ECONOMICS OF PASTURE ROTATIONS IN QUEENSLAND WHEAT AREAS

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Summary. Pasture rotations benefit wheat production by improving fertility, soil structure and providing a check on soil borne diseases. Protein is of particular importance to profit from wheat, because of its effect on the wheat prices. It is profitable to use pasture leys to maintain or restore fertility, once protein levels and wheat yields start to decline after 25-30 years of cultivation. An example is presented for wheat production at Goondiwindi, where average wheat yields of 1.6 t/ha are barely profitable if fertility decline has resulted in low prices because prime hard wheat is no longer grown in most years. Livestock on good pastures are more profitable than poor wheat crops. A rotation of wheat and pasture can be twice as profitable as wheat on land suffering from fertility decline.

INTRODUCTION

Fertility decline in the major wheat growing areas of Queensland is reducing the yield and quality of wheat (2). Soil N decline of the order of 25-45% was recorded by Dalal and Mayer (3) in six graingrowing soils cultivated for periods of up to 70 years in Southern Queensland. Over the last ten years, a high proportion of wheat in the northern grain growing region of Australia has been down graded from Prime Hard wheat because of low protein (10). A large amount of land producing wheat has passed or is soon to pass the critical age of cultivation at which nitrogen becomes limiting. For most of the lower rainfall areas this is around 25-30 years of cultivation.

The protein level and price of wheat is critical for profit. Within the 10-13% protein range, there have been premiums of the order of $30 to $50 per tonne for the higher protein wheat over the past few years. There is almost no profit from wheat at the prices received for low protein wheat in recent years and the combined effects of fertility decline on yield and protein is very serious for farm viability.

In the higher rainfall districts, farmers mostly grow other crops, such as barley, sorghum and cotton and commonly use nitrogen fertiliser. Much of the wheat in Queensland is now grown in the lower rainfall farming districts, such as the Western Downs. In these areas it is not practical or economically viable to use enough N fertiliser to maintain wheat protein levels.

Pastures based on lucerne are likely to be the most viable means of maintaining nitrogen fertility in southern Queensland and northern NSW. Pasture rotations also help to boost soil structure and to control important soil borne diseases of wheat. Because lucerne grows year round it utilises rainfall at any time to produced forage and nitrogen. Annual medics, by comparison are more variable in production and provide less fodder during spring than lucerne.

Fertiliser or legumes?

In the high rainfall areas, such as the Darling Downs, nitrogen fertilisers are used regularly on wheat and other crops. In the drier areas to the west, which comprise the main wheat growing areas, very little nitrogen fertiliser is used. The main problem is the reliability of response from nitrogen fertiliser.

In these areas, even where nitrogen fertility has declined after many years of cultivation, there is usually little or no response to nitrogen fertiliser in years when yield levels drop below 1.5 t/ha. This lack of response, in 50% of years, deters farmers from using nitrogen fertiliser

Another important reason for a lack of confidence in fertiliser nitrogen, is that it does not necessarily improve the protein content of the grain. In fact, the use of moderate amounts of nitrogen is more likely to result in reduced grain protein, because of the stimulation it provides to plant growth and yield. Farmers

also have concerns about nitrogen fertiliser causing yield reductions in dry years. This effect is infrequent, but can occur on occasions when moisture is limited and high rates of N fertiliser are applied.

Legume supplied nitrogen is much more likely to improve grain protein because it is released gradually during crop growth.

Grain or Pasture Legumes?

In higher rainfall areas there is increasing use of grain legumes, such as chickpeas and mung beans. Although the responses in cereal yields are good after legumes (8), the net contribution of nitrogen from these legumes is quite low in comparison to crop requirements (4). Grain legumes are not as well suited to the drier areas and pasture legumes are likely to be more important for the maintenance of fertility.

Lucerne is one of the most productive pasture legumes in southern Queensland and northern NSW. In a pure sward it is likely to produce 80-140 kg N/ha/year where conditions are reasonably favourable. This conclusion is based on the trial work of Whitehouse and Littler (7, 12) on the Darling Downs, Holford (5, 6) at Tamworth and the QDPI Warra trial, as yet unpublished.

In drier environments and dry years, lucerne will produce less forage and fix less nitrogen, but on average it could be expected that nitrogen inputs would be at least half these levels in the main wheat growing areas of the Western Downs and northern NSW.

This is likely to result in enough nitrogen produced from one year of lucerne ley pasture to grow a satisfactory wheat crop in a subsequent year. The research work by Littler at Jondaryan and Holford at Tamworth (5, 6, 7, 12) suggests an optimum period for nitrogen build-up by lucerne of three to four years. However, a shorter rotation of 2.5 years of lucerne, may well maximise overall benefits which include weed and disease control.

Rotation benefits

The production of wheat in a monoculture is still common in the drier farming areas of northern NSW and southern Queensland. Weeds, root diseases, such as crown rot and root rot and fertility decline are major problems of this system and commonly cause yield losses of up to 15% (13). These disease effects and less available nitrogen can limit the yield of wheat grown on reduced tillage fallows and prevent the benefits of improved moisture storage being realised (1, 9, 11).

A rotation program with lucerne, may overcome the dual problems of disease and nitrogen availability when minimum and zero tillage are used and maximise water use efficiency. A wheat cropping system which involves the use of minimum tillage, crop rotation, and phosphate fertilisers with pasture leys provides a balanced farming system which maximises profitability at the *same time* as improving sustainability(14)!

Profitability of wheat is calculated for the main wheat growing areas receiving 570 mm of rainfall; e.g. Goondiwindi. Wheat grown in a monoculture at average yield levels of 1.6 t/ha is barely profitable, with a net profit of $20/ha (Table 1). Research trials at Billa Billa over four years, from 1989 to 1992, demonstrated improved yield of wheat; from 1.6 t/ha to 2.2 t/ha with fertiliser, rotation and zero tillage (9, 11). Despite extra costs of fertiliser, profits from such a system are likely to increase to around $60/ha.

Research by Littler and Holford and more recently at Warra demonstrate increases in wheat protein levels of 2-3% following a rotation with lucerne (5, 6, 7, 12). If yields of 2.2 t/ha can be produced using zero-tillage and lucerne is used to provide rotation and extra nitrogen to boost protein to a prime hard quality level, this will increase profit from $60 to around $160/ha.

Table 1. Economic comparison of wheat production using minimum tillage, rotation and legumes compared to a standard monoculture, on a farm in 570 mm rainfall areas, e.g. in the Goondiwindi area of southern Queensland.

		Wheat	Zero-till wheat	Wheat	Lucerne
	monoculture	rotation 2	and after grazed		
	cultivated fallow	N fertiliser3	lucerne4		
Wheat yield (t/ha)	1.60	2.2	2.2		
Protein (%)	11.5	11.5	13.5		
Price ($/t)	140	140	175		
Gross return1 ($/ha)	224	308	385	190	
Growing costs ($/ha)	124	166		145	116
Overhead costs5 ($/ha)	80	80	80	40	
Profit	($/ha)	20	60	160	34

1. Prices over recent years and crop yields derived from research and farmer experience

2. Wheat grown in rotation with chickpeas or oats.

3. N, 50 kg/ha

4. Wheat in rotation, 3 years lucerne, 3 years wheat.

5. Includes: rates, administration, machinery depreciation and labour

Profit from livestock on lucerne

The profit from livestock grazing lucerne is variable according to seasonal rainfall, but can be comparable to run down cultivation. Estimates in table 1, show a profit from a lucerne pasture of $34/ha, compared to a profit $20/ha from wheat yielding 1.6 t/ha at a price of $140/t. This livestock return is based on annual liveweight gains of 250 kg/steer, grazing 1.4 ha of lucerne for 2.4 years of a 3-year rotation.

The profit from lucerne will depend upon whether there is existing infrastructure for livestock, such as fencing and water facilities on the property. It will also be affected by the benefit provided by the lucerne in improving the general quality of pasture. However, too much lucerne may result in not enough feed reserves in the form of standing grass feed. This can accentuate feed shortages in dry seasons and

drought. Growing lucerne pasture with a grass component will help alleviate this problem. Short term rotations with a significant amount of new lucerne each year growing on fallow moisture as a forage crop can improve the reliability of feed supply, particularly in spring.

Reasons why lucerne may be superior to grass-medic pastures, are that the nitrogen contribution from lucerne is likely to be much higher than medic and that lucerne will provide more spring feed than medics.

A common method of establishing lucerne is to undersow it with wheat. However, this can reduce wheat yields and in dry cropping areas there is a significant risk of lucerne failure in a dry spring. An alternative is to sow lucerne in autumn, following wheat. This requires additional land preparation costs, but these costs may be offset by the higher wheat yield and better lucerne production from improved establishment.

Profit from cattle grazing lucerne is likely to exceed that from wool production, but lucerne is an excellent feed for fat lambs and such a sheep enterprise may be quite profitable. Bloat deaths of cattle on lucerne is a major reason why lucerne is not more widely grown.

Bloat control strategies include the provision of roughage hay when lucerne is lush, rumen bloat capsules or bloat oil dispensers on water supplies.

CONCLUSIONS

• Profitability is declining to very low levels with soil fertility induced reductions in yield and protein in the main wheat production areas of Queensland and northern NSW.

• Nitrogen fertiliser produces erratic response in the major wheat growing areas and does not contribute significantly to the maintenance of wheat protein levels.

• Grain legumes have production problems in western wheat areas and will not contribute enough nitrogen to maintain the yield and protein content of wheat.

• Pasture rotations provide the main way to maintain wheat protein levels, with measured increases by 2-3% following a lucerne pasture.

• Lucerne is one of the most productive of the pasture legumes, with the potential of one year of lucerne rotation to provide nitrogen for at least one year of wheat production.

• Lucerne pasture rotations provide significant additional benefits in the form of a disease break and in helping to maintain soil structure.

• Annual average profit from a rotation of lucerne and wheat is calculated at $97/ha compared to $20 per ha for wheat grown under low N fertility conditions.

• Lucerne has provided successful pastures for livestock, with weed control and bloat of cattle being the major deterrents to more widespread use. New weedicide options and bloat control practices can alleviate these problems.

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