Double Cropping Field Peas with Cover Crops, Forages and Short Season Crops in Sub-Humid Climates

Final report for GNC18-271

Project Type: Graduate Student
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Grant Recipient: University of Nebraska - Lincoln
Region: North Central
State: Nebraska
Graduate Student:

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Project Information

Summary:

Farmers throughout the Corn Belt may want to consider diversifying traditional corn and soybean-based rotations to increase agronomic sustainability and to spread financial risks associated with low market prices of corn and soybean. An alternative is a more diverse crop rotation using field pea (FP) (short-season grain crop) followed by cover crops (CC), forages (F), or short-season crops (SC). Field peas are planted mid-March and harvested in early-July providing the window of opportunity to extend the growing season by double cropping. Potential benefits include reduced tillage, fertilizer and herbicide inputs, minimize soil erosion and compaction, increase the efficiency of cropping system water use, build up soil organic matter, suppress weeds and pests, and reduce nitrate leaching. The objectives of this project were to: (1) quantify the rotational costs and economic returns of FP-CC/F/SC as compared to corn-soybean rotation; and (2) evaluate soil nutrient dynamics, water use and total plant biomass provided by FP-CC/F/SC.

The study was conducted at the University of Nebraska-Lincoln Southeast Research and Extension Center Nebraska near Mead, NE in 2018 and 2019 as randomized complete block design. Field peas were planted in March and harvested early-July followed by the planting of short-season grain crops, forages, and cover crops. Short season grain crops included corn, soybean, sunflower, grain sorghum, and proso millet. Forages included sudangrass and forage sorghum, and cover crops were winter-sensitive and winter-hardy. Aboveground biomass was collected for forages and cover crops, and grain yield for the short season grain crops. Soil samples were collected after harvest, in March 2019. Corn grain yield in 2019, planted following FP-SCs/Fs/CCs rotation were evaluated.

Forage sorghum, sudangrass, cover crops winter-sensitive and winter hardy reached

13000, 7860, 3851 and 4187 kg ha^{-1} of dry weight, respectively. Corn, soybean, sunflower, grain sorghum, and proso millet grain yields were 1720, 697, 1930, 5996 and 1933 kg ha^{-1}. Corn, soybean, and sunflower were frost-killed before reaching maturity. The principal component analysis showed that SCs are associated with soil nitrate levels and Fs and CCs with soil organic carbon and soil respiration. Nitrate levels in the soil profile were reduced by 40 % when Fs and CCs were grown as compared to SCs. There were no differences in corn grain yield following FP-CC/F/SC rotation. Grain sorghum, proso millet, forage, and cover crop production showed the highest potential to be used as a double crop with field pea as an alternative crop rotation in eastern Nebraska.

Project Objectives:

Farmers will be able to: (1) identify the circumstances upon which replacing corn or soybean with FP-CC/F/SC will be economically viable and how using such a system can improve soil nutrient cycling and other ecosystem services; (2) select best-suited cover crop, forage, or short season crop following field pea for double cropping to diversify their corn-soybean crop rotation and spread production risks; and (3) improve their economic well-being, quality of life, and professional inquiry of issues related to environmental stewardship and long-term sustainability.

Cooperators

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Research

Materials and methods:

Field studies were conducted at the University of Nebraska-Lincoln Southeast Research and Extension Center near Mead, NE in 2018 and 2019. For the first year of rotation (2018), field pea was already planted in the spring (mid-March) and was harvested in the summer (mid-July, 2018) (SARE project LNC16-385). Therefore, a series of short-season crops were planted following field pea harvest. The treatments/crops include: (1) winter-sensitive cover crop species mix including 12 species; (2) winter-hardy cover crop mix including 10 species; (3) Sorghum-Sudan; (4) forage sorghum; (5) corn; (6) soybean; (7) grain sorghum; (8) sunflower; and, (9) millet.

Data collection included measurements during field pea and double-crop growing season. Crop phenology (growth stages) and grain yield (30 varieties) were collected during field pea growing season. On the same day of field pea harvest, the double crops were planted and watermark granular matrix sensors (Irrometer Co., Inc., Riverside, CA) were installed in one replication to monitor hourly soil water dynamics at in 1^{st} and 2^{nd} foot deep. After field pea harvest, a series of double crops were planted. Forage yield and quality of cover crops, forage sorghum, and sorghum-Sudangrass were evaluated by collecting dry biomass in mid-September. Grain yield of short-season grain crops was harvested from mid-October to November. During the spring, prior to corn planting, soil nutrient cycling was evaluated by taking soil samples for each treatment from different depths (0-8 and 8-24 inches) and having them tested for Haney test, nitrate (NO3-N), and sulfate.

System profitability estimations will be based on the market price of field pea, corn, soybean, and grain sorghum, actual costs of farm inputs (seed, fertilizer, herbicides, etc.), and cost of farm operations (planting, spraying, harvest).

Research results and discussion:

Forage sorghum, sudangrass, cover crops winter-sensitive and winter hardy reached 10000, 6700, 3600, and 3750 kg ha^{-1} of dry weight, respectively. Corn, soybean, sunflower, grain sorghum, and proso millet grain yields were 1000, 1000, 4170,

4900, and 1700 kg ha^{-1}. Corn, soybean, and sunflower were frost-killed before reaching maturity. The principal component analysis showed that short season grain crops (corn, soybean, sunflower, grain sorghum, and millet) are associated with greater soil nitrate levels and forages (forage sorghum and sorghum-Sudangrass) and cover crops with greater soil organic carbon and soil respiration. Nitrate levels in the soil profile were reduced by 40 % when forages and cover crops were grown as compared to short-season grain crops. There were no differences in corn grain yield following FP-SCs/Fs/CCs rotation. On average, the corn grain yield following FP-SCs/Fs/CCs rotation was 13000 kg ha^{-1}. This result can sustain that corn grain yield following the double-crop rotation is not impacted negatively. Grain sorghum, proso millet, forage, and cover crop production showed the greatest potential to be used as a double crop with field pea as an alternative crop rotation in eastern Nebraska. Financial and forage quality analysis is yet to be finished and will be published soon.

Participation Summary

Educational & Outreach Activities

2 Curricula, factsheets or educational tools

2 On-farm demonstrations

2 Published press articles, newsletters

4 Tours

6 Webinars / talks / presentations

2 Workshop field days

PARTICIPATION SUMMARY:

50 Farmers

250 Ag professionals participated

Education/outreach description:

Promotion of educational opportunities and dissemination of the data was completed through field days, winter workshops, timely newspaper articles, extension e-news (CropWatch), blog and twitter posts, extension bulletins, PowerPoint and poster presentations at conferences and scientific meetings. The primary audience was farmers in humid environments under corn-soybean rotation, as well as agronomists, researchers and extension personnel from Universities, policy decision makers, and seed and chemical industry. The audience can benefit because field pea are generally planted in mid-March and harvested in mid-July and in most cases there will be enough time for double cropping with cover crops, forages or short season crops. Besides the incomes of field pea production, farmers will have potential extra incomes with either grazing or hay baling cover crops, forages or short-season crops. Currently, a manuscript is being prepared for publication in a peer-reviewed journal, and later, a Nebraska

Nebguide will also be published.

Project Outcomes

1 Grant received that built upon this project

5 New working collaborations

Project outcomes:

This project aims to develop a sustainable crop rotation plan in eastern Nebraska as an alternative to the usual corn-soybean system, contributing to crop diversity, economic improvements, and environmental benefits.

Farmers will be able to: (1) identify the circumstances upon which replacing corn or soybean with FP-CC/F/SC will be economically viable and how using such a system can improve soil nutrient cycling and other ecosystem services; (2) select best-suited cover crop, forage, or short-season crop following field pea for double cropping to diversify their corn-soybean crop rotation and spread production risks; and (3) improve their economic well-being, quality of life, and professional inquiry of issues related to environmental stewardship and long-term sustainability.

Knowledge Gained:

This project was the first of its kind for me. I learned how to write and execute a grant proposal. My advisor gave me full responsibility to conduct the research, reach out to collaborators, farmers, and media. I believe that from my advisor's perspective it was very positive too, especially because we got along so well and developed a trustful and friendly relationship.

In addition, the double-crop project gave a new perspective on how sustainable agriculture can impact the traditional corn-soybean crop rotation in the Midwest. Our measurements showed that it is possible to harvest two crops in one year improving soil quality and using a similar amount of water as compared to corn only.

In the sense of skills gained, this SARE project helped me to build leadership, public speech, and networking.

Recommendations:

If I have the chance to bring this project to another level, I would research more in-depth a broad spectrum of varieties suitable to double-crop and inputs that can be applied to reach higher and sustainable yields. Other techniques such as row spacing and plant population have knowledge gaps that need to be addressed.

Finally, I would like to thank SARE for funding this project. Although we have not completed yet, this project was already a great success. It gave me the opportunity to develop my graduate student career and soft skills in many aspects such as leadership, networking, public speech, data analysis, agronomic knowledge, interaction with farmers, and more.

I hope that the outcomes of this project will help farmers to decide whether adopting double-crop in eastern Nebraska will be beneficial not only economically, but also environmentally and socially.

Information Products

- Double Cropping with Field Peas with Alex Rosa (Multimedia)

US Department of Agriculture

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