Nitrogen fertilizer availability to wheat under field conditions in Queensland and Western Australia measured with ^{15}n

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Over 80.000 tonnes of fertilizer nitrogen are applied to the Australian wheat crop annually. Less than half of this fertilizer nitrogen may be recovered by the current crop. It is not known how much of the remainder is lost completely from the system. is present in the soil in mineral form or becomes immobilized into soil organic matter. The tagging of N fertilizer with ^{15}N provides a means of quantifying the fate of nitrogen fertilizer under field conditions.

In Queensland the application of nitrogen fertilizer in February for wheat may be convenient but there is a risk of reduced availability due to immobilization and denitrification. The objective of the work reported here was to measure the recovery of ^{15}N labelled fertilizer in the soil and wheat plant under field conditions in Western Australia and Queensland under conventional and innovative management practices.

Methods

Queensland Experiments: Urea (labelled with ^{15}N) was applied at 80kg N/ha to the central lm x lm of 3m x 3m unconfined microplots of a black cracking soil (vertisol) on the Darling Downs in either February or May 1982. The urea was banded in rows 25cm apart at either the conventional depth of 7cm or much deeper at 17cm. The nitrification inhibitor, nitrapyrin, marketed under the trade name of N-Serve was added to the urea solution in half of the treatments. The plots were sown to wheat in July using tractor drawn planting equipment. At wheat anthesis (November 1982) soil to a depth of 90cm and plants were sampled for ^{15}N analysis.

Western Australia Experiments: Ammonium nitrate (labelled with ^{15}N) was applied at 30kg N/ha to confined microplots of a "medium" soil (red sandy loam over red clay loam) near Merredin in June 1981. The microplots consisted of 30cm long. 25cm diameter PVC tubes driven 25cm into the soil. The microplots were sown to wheat by hand in May. At wheat anthesis in September 1981. to a depth of 90cm where possible and plants were sampled for ^{15}N analysis.

Results and Discussion

Queensland Experiments: All of the fertilizer ^{15}N applied in May at the conventional depth could be accounted for in the soil (64%) and plants (36%) sampled at anthesis. However 41% of the February - applied N placed at the conventional depth of 7cm could not be accounted for in the soil (24%) and plants (35%). This loss was attributed to denitrification during the fallow rather than to leaching beyond the 9Ocm depth because there was essentially complete recovery (95%) of the February applied N in the soil (49%) and plants (46%) placed at 17cm depth.

Western Australia Experiments: The distribution of ^{15}N in the soil and wheat plants at anthesis under conventional management was as follows: plant tops - 45%; soil mineral N-4%; soil organic N-28%. unaccounted for N-23%. The fate of the unaccounted for N is uncertain. Because there was relatively little rainfall during the growing season it does not seem likely that either denitrification or leaching would be substantial.

The results from these experiments using ^{15}N under field conditions indicate that appreciable inefficiences in nitrogen fertilizer use may occur in widely contrasting soils in different parts of Australia. The results

clearly demonstrate that there is considerable scope for modifying fertilizer efficiency by innovative fertilizer technology.