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PROJECT: FACTORS AFFECTING THE RESPONSE OF SOYABEAN TO MOLYBDENUM APPLICATION.

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This study was conducted primarily to determine the effects of molybdenum (Mo) on soyabean yield and quality. Ancillary objectives included the acquisition of information to facilitate the diagnosis of Mo deficiency and prediction of Mo requirement (plant and soil tests), the determination of agronomic practices (liming and fertilization) which influence Mo availability, and the inherent Mo status of soils on which soyabean is produced. During the course of this investigation an unforeseen need to establish the cause of sporadic Mo-induced yield depressions was also identified.

Agronomic information was obtained from modifications made to 10 existing long-term soil fertility studies in KwaZulu-Natal. A total of 25 site-years of yield information was obtained during the period 1991/92-1995/96. Information regarding the Mo status of soils in the summer rainfall area was obtained from the chemical analysis of 800 samples from 200 representative profiles.

Findings obtained in this study have clearly demonstrated the very important role Mo plays in soyabean production in KwaZulu-Natal. Yields have been more than doubled at some sites and, in, addition, there have been significant increases in seed protein content (up to 1.9%). However, there have also been five instances in which yields were depressed (on average by 8%) after Mo seed treatment. These sporadic depressions in yield can still not be explained, but they appear to be restricted to low-vigour seed produced in dry years.

Leaf analytical data from the trials have clearly demonstrated the beneficial effects of Mo on nitrogen metabolism. Even where yields were not influenced positively, leaf and seed protein content was increased. The effects of Mo on NO_3 reduction were particularly consistent and on some soils reduced NO_3 reductase activity is the primary component of Mo deficiency. In most of the soils studied, however, Mo deficiency was expressed as N deficiency (reduced N_2 fixation) and this is likely to be the primary problem in most South African soils that are Mo deficient. Both lime and P resulted in increased Mo uptake. In the case of lime (pH increase) Mo deficiency can be eliminated in some soils by liming. However, in other soils with low Mo reserves additional Mo is still needed. More importantly from a practical viewpoint, Mo is capable of eliminating or substantially reducing lime requirement. This effect has important economic consequences, as inexpensive applications of Mo are capable of substituting for large and costly inputs of lime. Although P increases Mo uptake, the interactive effect with Mo is different from that of lime. Molybdenum responses increase rather than decrease as P levels increase. In other words, the

optimum Mo level shifts. The most important consequence of the P x Mo interaction is the limiting effect Mo has on response to P. Where Mo is deficient P response is drastically limited. Since P has very marked effects on both yield and seed protein content, Mo deficiency may in this way drastically reduce protein production per hectare.

A disappointing aspect of this study has been our inability to establish a reliable critical leaf Mo level. Molybdenum need is influenced by both N and P nutrition and seasonal conditions might also play a role. However, a reliable analytical procedure was established and, in general, it is probably safe to say that a deficiency is likely if the leaf Mo content is less than 0.1 mg kg⁻¹.

Similarly, the results obtained have clearly shown that it is not yet possible to predict Mo requirement from soil analyses. This is due to the harsh nature of established soil extractants. They are not sensitive to pH shifts or to the influence of P and N on Mo requirement. However, simultaneous consideration of Mo level and pH does provide a rough indication. Too rough a measure for on-farm use, but one which provides a useful country-wide yardstick. From the results of the survey conducted, it appears that Mo deficiencies are likely to be widespread in the eastern parts of the country, possible in the Free State and least likely in the North West and Northern provinces.

Findings obtained during the course of this project have been transferred to farmers and advisors on an on-going basis via two popular articles, numerous farmer's days and field visits, and three presentations at annual Crop Production Society Congresses. Scientific articles are currently being prepared.