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Improving fertiliser management: redefining soil test-crop response relationships for canola, wheat and lupins in Western Australia cropping systems

WEN CHEN[1,2], ROSS BRENNAN[2], RICHARD BELL[1], MIKE BOLLAND[2], GEOFF ANDERSON[2]

[1]School of Environmental Sciences, Murdoch University, South Street, Murdoch, WA 6150, Australia
[2]Department of Agriculture and Food WA, 3 Baron-Hay Court, South Perth WA 6151, Australia

Fertiliser input is one of the largest variable costs for grain production. This paper reports on a study (funded by the GRDC) to re-examine the soil test–crop response relationships from trial data to define critical soil test values (P, K and S) for major crops (wheat, canola and lupin) grown on the soils of Western Australia. Initially we created a database of fertiliser experiments conducted mostly by the DAFWA going back to the 1970's. The data on wheat (418), lupin (420) and canola (266) single-year fertiliser experiments were compiled and analysed to derive critical soil test values. Canola grain production occurs on most soils in the region. Derived critical Colwell soil test values (mg/kg) for the top 10 cm of soil were 25 for P and 52 for K, which adequately indicated when canola crops were likely to respond to fertiliser P and K applications. The derived critical KCl40 soil S test value was 10 mg/kg. However, the critical S value could only be used as a general guideline due to the poor correlation between top (0-10cm) soil test and crop grain yield response. It is suggested that for the soils where the soil S test value for the top 10 cm was below the critical value, soil test values for the 10-20 and 20-30 cm horizons were also required. If soil test S was above the critical value (10 mg/kg) in either of these 2 lower soil horizons, then canola grain yield response to applied fertiliser S was unlikely. Wheat critical Colwell soil P test value varied (15-39 mg/kg) with soil types due to the differences in soil P sorption. For wheat crops grown on soil types other than duplex soils, the derived critical value (mg/kg) for Colwell soil K test was 80. Critical values of soil Colwell P for lupins varied with soil types due to differences in soil P sorption. For soil types with PRI <=1, the critical value was 25 mg/kg. But for soil types with PRI =>2, the relationship between Colwell soil P test and relative yield was poor. The derived critical value of Colwell soil K test for lupins was 31 mg/kg. Further improvements in estimated critical values using different curving fitting approaches and critical ranges (rather than single value) were also reported.