South Dakota State University

STaPLE Drone - Soil Testing and Plant Leaf Extraction

Automating agricultural sampling for better data, higher yields, and greater efficiency

The Problem

- Manual soil and tissue sampling is slow and labor intensive
- Only field edges are typically sampled
- Nutrient deficiencies often go undetected
- Limits crop yields, efficiency, and sustainability

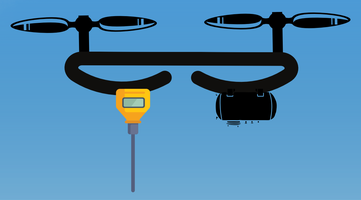
Current Technologies

- Manual tissue sampling (walking fields)
- ATV or pickup mounted soil probes

Key Innovative Solutions

Soil Testing Module

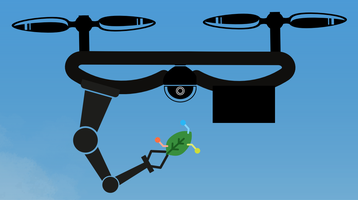
Soil probe for measuring nitrogen, phosphorus, & potassium



Water tank and sprayer for improved probe accuracy

Tissue Sampling Module

AI-guided leaf detection



Robotic arm with cutting tool and onboard leaf storage

Impact & Opportunities

- $25,177 increase in potential yearly earnings[1]
- Enables more frequent and real time collection
- Reaches field areas that were previously inaccessible
- Enable true precision agriculture with up to 7% fertilizer placement efficiency[1]
- 9% reduction in herbicide and pesticide use[1]

Challenges

- Weather conditions (wind, rain)
- Drone battery limits number of samples per flight
- Water tank and leaf storage capacity

Timeline

2025
- Prototype development
- AI vision training
- Manual field testing

2026
- Autonomous testing of flight & soil probe
- Manual leaf tissue field testing

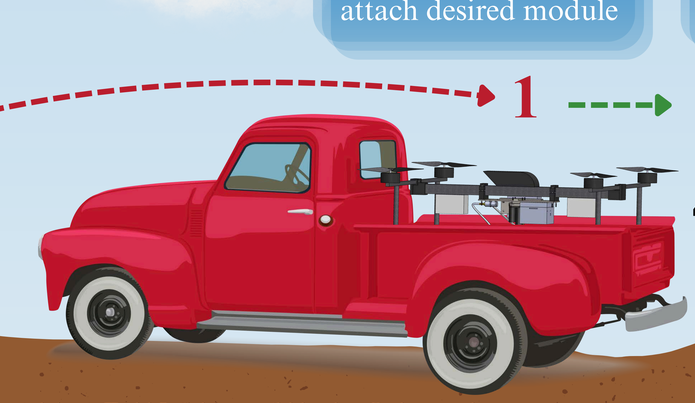
2027
- Soil Probe Module commercially available
- Autonomous testing of tissue sampling

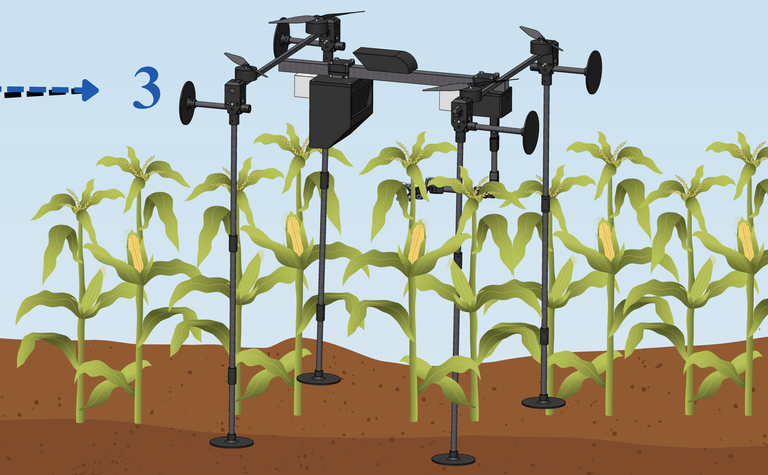
2028
- Final testing of tissue sampling & full autonomous operations

2029
- Tissue Sampling Module commercially available

Concept of Operations

1. Park near field and attach desired module
2. Upload mapping instructions for desired field
3. Autonomously fly, collect 15 samples, & store data
4. Return to base to recharge & refill tank





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[1] U.S. Wheat Associates. How will precision agriculture help farmers meet demand sustainably?