was applied at four rates (0, 10, 20 and 40 kg P/ha) and Zn at two rates (0 and 5 kg Zn/ha). For peas, there was a significant response in shoot dry weight and P concentration when P was applied at 20 and 40 kg/ka whereas wheat responded at 10 kg/ha and above. Zn fertiliser increased the node number in peas and Zn concentration in both peas and wheat. Any phosphorus-zinc interaction effects were small and variable compared to the main P and Zn effects.

Following this experiment a sequence of experiments was conducted to compare the responses of pea to P fertiliser application under field and glasshouse conditions. Since the response of wheat to P application in Australia is well recognised, unlike that of peas for which little data is available, it was decided that further experiments be pursued only with peas. The Warialda red-brown earth was used in preference to the grey clay used in Experiment I since a reliable yield response was expected on this soil which has a lower available P content (see later comment). Although a plateau in response to P was reached at 40 kg P/ha in Experiment I, the range of P application rates in the succeeding experiments was expanded beyond 40 kg P/ha to determine the optimum P application rate in relation to both 90% maximum yield and plant P content. Zn treatment was discontinued and Zn was applied as a basal nutrient because no distinct P-Zn interaction was found in Experiment I.

A preliminary experiment was conducted in a temperate glasshouse to investigate the response of the red-brown earth soil to the application of P fertilisers, using the two varieties of *P. sativum* L. (Bluey and Dundale) as indicator crops. Two rates of P (0

and 60 kg P/ha) were applied; before the experiment started, the soil contained 15.6 ug/g available P. A strong response to the P application was obtained and hence the soil was confirmed for use in the main experiments.

Two experiments were conducted at the same time, one in the glasshouse and another in the field, to assess the response of field pea (*P. sativum* L.) var. Bluey to P fertiliser application. In both experiments P fertiliser was applied at rates of 0, 10, 20, 40, 80, 160 and 320 kg P/ha with a basal treatment of sulphur at 15 kg S/ha as gypsum ($CaSO_4.2H_2O$), and of Zn at 5 kg Zn/ha ($ZnSO_4.7H_2O$). The highest rate of P application inhibited seed germination and seedling growth in the glasshouse, with the optimum rate of P fertilisation being between 45 and 91 kg P/ha. In the glasshouse, P application rate was related quadratically with dry matter yield, N and P uptake and N content of the seed, and linearly with the P concentration in the plant. However, in the field, P application rate was correlated with P uptake and P concentration only and the relationships were both linear. The correlation between P concentration in the plant and dry matter yield was not consistent under field conditions but, where it occurred, it was linear. The correlation between the P uptake and the concentration in the whole plant was linear in both the field and glasshouse trials. The variation between the results of the two experiments appeared mainly due to unsuitable climatic conditions for the field trial. Yield responses in both experiments indicated maximum yields at close to 40 kg P/ha; the critical P concentration of youngest leaves at 57 to 79 days after sowing was 0.5 - 0.65 %.