Economic and Environmental Influence of No-Till and Cover Crops on Dryland Cotton Production

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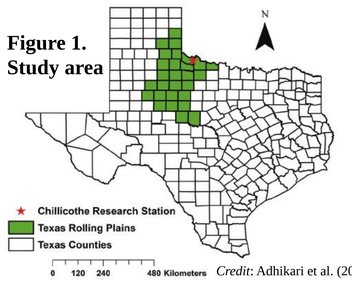
Background and Objectives

- Benefits of cover crops: curtail soil erosion, improve soil health with organic matter and nutrients, increase crop yield and farm income.
- Low cover crop adoption rate in the semiarid Southern Great Plains.
- Insignificant crop yield and farm profit from adopting cover crops.
- This study evaluates economic and environmental influence of multiple cover crops in Texas Rolling Plains dryland cotton systems.

Data and Methods

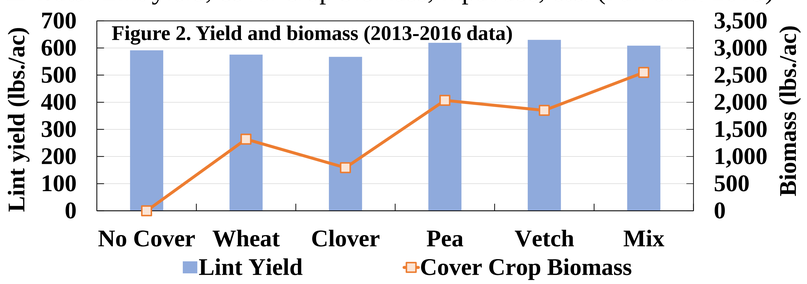
- Location: Texas A&M Chillicothe Research Station.
- Cotton systems: dryland, continuous, no-till; 2013-2016.
- ***Treatments*** (DeLaune et al, 2020):
  - 1) No cover crop
  - 2) Winter wheat
  - 3) Crimson clover
  - 4) Austrian winter pea
  - 5) Hairy vetch
  - 6) Cover crop mixture

Figure 1. Study area



Credit: Adhikari et al. (2017)

- Data: Lint yield, cover crop biomass, input use, etc. (Fan et al. 2019)

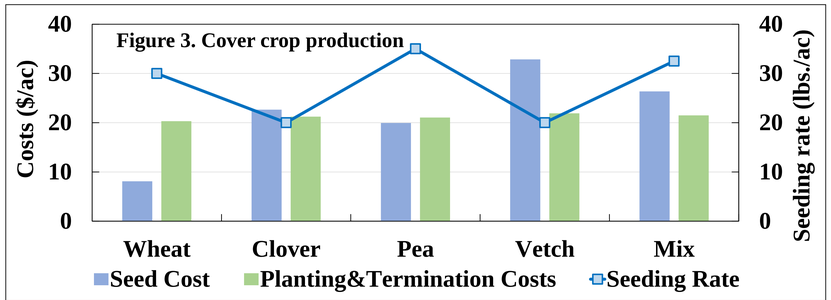


Simulation and Estimation Approach

- Utility maximization: max $U = f$ (farm income, soil health, environment)
- Net present value (NPV): $NPV = \sum_{t=0}^{n}[NR_t/(1+r)^t]$, NR_t: net return in year t, with interest rate r. $NR_t = Total\ Revenue_t - Total\ Cost_t$
- Baseline scenario: No cover crop; Simulation time: $n = 30$ years
- Simulation based on a cover crop decision support tool—*Economic Analysis of Cover Crops* (Cartwright and Kirwan, 2015).

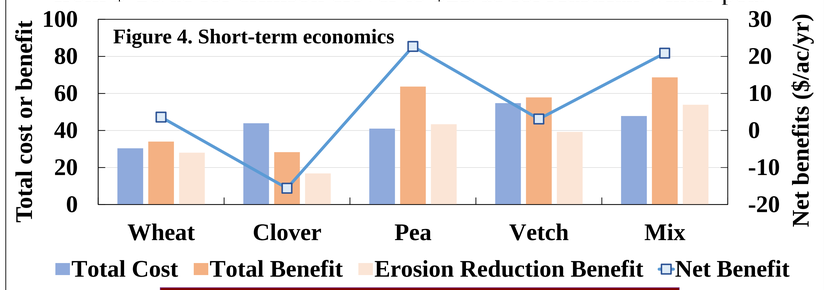
Model Parameters

Table 1. Model parameters	Wheat	Clover	Pea	Vetch	Mix
Reduction in N purchase (lbs./ac)	0	10	26	23	16
Erosion reduction (ton/ac)	4	2.4	6.2	5.6	7.7
Yield change relative to no cover crop scenario (%)	-2.7	-4.1	4.7	6.5	2.9
Years to increase SOC by 1%	15	18	12	12	11



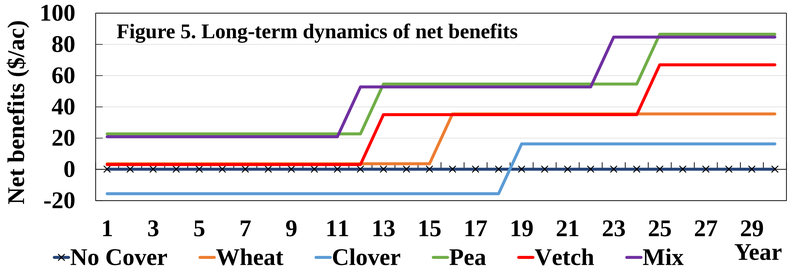
Results – Short Term Economic Results

- Both short- and long-term evaluations are conducted relative to the no cover crop scenario.
- Variable costs include expenses on tillage, seed, fertilizer, chemical, fuel, repair and maintenance, labor, irrigation, insurance, interest, harvest, and ginning. Fixed costs include all machinery depreciation.
- Relative to no cover, adding wheat cover crop increases production cost by $30/ac, while crimson clover, Austrian winter pea, hairy vetch, and mixed cover crops increase costs by $41-$55/ac.
- Relative to no cover, the erosion reduction benefits range from $17/ac for crimson clover to $54/ac for mixed cover crops.
- Relative to no cover, the net benefits of adding cover crops range from $-16/ac for crimson clover to $23/ac for Austrian winter pea.

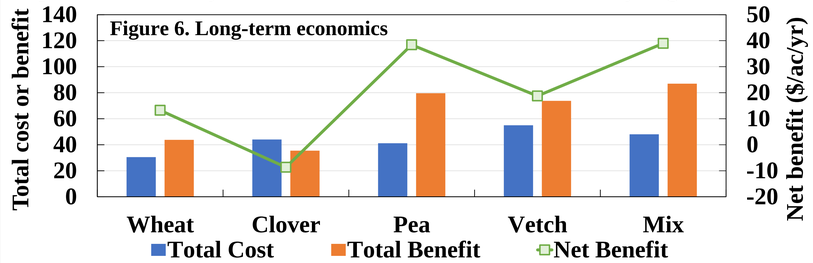


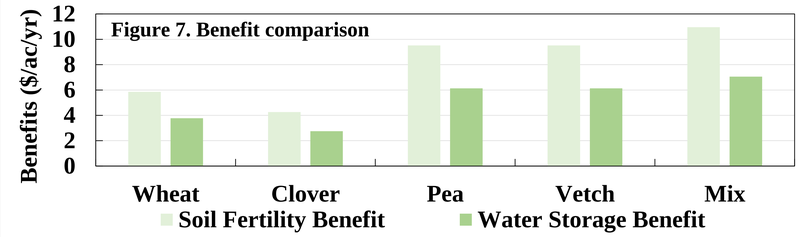
Long Term Economic Results

- The 30-year economic results show dynamic changes following soil organic matter changes (see Table 1) primarily due to different biomass amounts of the cover crops.
- In the long term, compared to no cover crop, wheat increases the annual cost by $31/ac, and other cover crops increase the costs from $41/ac (Austrian winter pea) to $55/ac (hairy vetch) (see Figure 6)



- The long-term annual total benefit of crimson clover is lowest ($35/ac) due to low biomass amount. The annual benefits of other cover crops range from $44/ac (winter wheat) to $87/ac (cover crop mixture).
- The long-term net benefits of adding cover crops are $-9/ac for clover and range from $13/ac for wheat to $38/ac for pea and $39/ac for mix.
- The soil fertility and water storage benefits are consistently low for crimson clover ($4.26/ac and $2.75/ac, respectively). Austrian winter pea, wheat, hairy vetch, and mixed cover have similarly high benefits.





Conclusion

- Cover crops do not affect short-term cotton yield. Different biomass amounts influence soil biophysical characteristics over years and the benefits of erosion reduction, soil fertility and water storage vary.
- In a short term, positive net benefits are observed for cover crops other than crimson clover, ranging from $4/ac (wheat) to $23/ac (mixture).
- In a long term, the positive net benefits range from $13/ac (wheat) to $39/ac (mixture).

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