On-Farm Precision Experiment (OFPE)

https://sites.google.com/site/ofpeframework/

Funded by Montana Research and Economic Development Initiative (MREDI)

Previous year crop yield and protein

Current year experiment

Data analysis from experiment

Next year profit maximizing prescription

Profit maximizing prescription

Profit maximizing prescription
On-Farm Precision Experiment (OFPE)

**MSU Development Team**
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Clain Jones, Crop fertility
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**Primary Cooperators:**
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OFPE premise for fertilizer prescription

- Applied fertilizer (lbs per acre)
- Crop yield (lbs or bushels per acre)

**Effect of fertilizer decreases with increased application rate**

- Unimproved yield (or protein)
- Maximum profit
- Maximum yield
- Unrecouped investment

- INCREASING
OFPE premise for fertilizer prescription

Scientific challenge: Find models of fertilization and other constraints on crop quality/quantity that allow us to identify the application rate that produces maximum profit.

Effect of fertilizer decreases with increased application rate

Unimproved yield (or protein)

Maximum profit

Maximum yield

Unrecouped investment

Applies fertilizer (lbs per acre)

Crop yield (lbs or bushels per ac)

INCREASING

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Defining and using the model

Step 1: Select/calibrate the model for a field
Step 2: Use the calibrated model to generate fertilizer prescriptions for maximum profit
OFPE calibration example: On-farm experimentation and a hypothesis-based empirical model

Variables in best 2016 crop yield prediction model:
- Nitrogen fertilizer app. Rate
- Yield_2014
- NDVI_2016 (March)
- NDVI_2015 (max.)
- TPI
- Slope
- Aspect (sin)
- Aspect (cos)
- Elevation

Variables in best 2016 crop protein prediction model:
- Nitrogen fertilizer app. Rate
- NDVI_2016 (March)
- NDVI_2015 (max.)
- Elevation
- Slope
- Aspect (sin)
- Aspect (cos)
Three topdress (after planting) nitrogen fertilizer strategies were compared to determine which would maximize net return in the field in 2016. Only fertilizer costs are included in the net return for this analysis.

Base price for WW = $3.32/bu
N-fertilizer cost  $0.34/lb

Site-specific Nitrogen fertilizer rates to maximize net return

37% increase in net return for the full field using the site-specific optimized fertilizer rates over uniform standard rate.
Profit maximizing site specific N-fertilizer application

No N-fertilizer applied

Producer selected uniform N-fertilizer rate application (50 lbs/acre)

Base price for WW = $3.32/bu
N-fertilizer cost $0.34/lb

Ave. NR = $184.50/acre

Ave. NR = $70.56/acre

Ave. NR = $133.84/acre
OFPE data and workflow management

- **Data management system**
- **Database**
  - **Data QAQC and Rectification**
  - **Data import**
  - **Data assimilation**
  - **Field data collection**

- **Optimization R & D**
  - **Best performing agronomic models**

- **Production Optimization**
  - **Export prescription**
  - **Data explorer**
  - **Producer application**
  - **Field applications**

**External data systems**

**Optimization modeling**
OFPE producer’s use case
On Farm Precision Experiment Framework

GIS-based maps from sensors on each field

Data Organization & Analysis

Prescriptions Maximizing Profit Optimizing Inputs

Building the database increases the predictive ability over time

Parameterize functions

Fertilize and spray only where profits are increased

Experiment

Inexpensive data

Data on crop performance

Montana State University