Economic Risk Analysis of Adopting Enhanced-Efficiency Urea Fertilizers in Winter Wheat Production of the Southern Great Plains

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Background and Objectives
- Urea is a common N source for winter wheat due to its low price, though potential N loss by volatilization can make urea a less effective fertilizer.
- To minimize N loss, growers may split urea applications at planting and mid-winter or use enhanced-efficiency fertilizers.
- This study investigates the performance of enhanced-efficiency urea fertilizers on dryland winter wheat in the Southern Great Plains.
- This study evaluates the risk-adjusted profitability of enhanced-efficiency urea fertilizers and application strategies in wheat production.

Data and Methods
- Locations: Two Texas A&M AgriLife properties near Vernon, TX
- Soil type: Abilene clay loam soil
- Climate and precipitation: Semi-arid, 260 mm (Nov. 2016-May 2017)
- Cropping system: Dryland no-till winter wheat
- Exp. design: Randomized complete block design with 4 replications.
- Plot size: 40 plots per location; 4.06 m wide and 9.14 m long.

Ten treatments (Adams et al., 2018):
1. Zero urea (N0)
2. Untreated urea (Urea31.5)
3. Polymer-coated urea (PCU31.5)
4. Untreated urea (Urea70)
5. Stabilized urea (SU31.5)
6. Polymer-coated urea (PCU70)
7. Stabilized urea (SU70)
8. Untreated urea (Urea70S)
9. Stabilized urea (SU70S)
10. Polymer

Simulation and analytical procedures (Richardson et al., 2008):
- Simetar: Multivariate normal distribution, 500 iterations
- Net return = Risk premium (RP) - total cost
- Stoplight chart
- The cumulative distribution functions (CDF) of net returns show N0 has a distribution further to the right, indicating a higher chance of getting a higher net return, followed by Urea31.5 and SU70.
- The CDF distributions of SU31.5 and SU70S are in the middle of the range, while the more risk-averse producers would be indifferent between N0 and SU70.
- Net return = price * yield – total cost
- Stochastic Efficiency with Respect to a Function (SERF)
- Absolute risk aversion coefficient (ARAC)
- Certainty equivalent (CE)
- Risk premium (RP) is the minimum payment that a decision maker will have to receive before switching from risky practices B to A under a certain risk aversion level r_a.

Results – Simulated Yield
- Wheat yield simulations show the largest yield variation in Urea70, followed by a moderate variation in PCU31.5, Urea31.5, and SU70S, while a smaller variation is observed for SU31.5, SU70, and SU31.5.
- The yield is 1.72 and 1.80 Mg/ha for N0 and Urea31.5, respectively, and a greater yield is observed for SU70 and SU70S at 2.26 and 2.01 Mg/ha, respectively.
- PCU70 and PCU31.5 have lowest wheat yield—1.24 and 1.64 Mg/ha, respectively.

SERF Results
- N0 is most preferred by risk-neutral, somewhat risk-averse, and rather risk-averse producers, while very and extremely risk-averse producers may not be different with N0 and SU70.
- Risk-neutral producers are not really different with SU70 and Urea31.5, while the more risk-averse he gets, the more likely he becomes more preferred to SU70.
- PCU70 is the least preferred strategy regardless of risk aversion levels.
- Slight differences are observed for risk-neutral producers, while as producers become more risk-averse, Urea70 and PCU31.5 get less and less preferred.

Stoplight Chart
- The probability of average net return >$100/ha is highest for N0 (0.67), followed by SU70 (0.53), and Urea31.5 (0.45).
- For the middle-income category ($0-$100/ha), SU31.5, PCU70S, Urea70S, and SU70S have a higher probability, about 0.53-0.64.
- PCU70 is 99% likely to have a negative net return on average.

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References

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