Use of lucerne leys for maintaining the productivity of wheat-growing soils

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There is a lack of detailed experimental data on the effects of grazed lucerne on soil fertility in the wheat growing areas of Australia. In particular, it is not known how much nitrogen grazed lucerne adds to the soil and how long this contribution continues under conditions of increasing nitrogen accumulation. In addition, little is known of the optimum duration of a lucerne ley or whether the beneficial effects of lucerne vary between soil types.

The long term effects of varying durations of lucerne ley, extended fallowing, and continuous wheat growing on the growth, yield, and nitrogen uptake of subsequent wheat crops were determined on two contrasting soils in northern New South Wales. Durations of lucerne leys were 3 1/2, 3 1/2 and 1 1/2 years on a black earth and 5 1/2, 1 1/2 and 1 1/2 years on a red brown earth. The treatments ended simultaneously so that their effects on soil productivity could be tested by wheat growing under identical climatic conditions.

With the exception of the first wheat crop, which was affected by moisture deficiency in the lucerne treatments after too short a fallow (Holford and Doyle 1978), wheat production for several years following lucerne exceeded that following extended fallow or continuous wheat growing, whether measured as vegetative nitrogen uptake at anthesis or grain yield. The former parameter is probably the better indicator of soil N fertility because grain yield is so sensitive to climatic effects during the post-flowering period. Grain yields following lucerne either equalled, or in most cases significantly (P <0.05) exceeded, the yields of continuous wheat grown with N fertilizer in the first six crops on the black earth and the first three crops on the red brown earth.

Both parameters indicated that the beneficial effects on the black earth were greatest and most persistent after 3 1/2 years of lucerne. Although smaller the beneficial effects of 3 1/2 years of lucerne lasted as long as those of the 1 1/2 year lucerne ley. In terms of grain yield, 3 1/2 years of lucerne also appeared to be the optimum treatment on the red brown earth, but an extra two years of lucerne caused larger and longer-lasting effects on N uptake.

It was concluded that 3 1/2 years was the optimum duration of lucerne on both soils, providing adequate nitrogen for at least five wheat crops on the black earth and three crops on the red brown earth. The shorter duration on the latter soil appeared to be caused by its more freely draining nature and consequent more rapid loss of accumulated nitrogen. The susceptibility of the soil to leaching is probably an important factor controlling the persistence of the lucerne effect. The extra nitrogen recovered from the soil by the wheat crops (herbage only) following 3 1/2 years of lucerne amounted to 176 kg ha⁻¹ on the black earth (seven crops) and 139 kg ha⁻¹ on the red brown earth (five crops).