



AWARD YEARS 2021 AND PRIOR

This annual Performance Progress Report (PPR) must illustrate the progress made toward the completion of your project. If this project is completed at the time of the annual PPR submission, the project report should be marked as final. Please note character limits (abbreviated "char.") throughout.

PROJECT INFORMATION

Project Title (250 char.)	Winter Pea Development in South Dakota and Nebraska: winter survivability, crop management, soil health and nutritional quality
Organization Name (250 char.)	South Dakota State University
Project Start Date	9/30/2020
Project End Date	9/29/2023

ORGANIZATION POINT OF CONTACT

Full Name	Dianne Nagy
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BACKGROUND INFORMATION

PROJECT PROGRESS

Please provide the total percentage of work completed on the project.	90%
Is this a final report? Please select the box to the right if the answer is "yes".	☐

PROJECT BACKGROUND (REQUIRED FOR FINAL REPORTS)

Provide enough information for the reader to understand the importance or context of the project and any key findings. This section may draw from the background and justification contained in the accepted project plan. As the project has been completed, write this section in past tense. If this is an annual report, please skip this section. (1200 char.)

The breadth and scope of this project was fairly broad with seven primary objectives. Pulse growers in South Dakota have expressed a great deal of enthusiasm for the ability to grow winter field peas. This project provides extremely valuable information to growers and seed companies looking to expand their production. Diversity of rotations is critical for sustainable farming, but farmers need viable, profitable options. Development of a winter field pea market could have enormous potential, but it will not happen without early, high-risk trials such as the project described here. This basic information is needed before producers will be willing to

take the risk.

We gained very valuable information on: 1) which winter pea varieties have the potential to withstand the harsh winters of the upper Plains, 2) how winter peas (if they survive the winter) compare to spring varieties with respect to yield, test weight and protein, 3) how planting date affects winter survivability, 4) estimates for nitrogen fixation potential from winter peas compared to spring types and 5) if the use of microbial seed treatments can enhance winter survivability.

OBJECTIVE(S) (REQUIRED)

Please provide the approved project's objectives from the accepted project plan. Use the boxes to indicate if the objective is in progress, has been completed, or is not (and will not be) completed. At the final report, if "no" is selected for any of the listed objectives, you must expand upon this in the Challenges and Developments Section. Additional objectives may be added as needed.

+	#	Objective (2,000 char.)	Objective Completed?
-		Identify winter pea varieties that have the potential to withstand the harsh winters of South Dakota	Yes
-		Assess how winter peas compare to spring varieties with respect to yield, test weight and protein	Yes
-		Evaluate how planting date affects winter survivability	Yes
-		Estimates for nitrogen fixation potential from winter peas compared to spring types	Yes
-		Assess the use of microbial seed treatments to enhance winter survivability	Yes

OUTCOMES

Please only report on the outcomes and indicators that are selected and approved for this project. Use the check boxes to indicate which outcomes and indicators are selected. Select the "N/A" box for any indicators that are not applicable.

1. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH INCREASED SALES

☐

2. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH INCREASED CONSUMPTION

☐

3. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH INCREASED ACCESS AND AWARENESS

☐

4. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH GREATER CAPACITY OF SUSTAINABLE PRACTICES OF SPECIALTY CROP PRODUCTION RESULTING IN INCREASED YIELD, REDUCED INPUTS, INCREASED EFFICIENCY, INCREASED ECONOMIC RETURN, AND/OR CONSERVATION OF RESOURCES

☒

Please provide the numbers of plant/seed releases (e.g., cultivars, drought-tolerant plants, organic, enhanced nutritional composition, etc.) for this reporting period.

Indicators	Value	N/A
1. Number of plant/seed releases	3	☐

Please select the applicable indicators and provide data for the adoption of best practices and technologies resulting in increased yields, reduced inputs, increased efficiency, increased economic return, and conservation of resources for this reporting period.

Indicators	Value	N/A
2.a. Number of growers/producers indicating adoption of recommended practices		☒
2.b. Number of growers/producers reporting reduction in pesticides, fertilizers, water used/acres		☒
2.c. Number of producers reporting increased dollar returns per acre or reduced costs per acre		☒
2.d. Number of acres in conservation tillage or acres in other best management practices		☒

Please provide the total number of adults reached and select the applicable indicators for this reporting period.

Indicators	Value	N/A
3. Number of habitat acres established and maintained for the mutual benefit of pollinators and specialty crops		☐

5. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH MORE SUSTAINABLE, DIVERSE, AND RESILIENT SPECIALTY CROP SYSTEMS

☒

Please provide data for the applicable indicators for this reporting period.

Indicators	Value	N/A
1. Number of new or improved innovation models (biological, economic, business, management, etc.), technologies, networks, products, processes, etc. developed for specialty crop entities including producers, processors, distributors, etc.	3	☐
2. Number of innovations adopted		☒
3. Number of specialty crop growers/producers (and other members of the specialty crop supply chain) that have increased revenue expressed in dollars		☒
4. Number of new diagnostic systems analyzing specialty crop pests and diseases		☒
5. Number of new diagnostic technologies available for detecting plant pests and diseases		☒
6. Number of first responders trained in early detection and rapid response to combat plant pests and diseases		☒

Indicators	Value	N/A
7. Number of viable technologies/processes developed or modified that will increase specialty crop distribution and/or production		☒
8. Number of growers/producers that gained knowledge about science-based tools through outreach and education programs		☒

6. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH INCREASING THE NUMBER OF VIABLE TECHNOLOGIES TO IMPROVE FOOD SAFETY ☐

7. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH INCREASED UNDERSTANDING OF THREATS TO FOOD SAFETY FROM MICROBIAL AND CHEMICAL SOURCES ☐

8. ENHANCE THE COMPETITIVENESS OF SPECIALTY CROPS THROUGH ENHANCING OR IMPROVING THE ECONOMY AS A RESULT OF SPECIALTY CROP DEVELOPMENT ☐

ADDITIONAL APPROVED OUTCOME (IF APPLICABLE) ☐

OUTCOME REMARKS (REQUIRED)

Please explain any quantifiable results, along with an update on their progress and data collection efforts for each of the outcomes and indicators selected in the accepted project plan. It is understood that the results may not yet be final at the time that this report is submitted; however, please provide an update on progress to date. If you do not have any data on the indicator(s) listed above, you must explain why in this section. (2,000 char.)

In total, 26 varieties of winter peas were tested across two full growing seasons (2021 and 2023). Data were not gathered during the 2022 growing season due to a variety of issues including both hail and spray drift. Of these 26 varieties, 7 varieties were tested both growing seasons, and 13 varieties were experimental lines not released to the public as of yet. Yields varied dramatically between the growing seasons with 2021 characterized by severe drought while 2023 had very conducive growing conditions. The difference in yield was 16 bu/ac vs 61 bu/ac for 2021 and 2023, respectively. One critical finding from this research was that when compared to their spring counterparts, which were grown in the same field, spring peas yielded 24 and 71 bu/ac in 2021 and 2023, respectively. Further, since protein content is critical in field pea production, we found that winter peas averaged 27.0% in 2021 and 25.0% in 2023. This compares favorably to spring peas, which averaged 26.6% and 24.3% over the same time period. This is partly expected as there is a general negative trend between yield and protein content. However, this finding is significant as it supports further development of winter pea lines that can maintain protein content with increasing yields.

With the numbers and comparisons mentioned above, I have been able to make significant outreach efforts to reach a broad audience of farmers and stakeholders. Over the past three years, I have given 9 separate presentations and 4 field tours demonstrating the value of field peas broadly in expanding crop rotations as well as the potential for winter pea production in South Dakota. Perhaps the most critical component of this was the simple demonstration that winter peas could survive our harsh winters. This was the first hurdle to be cleared in the development of winter pea production in the region. The data generated from this research gives farmers confidence that they can produce a successful winter pea crop.

NARRATIVE

ACCOMPLISHMENTS (REQUIRED)

If this is an annual report, list your accomplishments for this reporting period. If this is a final report, your accomplishments should be cumulative and include all accomplishments previously reported on and updated to include activities conducted this past reporting period. Indicate how these accomplishments associated with each of your project's objective(s), outcome(s), and/or indicator(s). This listing should identify your project's partners and their contributions. Additional accomplishments can be added as needed.

+	#	Accomplishment (1,200 char.)	Related to (Objective/ Outcome)
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-	1	Generated data on yield and protein content for 26 varieties of winter peas. We demonstrated that the vast majority of these varieties will survive the harsh winters of South Dakota and further identified those that thrive in this environment.	1
-	2	Identified 3 to 5 winter pea varieties that compare favorably to the top performing spring varieties across the primary growing regions of South Dakota and have made this data available for public use. Further, we have identified several other unreleased varieties that show significant potential as primary varieties in this region. These will hopefully be released following further evaluation.	2
-	3	Based on varying planting dates, we found that field peas are less sensitive to planting than expected. Our work is supported by other researchers in the region who found that a planting date that follows typical winter wheat planting dates (ie. early October) is likely most favorable for winter survivability	3
-	4	This objective is ongoing with post-grant lab analysis. Our initial data suggests that winter peas perform similarly to spring peas for nitrogen fixation and may even outperform spring peas under favorable conditions. We have conducted multiple years of research on this objective and will use these data as a benchmark for future testing.	4
-	5	Through this work we have discovered three microbial species that are able to withstand harsh conditions and abiotic stress. These species have been fully characterized and are undergoing final genome sequencing for publication, which will be conducted post-grant. This is a very exciting finding as we have identified new sources to strengthen the field pea complex to withstand abiotic stress, which will hopefully lead to multiple new lines of research and inquiry.	5

CHALLENGES AND DEVELOPMENTS (REQUIRED)

Provide any challenges to the completion of your project or any positive developments outside of the project's original intent that you experienced during this reporting period. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objective, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column. For developments, you may put "N/A" under Corrective Actions. Additional challenges/developments may be added as needed.

+	#	Challenge or Development (1,200 char.)	Corrective Action
-	1	Drought conditions persistent in 2021-2022	N/A
-	2	We encountered some difficulty in obtaining high quality DNA material to perform " Objective 5 Assess the use of microbial seed treatments to enhance winter survivability".	We made some changes to our protocol to obtain better data
-	3	Spray drift	Plots were clearly marked and the employee responsible for spraying these plots was made aware of the issue so it would not happen again.

-	4	Hail	Two significant hail events occurred during the vegetative growth stages of the trial. Hail caused significant damage to the leaves and early reproductive organs across the plot. This effectively destroyed the remainder of the trial that was not affected by spray drift during the second year of the project.
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UPCOMING ACTIVITIES (REQUIRED FOR ANNUAL REPORTS)

Provide a description of the activities that you are planning to complete during the next reporting period. Additional activities can be added as needed. Please note, if this is a final report there should be no upcoming activities associated with the project, and this section should be left blank.

+	#	Activity (600 char.)	Anticipated Completion
-			
-			

LESSON LEARNED (REQUIRED FOR FINAL REPORTS)

The recipient or subrecipient is required to provide recommendations or advice that others may use to improve their performance in implementing similar projects. If this is an annual report, please skip this section. (1200 char.)

Potential Benefits

- First and foremost, winter peas are a viable crop in South Dakota, able to survive the often harsh cold of the winter.
- Yields of the highest performing winter pea varieties are similar to most spring pea varieties but may still lag some of the elite spring varieties.
- Nitrogen fixation in winter peas appears to be similar to spring pea nitrogen fixation.
- Protein content in winter peas is comparable, if not slightly higher, than in spring peas.
- By planting in the fall, winter peas allow farmers to spread out their workload and reduce the burden in the spring.
- Winter peas offer an appealing fall planting window compared to the increasing difficulty to plant in early spring due to the prevalence of wet springs.

Potential Obstacles

- If winter peas are not allowed enough time to develop in the fall, it is likely that they will mature later than spring varieties due to the generally longer overall maturity of current varieties.
- Weed control is a limiting factor in successful winter pea production due to the extended vegetative period of the peas.
- Most winter pea are susceptible to powdery mildew, which is an intermittent issue in South Dakota.

CONTINUATION AND DISSEMINATION OF RESULTS (REQUIRED FOR FINAL REPORTS)

Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results. If this is an annual report, please skip this section. (1200 char.)

This research has been established again in the Fall of 2023 to conduct a third year of research on this crop. A third growing season will

allow us to incorporate an additional year of variable weather and provide increased power to our statistical methods. With these results, we will seek peer-reviewed publication on the yield, protein and nitrogen fixation results. To my knowledge, this would be the first data presented in our growing area, particularly for nitrogen fixation. Moreover, less formal writings will be submitted as extension reports to supplement the already-completed yearly summaries of yield results. Additionally, these data will be presented at the upcoming Ag Horizons event in December, 2023 as well as to the regional Pulse Crop Working Group in February, 2024. Less formal opportunities also exist to present these data to the South Dakota Pulse Council and other stakeholder groups. Lastly, the data gathered from this research will also form the basis for future research on this topic. In particular, we are hoping to extend this work to continue to discover new, improved winter pea varieties as well as potential molecular markers that confer increased N fixation.

PROJECT BENEFICIARIES (REQUIRED FOR FINAL REPORTS)

Provide the number of project beneficiaries. If this is an annual report, please skip this section. (12 char.)

380

FEDERAL PROJECT EXPENDITURE

EXPENDITURE (REQUIRED)

You must respond to at least one cost category. Please note, the subtotal and total rows include formulas to auto-calculate totals. The approved budget should come from the accepted project plan or any approved budget amendments.

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds Only)
Personnel	\$9,520.00	\$10,358.45
Fringe Benefits	\$1,434.00	\$3,359.70
Travel	\$0.00	\$0.00
Equipment	\$0.00	\$0.00
Supplies	\$5,571.00	\$4,316.14
Contractual	\$11,424.00	\$9,734.75
Other	\$0.00	\$0.00
Direct Costs Sub-Total	\$27,949.00	\$27,769.04
Indirect Costs	\$2,236.00	\$2,415.96
Project Expenditure Total Federal Costs	\$30,185.00	\$30,185.00

DISCUSSION OF EXPENDITURES (REQUIRED)

For 1st Annual Reports, if total project expenditures is less than 30 percent, and for 2nd Annual Reports, if total project expenditures is less than 60 percent, include a statement explaining how the grant funds will be expended and project activities completed as planned by the end date on the grant agreement. Any state approved budget amendments should be included here; Include the line item that the funds are coming from and going to and when the state approved the budget amendment. (1,200 char.)

All budgeted funds have been expended to complete the research goals of the project.

PROGRAM INCOME (IF APPLICABLE)

If program income was earned on the project, grant recipients are required to report on the source, amount, and how funds were expended. Program income is gross income --earned by a recipient or subrecipient under a grant --directly generated by the grant-supported activity or earned only because of the grant agreement during the grant period of performance. Program income includes, but is not limited to, income from fees for services performed; the sale of commodities or items fabricated under an award (this includes items sold at cost if the cost of producing the item was funded in whole or partially with grant funds); registration fees for conferences, etc.

+	Source/Nature of Program Income (100 char.)	Amount Approved in Budget	Actual Amount Earned
-		\$0.00	\$0.00

USE OF PROGRAM INCOME (IF APPLICABLE)

Describe how the earned program income was used to further the objectives of this project during the performance period. Any income generated must be reinvested back into the project and not set aside or reserved for future expenses after the grant ends. (1,200 char.)

PPR ATTACHMENTS DESCRIPTION (IF APPLICABLE)

Grantors will rely on the data that is submitted in this form when they report to congress. However, if you think additional documents are necessary to support PPR, please attach then and provide a document name and description of document below.

+	Document Name	Document Description
-		