

Effect of rotations and stubble treatments on soil fertility and crop yields

J.E. Schultz

Northfield Research Laboratories, Department of Agriculture, S.A.

The trend from ley-farming towards increased cropping intensity on many South Australian farms has led to queries about the possible effects on soil fertility and structure, the role of grain legumes, the need for nitrogen fertilizer, the incidence of soil-borne diseases and methods of handling crop residues. A trial was begun in 1977 to monitor the effects of intensive and traditional rotations on soil properties and crop production. The aim is to define the inputs necessary to maintain production under intensive farming systems.

Methods

The trial is on a hard-setting red-brown earth, 50 km north of Adelaide where ley-farming is the traditional farming system. Continuous cropping systems are compared with pasture/wheat and fallow/wheat rotations. Wheat is grown every second year in each of eight rotations which are in factorial combination with three stubble treatments - burning, incorporation and surface retention. All plots are cultivated for seedbed preparation but the number of cultivations has been reduced as new herbicides have become available for weed control. Three rates of nitrogen - 0, 40, 80 kg/ha - are applied to the wheat phase and to wheat and barley in the alternate crop phase.

Results and Discussion

Table 1: Total production (t/ha) 1977-1983. Averaged for stubble treatment.

Rotation	Total Production, '77-'83, t/ha			
	Wheat		Alternative Crop	
	0 kg/ha N	80 kg/ha N	0 kg/ha N	80 kg/ha N
Continuous Wheat (7 crops)	7.76	11.77	-	-
Wheat/Barley	4.30	6.22	4.32	6.85
Wheat/Peas	5.81	6.96	3.34	3.33
Wheat/Lupins	6.30	7.48	2.71	2.83
Wheat/Beans	6.46	7.31	5.49	5.39
Wheat/Vol. pasture	4.97	6.60	-	10.52
Wheat/Sown pasture	5.11	6.48	-	15.77
Wheat/Fallow	6.60	7.94	-	-

Wheat yields and N responses have varied from year to year. Table 1 gives total production \1977-1983) for the eight rotations with 0 and 80 kg/ha N. Wheat has responded to N in all rotations with the biggest gains in those which do not include a reliable legume. Field beans have been the most successful grain legume in this environment. The sown legume pasture has been more productive than the volunteer pasture which consists mainly of grass and weeds. Although grain legumes remove large amounts of N, soil nitrate-N in the following year is just as high after grain legumes as after legume pasture.

Stubble treatments have had little or no effect on wheat yield, total soil N, or organic C at this stage and there is no interaction with N fertilizer. Measurements of aggregate stability suggest that all systems are maintaining an adequate soil structure.

Seven annual applications of the high rate of N fertilizer on continuous wheat plots have decreased the pH by about one unit from the initial value of 6.7.

The common soil-borne root diseases are present at the site but levels of infection have been relatively low and variable. In 1984, CCN appears to be causing a significant yield loss on the continuous cereal rotations.

The data so far suggest that the hard-setting red-brown earths, previously regarded as 'problem soils', can be continuously cropped providing that suitable rotations, cultivation practices and management techniques are used.