

**Maximizing the Profitability of  
Cotton Cropping Systems with Legumes**

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**Summary**

- Most profitable systems include legumes.
- The most profitable system per ha: was continuous cotton-vetch system.
- The most profitable system per ML: the cotton-faba bean & cotton-vetch-wheat systems.
- Changes in lint or N fertiliser prices do not substantially affect gross margins.
- Applying more or less N fertiliser than required will impact significantly on gross margins.
- The N added by the legume crops more than paid for the production of the legume crop.

**Cotton Profits are Increased by Including Legumes in Cotton Cropping Systems**

In earlier research, vetch was shown to be the best legume for N fixation, and it is now grown commercially as part of the cropping system on some farms across most cotton growing regions. After nine years of research on a cropping systems experiment conducted at the Narrabri Australian Cotton Research Institute growing vetch as a green manure crop provided not only substantial nutritional benefits to cotton and improved soil structure, but also gave a greater economic return. This article reports the economic benefits of incorporating legumes into cotton cropping systems.

The cropping system experiment included five systems; each system was evaluated at the end of a two-year cycle:

- Continuous Cotton (C-C) – Cotton was planted each year with a fallow over winter.
- Continuous Cotton Vetch (CVCV) – Cotton was planted each year and vetch was grown in winter and incorporated back into soil before cotton is sown.
- Cotton Wheat (CW~) – Wheat was planted after cotton; once the wheat is harvested there was a nine-ten month fallow.
- Cotton Wheat Vetch (CWV) – Similar to the cotton-wheat system however the fallow was shorter and vetch was planted between January and April and incorporated before cotton sowing.
- Cotton Faba Bean (CF~) – Faba bean was sown after cotton; after faba bean grain was harvested, stubble was incorporated back into the soil and the soil fallowed for nine-ten months.

The rotation crops were not fertilized or irrigated. The variable costs associated with each crop were determined via information from the NSW Department Primary Industries

([www.dpi.nsw.gov.au](http://www.dpi.nsw.gov.au)) and local businesses CGS, CropJet Aviation and Wesfarmers.

Gross Margins were assessed on using the following prices: (a price sensitivity analysis is shown later)

- Cotton – Lint \$500/bale, Fuzzy Seed \$176/t
- Wheat – Grain \$150/t
- Faba Bean – Grain \$220/t
- Input of N from the legumes priced at the cost of N fertilizer - \$0.89/kg.

Comparison of these five cropping systems indicated that legume based systems produced higher gross margins than non-legume (fallow) systems (Table 1).

Our data shows that:

- Cotton yields were higher in vetch systems.
- Continuous cotton produced lower yields than rotation systems.

- Legume systems required zero to little N fertilizer to produce optimum economic yields whereas non-legume systems required more N fertilizer.
- Gross margins were higher for legume based systems for both \$/ha and \$/ML.
- All costs associated with growing and incorporating legume crops (\$76/ha) were offset by allowing for the input of N fixed by the legumes (\$130/ha).

#### **Gross margins \$/ha**

In the continuous cotton system, the gross margins per hectare increased 23 per cent with addition of vetch into the cropping system. In the cotton wheat system, the addition of vetch increased the gross margin per hectare by 12 per cent. Profits were increased through higher yields, and lower variable costs associated with not having to purchase or apply N as it was added by the vetch. Hence, for growers with limited land, the best option to maximize economic profit would be the continuous cotton vetch system as it has the highest gross margin per hectare of all the systems we compared.

#### **Gross margin \$/ML**

In the continuous cotton system, the gross margins per megalitre increased by 23 per cent with addition of vetch into the cropping system. In the cotton wheat system, the addition of vetch increased the gross margin per megalitre by 13 per cent. However, the cotton-faba bean system was the most profitable system per megalitre. Faba bean produced grain for harvest and also fixed N. Faba bean produced higher yields than wheat crops, plus the reduced need for N fertilizer by subsequent crops allowed this system to give greater returns than the cotton-wheat system. The cotton-faba bean system was only slightly better than the wheat vetch system, due to lower variable costs associated with less planting and cultivation costs and higher grain yields. Therefore, farmers with limited water can maximize profit by adopting the cotton-faba bean system.

#### **Affect of Changing Cotton Prices on Gross Margins**

A sensitivity analysis showed that there was a substantial difference in gross margin/ha between continuous cotton systems and rotation systems (Figure 1) as there was cotton in each year for the continuous cotton system. However, there were no significant differences in gross margin between each system within these two groups.

#### **Nitrogen fertiliser rates**

The rate at which N is applied can have a major impact on yield and therefore gross margin (\$/ha), so it is important to apply the optimum rate of fertiliser that will achieve maximum return. The response to N fertilizer was determined by applying N at various rates between 0 and 200kg N/ha and assessing lint yields of each rate in each cropping system to find the optimum N rate (Figure 2). The optimum is found when the marginal (\$) return of lint equals the marginal cost of nitrogen i.e., for each additional kg of N you apply (this costs \$0.89), you need to recover at least \$0.89 worth of lint (0.4 kg). The optimum N fertilizer rate varies for each cropping system as shown in Figure 2.

Figure 3 shows that the application of N fertiliser to the wheat-vetch and faba bean systems has a negative affect on gross margin as they had enough N already to produce maximum yields. Applying more nitrogen decreased gross margin. However, in the continuous cotton-vetch system applying a small amount of N can improve the gross margin but applying excessive N can decrease gross margin by up to eight per cent. Adding N to back-to-back cotton increased gross margin by up to 15 per cent at the economic optimum N rate, but applying N beyond this point decreased gross margin by seven per cent.

#### **The Affect of Price Changes on Optimum N Fertiliser Rates**

The NutriLOGIC Decision Support System identifies the optimum N fertiliser rate given soil the pre-sowing nitrate levels. However, the optimum N fertiliser rate will vary with the cost of N fertiliser and price of cotton. How do N fertiliser and cotton price changes affect the optimum N

fertiliser rate of a crop? If the price of N (\$/kg) increases then the optimum N fertiliser rate will decrease. Also, as the price of cotton increases, the optimum N rate should increase. The optimum N rate suggested by NutriLOGIC is quite robust. For example, increasing lint price from \$300-\$500 (67 per cent increase) produces only a 12 per cent increase in the optimum N rate. And increasing N fertiliser costs from 90c to \$1.50 (68%increase) reduces optimum N fertiliser rate by only seven per cent.

### **Conclusions**

The best option for growers to achieve a high return with minimal land would be to grow continuous cotton, with a vetch green manure crop each winter, which will increase yield, require less nitrogen and thus increase gross margin by about 23 per cent. This system has the highest gross margin per hectare. For growers who have limited water the best option would be to use a cotton-wheat-vetch or cotton- faba bean system as these systems have the best gross margin per megalitre. The best option to maximise profit will depend on availability of suitable land and water. Optimum N fertiliser rates determined by NutriLOGIC are robust as large increases in cotton \$/bale or N fertiliser \$/kg do not substantially change the N fertilizer rate needed to maximize gross margin. Growers who include legumes in their cropping systems will not only be improving yield and their profits but also improving soil quality and the environment through reduced use of fertiliser. But further, this economic analysis indicates that including a legume in a cotton cropping system will significantly improve economic return.

### **Acknowledgements**

The cropping systems research and Emma Williams' project are funded by the CCC CRC & CRDC.

### **Further Reading**

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