

Long term uptake of fertilizer nitrogen residues by wheat

I.C.R. Holford

New South Wales Agriculture and Fisheries, Tamworth, NSW 2340

A major obstacle to the increased use of nitrogen fertilizer on N-deficient wheat crops is the belief that N residues, unused by the first crop, are lost from the soil and unavailable to subsequent crops. The unpredictability and frequency of dry conditions during the wheat crop often result in low uptake and efficiency of fertilizer N in the year of application, so the availability of fertilizer residues is an important factor in assessing the profitability of fertilizer use. This paper reports results of fertilizer N uptake by wheat in the second and third years after application on two soil types in northern New South Wales.

Methods

On each soil type, wheat (cv Kite or Songlen) was sown in 1977, 1978 and 1979 on 4 treatments of a rotation experiment with 6 replications. The rotation treatments, which terminated in 1970 on a black earth and 1972 on a red clay, comprised a short lucerne ley (1.5 years), a medium lucerne ley (2.5 or 3.5 years), extended fallowing (4 or 6 years), and continuous wheat growing (1). Urea was applied at sowing in 1977 only, at 68kg N/ha to half of each plot. Superphosphate was applied to all plots in 1977 at 32kg P/ha. Wheat grain was harvested at maturity. Uptake of fertilizer N was estimated from the difference in grain N uptake between the half plot receiving fertilizer and the unfertilized half plot.

Results and discussion

Grain yield responses to fertilizer N were very large in the year of application, averaging 92% on the black earth and 34% on the red clay, with much larger responses in the non-lucerne treatments than in the treatments following lucerne. Yields in the following year more than doubled, especially on the red clay, but they did not respond to N on the black earth and responses were about half as large as in the previous year on the red clay. In the third year yields were similar to those in the second year, but there were moderate to large responses to N on the black earth and red clay respectively.

Table 1. Uptake of fertilizer nitrogen (kg N/ha) by wheat in 1st, 2nd and 3rd years after application

Rotation Treatment	Black earth				Red clay			
	yr 1	yr 2	yr 3	Total	yr 1	yr 2	yr 3	Total
Contin. wheat	14.7	0	3.7	18.4	6.8	10.8	7.2	24.8
Extended fallow	18.8	2.2	5.8	26.8	7.3	12.2	8.2	27.7
Short lucerne	18.2	0.8	8.8	27.8	7.0	11.5	12.9	31.4
Medium lucerne	15.9	6.5	12.4	34.8	9.7	1.6	12.2	23.5
Mean	16.9	2.4	7.7	27.0	7.7	9.0	10.1	26.9

Uptake of fertilizer N was much greater in the first year on the black earth than on the red clay, but in the second and third years uptake of N residues was greater on the red clay. The total uptake for the three crops was the same on both soils. Uptake of N residues in the second and third years amounted to 37% of the total uptake on the black earth and 71% on the red clay. These results suggest that significant proportions of unused N residues remain within the root zone for at least 2.5 years after application on these slow leaching clay soils.