Table of Contents

Application Summary

Competition Details

Competition Title:	2025 South Dakota Nutrient Research and Education Council Invited Proposals
Category:	SDAES
Cycle:	2025
Submission Deadline:	10/15/2024 5:00 PM

Application Information

Application Title:	Investigating P and K Fertilizer Application Timing and Management Strategy on Crop Yield, and Nutrient Uptake
Application ID:	3458
Submission Date:	10/14/2024 9:22 PM

Personal Details

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Co-Applicant(s)

Name	Email	Affiliation
No Co-Investigator(s)		

Application Details

Proposal Title

Investigating P and K Fertilizer Application Timing and Management Strategy on Crop Yield, and Nutrient Uptake

Proposal Abstract

Phosphorus (P) and Potassium (K) are important nutrients for corn and soybean production. These nutrients being applied either in the fall or in the spring by South Dakota farmers. While P is not mobile it is still considered as a risk for environment, especially with inappropriate applications. Strip-tillage can be a good transitional way from conventional tillage to conservational tillage and to improve the soil. In addition, we can subsurface band the nutrient at the time of tillage, potentially improving plant's nutrient accessibility, improving nutrient recovery, lowering environmental risk and perhaps lowering fertilizer application rates while maintaining/improving grain yields. The goal of this project is to compare the effect of tillage and associated P and K fertilizer placement and application timing on grain yield and nutrient uptake. To objectives of the project are 1) to determine the fertilizer placement (subsurface banded vs broadcast) impact on grain yield and nutrient uptake, 2) to determine if fall or spring strip-till banded P and K application timing influences corn and soybean yield responses. The study will be the continuation of the field study established in the fall of 2023.

The study consist different tillage and nutrient application placement combination (fall strip-tillage with banded P,K nutrient application, fall strip-tillage with surface P,K application, fall conventional tillage with broadcast P,K application, spring strip-tillage with banded P,K nutrient application, spring strip-tillage with surface P,K application), and three different fertilizer rates (e.g. recommended P, K rates and 75% of the recommended rates, and control treatment) in both a corn and a soybean crop phase. One of the locations also includes a no-till broadcast P, K application. The 2024 corn plots will rotate into soybean plots in 2025.

2025 Total Budget Request

93,304

Acknowledgment

Acknowledgement of Terms and Conditions

[Acknowledged] I have read and agree to abide by the South Dakota Nutrient Research and Education Council Terms and Conditions attached to this RFP.

Investigating P and K Fertilizer Application Timing and Management Strategy on Crop Yield, and Nutrient Uptake

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Summary

Phosphorus (P) and Potassium (K) are important nutrients for corn and soybean production. These nutrients being applied either in the fall or in the spring by South Dakota farmers. While P is not mobile it is still considered as a risk for environment, especially with inappropriate applications. Strip-tillage can be a good transitional way from conventional tillage to conservational tillage and to improve the soil. In addition, we can subsurface band the nutrient at the time of tillage, potentially improving plant's nutrient accessibility, improving nutrient recovery, lowering environmental risk and perhaps lowering fertilizer application rates while maintaining/improving grain yields. The goal of this project is to compare the effect of tillage and associated P and K fertilizer placement and application timing on grain yield and nutrient uptake. To objectives of the project are 1) to determine the fertilizer placement (subsurface banded vs broadcast) impact on grain yield and nutrient uptake, 2) to determine if fall or spring strip-till banded P and K application timing influences corn and soybean yield responses. The study will be the continuation of the field study established in the fall of 2023.
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Goal and objectives

The goal of this project is to compare the effect of tillage and associated P and K fertilizer placement and application timing on grain yield and nutrient uptake. The specific objectives are 1) to determine the fertilizer placement (subsurface banded vs broadcast) impact on grain yield and nutrient uptake, 2) to determine if fall or spring strip-till banded P and K application timing influences corn and soybean yield responses.

Justification Statement

Phosphorus (P) and potassium (K) are some of the most used fertilizers in corn and soybean production. Producer survey conducted in SD indicated that 70% and 63% of the producers applied P and K fertilizers, respectively, in corn, and 39% and 30% of the producers applied P and K fertilizers, respectively, in soybean in SD. The fall and spring application timing were close to evenly distributed among producers. Phosphorus even though is not as mobile as N, it can also considered as an environmental risk with inappropriate applications.
Therefore, identifying a management practice (e.g. most appropriate application timing or placement) that both beneficial for the crop and the environment is important.

Strip-tillage can be a good transitional way from conventional tillage to conservational tillage and to improve the soil. In addition, we can subsurface band the nutrient at the time of tillage, potentially improving plant's nutrient accessibility, improving nutrient recovery, lowering environmental risk and perhaps lowering fertilizer application rates while maintaining/improving grain yields.
The research will compare different tillage and nutrient application placement combination, tillage/nutrient application timing and different fertilizer rates to provide information to eastern South Dakota producers to maximize crop yields, and lower their environmental impact. We can also evaluate the long-term impact of these different fertilizer management strategies and update the P and K fertilizer best management practices.

Work Plan

The proposal is going to be the second crop year of a long-term study (at least five-year) to investigate longer-term impact of different tillage and fertilizer application strategies in corn-soybean rotation at two locations in eastern South Dakota (north-east and east-central part of the state). This long-term study will ensure that we can also examine the fertilizer accumulation effect due to the different fertilizer strategies.
We established the field studies in the fall of 2023, in a corn-soybean crop rotation, with the following tillage and fertilizer placement combinations:

- fall strip-tillage with banded P, K nutrient application,
- fall strip-tillage with surface P, K application,
- conventional tillage with broadcast P, K application,
- spring strip-tillage with banded P, K nutrient application,
- spring strip-tillage with surface P, K application,
- no-till with broadcast P, K application (at the NERF location only),
-

and three different fertilizer rates

- recommended fertilizer rates
- 75% of the recommended rates.
- without P, K fertilizer

Treatments will be arranged in a split plot design with 4 replications where the tillage and nutrient application treatments are in the main plot, and the fertilizer rates are in the sub-plot.

The initial plot arrangement will remain the same in 2025, but the crop will rotate around (e.g. corn conventional tillage with broadcast P, K application plots in 2024 will be planted with soybean in 2025, and vice versa).

Crop and soil measurements will include:

- soil temperature monitoring in the different tillage treatments following the tillage passes until planting (e.g. soil temperature sensors will be placed in about 3 inch depth in the strip till berm, and in between the berms for fall strip-tillage treatments, while the sensors

will be randomly placed at the same soil depth in the conventional tillage and spring strip tillage treatments)

- early season (e.g. at V6 growth stage in corn) biomass accumulation and nutrient uptake determination,
- rate of canopy closure, and light interception
- whole-season nutrient accumulation, and partitioning,
- yield component analysis.

Potential Impacts

- Project will provide information to producers and advisors about the use of strip-tillage in our region,
- Positive results will help to promote both a reduced (conservation) tillage system and a potential of use of lower fertilizer amount providing more sustainable production practices.
- The project will provide guidance about the importance of P and K banding, and their application timing for nutrient uptake and grain yield

Timeline

Annual field activities and their distribution during the year to achieve the research goals.

Activity	Fall (‘24)	Apr-June	July	Aug	Sept	Oct	Nov
Fall Fertilizer application	**						
Pre-plant fertilizer application/planting		**					
Plant development measurements		*	**	**	*	*	
Biomass sampling		*				**	
Harvesting						**	
Grain and data analysis						*	**

(The number of *s indicates the level of effort for each activity within each month.

Project Budget

The 2025 budget is $93,304 for this project. This cost will provide funding for partial salaries to PIs, and a research manager, and salary of a MSc student and undergraduate student workers, cost of nutrient analyses, travel to fields, purchase research supplies, and cover land and machinery use fees.

Personnel and Fringe: $42,607

Peter Kovacs	$5,659	Provide oversight of the whole project and personnel throughout the year. Dr. Kovács will supervise study establishment, field activity in coordination with Research manager and graduate student. He will also be responsible to disseminate the results to producers and advisors.
M.S. Student	$19,248	M.S. student will be responsible to collecting samples and field data, conducting data analysis, and interpretation and writing of results.

Undergraduate Student stipend	$10,200	Undergraduate student wages to help in field and laboratory work to collect and process samples.
Research Manager	$7,500	Partial salary for a Research Manager who will help in machinery work (e.g. planting, spraying, harvesting, etc), and will coordinate data collections with other projects in a timely manner
Fringe Benefits	$4,135	Fringe benefits for full- and part-time personnel.

Travel and Accommodations: $5,500

To cover the travel from Brookings to the field research locations. This includes approximately 15 trips to fertilizer application, establish, maintain, and collect samples to each location during the growing season. In addition to travel a national conference to present our research findings.

Materials & Supplies: $5,000

Costs of materials and supplies (plot flags, plot stakes, bags, seed, fertilizer, chemicals for wee control, harvest materials, hand tools, etc.) for establishing treatments and collect samples, and necessary personal protection items. Cost also and computer and software supplies for researchers to complete statistical analyses.

Contractual: $28,000

These contractual expenses will cover the soil and plant tissue analyses conducted by a certified ag laboratory, to pay land rental fees for the University research farms, and to cover machinery/application usage fees (e.g. planting, spraying, grinder fees, etc)

Tuition Remission:

$8,062 is budgeted for tuition remission for the M.Sc. student in accordance with SDSU and the SD Board of Regents program.