Legume Fallow Economics: 2020 Case Study

Proserpine grower: Frank Clayton

Project Catalyst growers worked with economists from the Department of Agriculture and Fisheries to identify costs and benefits of their trials. In this study, Frank Clayton and Farmacist trialled a low-cost legume versus bare fallow strategy.

The objective of the trial is to investigate the yield response and economic benefit of taking soybeans to grain after planting them directly into the cane bed without applying nutrients (low cost strategy). This is compared to a typical bare fallow strategy. It is anticipated that added soybean costs would be offset by grain income and improved cane yield (from added nitrogen). The analysis presents an economic comparison between the soybean and bare fallow, including an investment analysis and yield risk assessment at long-term pricing.

Trial Design & Soybean Yield

Farmacist assisted Frank in conducting the trial between 2019 and 2020 on his farm located south of Proserpine (55ha fallow & 305ha cane land, including leased area). The trial was a randomised strip trial with three replications for two treatments. The treatments included a soybean crop versus bare fallow prior to cane. The soybean crop averaged 1 t/ha across the treatments. Due to limitations with the harvesting method, replicate soybean yields were not available. Harvesting of the plant crop (variety Q208) will take place in 2021.

Key findings

- The soybean fallow crop (at $930/t) provided a positive return compared to that of the bare fallow.
- Considering the grower's capital investment, a longer-term analysis shows that a 1.2t/ha soybean yield is required to remain more profitable than the bare fallow.
- The economic benefits improve significantly when soybean yields increase (i.e. to 1.5t/ha).

Figure 1: Frank Clayton and his 'header' on his Proserpine farm

Variable Costs

Figure 2 presents the total variable costs for bare fallow (fallow) and soybean treatments. The soybean costs were $560/ha higher than the bare fallow.

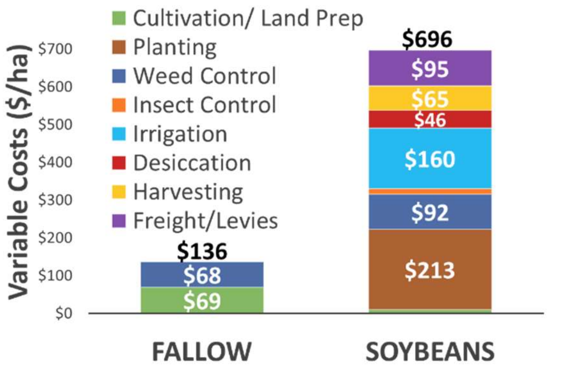

Figure 2: Soybean & fallow variable costs ($/ha)

Figure 3 presents the plant cane variable costs which were the same for both the soybean and bare fallow. These include actual growing costs and harvesting/levy costs based on an 80t/ha cane yield (grower expected yield).

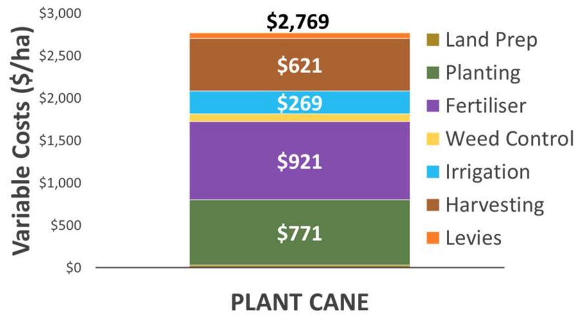

Figure 3: Plant cane variable costs ($/ha)

Soybean Gross Margin

With a soybean yield of 1t/ha and price of $930/t (2020 price), the total revenue for soybeans is $930/ha. Less variable costs of $696/ha, the gross margin for soybeans is $234/ha. This is compared to the variable cost of the fallow in Figure 4.

Figure 4: Soybean gross margin and fallow cost comparison ($/ha)

Table 2 presents the soybean gross margin sensitivity to price and yield changes. It shows yields below 0.7t/ha result in a negative gross margin (at $930/t). It presents the same result for prices falling below $700/t (at 1t/ha). Sensitivities assume the same cane yield in both treatments.

Table 2: Soybean gross margin sensitivity to price and yield changes

Yield	Price ($/t)					
(t/ha)	$500	$600	$700	$800	$900	$1000
0	-$582	-$582	-$582	-$582	-$582	-$582
0.5	-$384	-$336	-$287	-$238	-$189	-$140
1	-$187	-$89	$9	$106	$204	$302
1.5	$10	$157	$304	$451	$597	$744
2	$207	$403	$599	$795	$990	$1,186

Soybean Capital Costs

Table 1 presents the soybean machinery and equipment costs required for planting and harvesting operations. The planter has an expected life of 10-years. The second-hand header and auger/silo have expected 20-year life spans with machinery investments totalling $54,000.

Table 1: Soybean machinery & equipment costs

Type *(second hand)*	**Purchase Price** ($)	**Expected Life** (Years)
Soybean Planter	$8,000	10
JD Header	$38,000	20
Auger/Silo	$8,000	20
Total	**$54,000**	

Note: affordability of new machinery would likely require a higher gross margin in the soybean crop.

Investment Analysis (at $600/t)

Given a high 2020 soybean price, the investment analysis determines the payback period using a long-term soybean price of $600/t (source: PB Agrifood). It also considers the initial $54,000 investment in soybean machinery and equipment and applies a discount rate of 7%.

The analysis presents three scenarios. The first scenario includes soybean yields at 1t/ha (trial yield) with scenarios two and three increasing to 1.5t/ha and 2t/ha respectively. Scenario 1 shows that with a $2,423 higher annual gross margin from the soybean treatment, the capital investment is unaffordable against the bare fallow (Table 3). At 1.5t/ha and 2t/ha, the payback period reduces to 5-years (scenario 2) and 2-years (scenario 3) respectively.

Table 3: Payback and return on investment for three soybean versus bare fallow scenarios

Soybean Scenario	**1**	**2**	**3**
Soybean yield (t/ha)	1.0t/ha ⇨	1.5t/ha ⇨	2.0t/ha
Soybean Price ($/tonne)	$600	$600	$600
Gross margin increase ($/year)	$2,423	$14,599	$26,451
Discounted payback period (years)	n/a	5	2
Annual benefit ($/ha/yr)	-$8	$17	$41
Internal rate of return	-2%	24%	47%
Investment Capacity ($)	$27,022	$112,540	$195,781

Table 3 shows that over a ten-year investment horizon, the 1t/ha soybean crop incurs an estimated annual farm loss of $26,978 (-$8/ha/yr). Assuming constant cane yields, an improvement in yield to 1.5t/ha adds $6,060 profit per year ($17/ha/yr) over the bare fallow. The internal rate of return also improves significantly to 24%.

Investment capacity is the maximum amount of money that can be spent before an investment becomes unprofitable. Only a $27,022 investment was affordable for a 1t/ha soybean yield (at the required 7% return on investment). The investment capacity is significantly higher for the improved soybean yield scenarios.

Production Risk (Soybeans)

A production risk analysis for scenario 1 (Figure 5) shows that overall soybean yields would need to increase to1.2t/ha before the soybean investment is more profitable than the bare fallow (at a soybean price of $600/t).

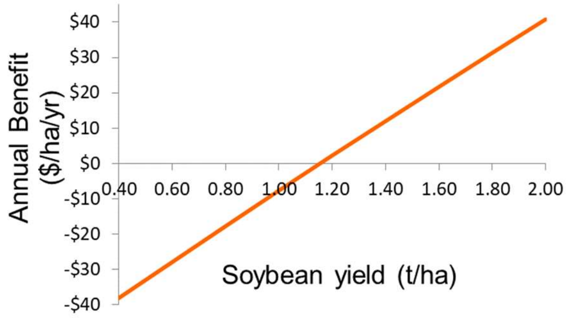

Figure 5: Annual benefit of investment ($/ha/yr) sensitivity to soybean yield (at $600/t)

Conclusion

The preliminary economic analysis shows that at high soybean prices (2020), the low-cost soybean strategy was more profitable when compared to a bare fallow. However, this is not the case with prices closer to $600/t (long-term price).

Considering longer-term pricing, an investment analysis and yield risk assessment show that soybean yields would need to improve to 1.2t/ha for the strategy to remain more profitable than the bare fallow. It also shows that a significant improvement in both the annual benefit and internal rate of return occurs with a soybean yield of 1.5t/ha.

It is not yet certain whether significantly higher soybean yields are achievable under a low-cost strategy. It is anticipated that the purchase of a new planter will improve germination and subsequent yield. Frank is also considering fertilising and improving land preparation to reduce harvesting losses (uneven paddock surfaces).

Australian Government | REEF TRUST | Great Barrier Reef Foundation | PROJECT CATALYST

Project Catalyst is funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation, and the Coca-Cola Foundation with support from WWF-Australia and Catchment Solutions Pty Ltd.

"We expect to improve soybean yields in a low-cost strategy through incorporating better planting machinery and operations. This should give us a better strike (germination) which should also reduce weed control costs. We are also considering a higher-cost strategy where fertiliser is expected to improve soybean yields even further."
Frank Clayton.

Note: the trial results are specific to this grower, paddock and prevailing conditions.

We acknowledge the significant contribution made by Farmacist to this publication.

For more information on the economic analysis, please contact DAF:

Brendon Nothard – Ph: (07) 4999 8564

Email: Brendon.Nothard@daf.qld.gov.au

For more information on the agronomic results please contact Farmacist:

John Turner - Ph: (07) 4959 7075

Email: johnt@farmacist.com.au

Publication date: August 2021

Queensland Government