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# INVESTIGATIONS ON GROWTH AND P UPTAKE CHARACTERISTICS OF MAIZE AND SWEET CORN AS INFLUENCED BY SOIL P STATUS

A thesis presented in partial fulfilment  
of the requirements for the degree of

Doctor of Philosophy (PhD)

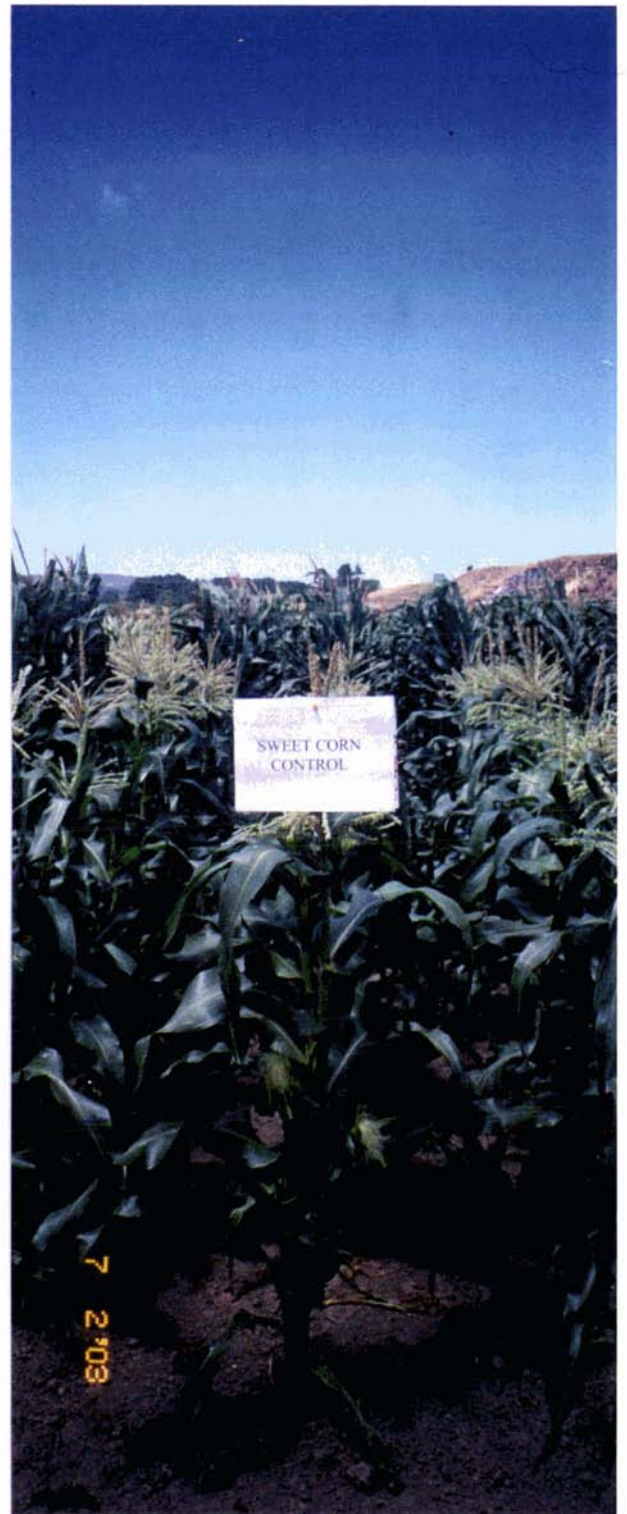
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*This thesis is dedicated to my family and teachers,  
all of them supported a lot and expected from me to fulfil this task one day.*

## ABSTRACT

Despite being different cultivars of the same plant species (*Zea mays* L.), maize and sweet corn have contrasting P fertiliser recommendations in New Zealand, that are reflected in different target Olsen P values of 10-15 mg P/kg soil for optimum maize growth and 26-35 mg P/kg soil for optimum sweet corn growth. Three key hypotheses were developed in this study to explain why these differences may exist: i) maize and sweet corn differ in their responsiveness to P fertiliser i.e. maize is more internally P efficient and requires less P than sweet corn to grow, ii) both cultivars differ in external P efficiency i.e. their ability to take P up from soil iii) both cultivars differ in external P efficiency because they have different root system structure.

Two field experiments evaluated the growth and yield responses of maize and sweet to different rates of P fertiliser application. The first experiment was conducted in Hawke's Bay (2001-02) and second in the Manawatu (2002-03) with P application rates of 0, 100 and 200 kg P/ha in the Hawke's Bay and 0, 15 and 70 kg P/ha in the Manawatu. Both experiments were conducted on soils of low available P status. The Olsen P test values of 13 mg P/kg soil in the Hawke's Bay and 11 mg P/kg soil in the Manawatu were far below the recommended values for sweet corn (25-35 mg P/kg soil).

In both experiments and across all P treatments maize produced significantly higher dry matter yields than sweet corn during all sampling stages. In the Hawke's Bay experiment at 100 days after sowing (DAS), the maize (87719 plants/ha, 20.9 t/ha) produced 43% more dry matter than sweet corn (71124 plants/ha, 14.6 t/ha), whereas, in the Manawatu experiment (140 DAS), maize (71124 plants/ha, 15.2 t/ha) had a 39% higher dry matter yield than sweet corn (71124 plants/ha, 10.9 t/ha). In both the field experiments, the sweet corn fresh cob yield of 27 and 28 t/ha in the Hawke's Bay and the Manawatu regions and maize grain yields of 16 and 10 t/ha, respectively, were within the range of the reported commercial yields for each region.

In both experiments, the P fertiliser application raised the soil P status (Olsen P test values) but caused no significant increases in either maize or sweet corn yields (total dry matter, sweet corn fresh cob or maize grain). Commercially viable yields of both

cultivars were able to be achieved without P fertiliser application with Olsen P soil test in the range of 10-15 mg P/kg soil.

Sweet corn reached harvestable maturity at 115 DAS in the Hawke's Bay and 140 DAS in the Manawatu experiments. By this time maize had produced 4-6 t/ha more total dry matter yield than sweet corn, yet maize and sweet corn had achieved similar total P uptake (32- 37 kg P/ha at 100 DAS in the Hawke's Bay and 18-19 kg P/ha at 140 DAS in the Manawatu). At silking (after 75 DAS in the Hawke's Bay and approximately 110 DAS in the Manawatu), both cultivar's total leaf P concentrations (0.21-0.25%) were within the sufficiency range values for maize crops in New Zealand (0.18-0.33 %). Maize, however was more internally P efficient growing more dry matter per unit P taken up, which was more noticeable in the drier season. Fertiliser P application increased P uptake with both cultivars under moist conditions in the Hawke's Bay experiment (2001-02). However, the dry conditions in the Manawatu (2002-03) limited P uptake as well as restricted dry matter yields with both cultivars. Further, there were no significant differences between maize and sweet corn P uptake efficiency (kg P/kg root) despite significant differences in the root system structure (biomass) for both cultivars at all stages, which lead to different temporal patterns of P uptake.

The lack of maize yield response to fertiliser P in both field experiments is consistent with the New Zealand recommendations for growing a maize grain crop (because soil Olsen P was in the range of 10-15 mg P/kg). However, the lack of sweet corn yield response in both field experiments does not support the New Zealand recommendations for growing sweet corn (which assume optimal Olsen P values are 26-35 mg P/kg).



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