

United States Department of Agriculture
Project Initiation

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Project Title

Addressing the Emerging Threat of Soybean Cyst Nematode to Dry Bean: Yield Impact, Management Strategies, and Grower Education

Project Details

Sponsoring Institution National Institute of Food and Agriculture	Project Status ACTIVE
Funding Source NIFA Non Formula	Grant Year 2025
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Program Code [A1701] Critical Agricultural Research and Extension: CARE	

Project Director

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Recipient Organization

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Performing Department

(N/A)

Non Technical Summary

The leading dry bean producing states in the US, North Dakota (ND) and Minnesota (MN) currently face a serious production threat due to the presence of soybean cyst nematode (SCN). This is alarming as the majority of the areas grow soybeans in soils where SCN is already reported, and in many cases, dry bean farming overlaps in those fields, which is very unique to this region. Up to 56% seed yield reduction in dry beans has occurred in microplot studies inoculated with SCN. This proves that beans are a good alternative host to this pest, and it is critical to develop effective management strategies for minimizing crop losses and ensuring a profitable industry. The foundation of this research builds on past research and ongoing efforts to study the impact of the nematode on seed yield in naturally SCN-infested fields, discover and deploy host resistance, identify effective seed treatments, and educate growers with outreach and extension activities. As field experiments will be conducted in both ND and MN, results obtained will be

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robust and applicable to different environmental conditions in the region. Through this project, collaboration between Nematology Programs, Dry Bean Breeding Program, Extension Plant Pathology, and industry stakeholders will lead to development of effective solutions for SCN management and increase growers' awareness of SCN in dry beans. Thus, the findings from this project will make significant contributions to the existing economy and promote the industry to a wider agricultural horizon with promising perspectives on agricultural sustainability and global food security.

Animal Health Component

Animal Health Component: 0%

Research Effort Categories

Basic	10%
Applied	90%
Developmental	0%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
212	1410	1120	100%

Knowledge Area

[212] Diseases and Nematodes Affecting Plants

Subject Of Investigation

[1410] Beans (dry)

Field Of Science

[1120] Nematology

Keywords

dry bean, grower education, management, soybean cyst nematode, yield impact

Goals / Objectives

The ultimate goal is to ensure long-term productivity and profitability in dry bean production by minimizing the seed yield losses due to soybean cyst nematode (SCN). We will achieve the long-term goal by pursuing these four objectives: 1) Elucidate yield impact of SCN on dry bean in the field, 2) Evaluate breeding lines and cultivars in fields for impact on SCN reproduction to identify resistant germplasm, and compare their responses to SCN infection in field conditions with greenhouse conditions, 3) Identify efficacy of select seed treatments on dry bean, and 4) Enhance growers' education through field plot demonstrations, extension publications, grower meetings, and leveraged media to increase the awareness and management of SCN on dry bean. This project aims to safeguard the livelihoods and economy of this important dry bean producing region in the US.

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Project Methods

Objective 1. Elucidate yield impact of SCN on dry beans in the field. NDSU Nematology Lab, Extension Plant Pathology, and Dry Bean Breeding Program will coordinate to set up field trials to assess the impact of SCN on dry bean yield in ND. Similarly, the Nematology Lab at the University of Minnesota (UMN) will establish field trials in MN. The trial locations with SCN will be selected with reference to previous work done at both NDSU and UMN. Soil sampling will be done before planting at trial locations to evaluate the nematode density. The nematode species will be confirmed using molecular methods. SCN egg levels will be determined, and the fields will be categorized as High and Low (L) or no SCN depending on the egg number per 100 cm³ of soil. Soil analysis will be conducted to gather key information on the soil texture, pH, and nutrient levels to select field sites with similar soil properties. Collected nematodes will be established in plastic pots in a greenhouse for population increase and for HG type confirmation in plastic cone-tainers in growth chamber conditions. Field trials with natural SCN populations will be conducted by following the dry bean production guide at different locations (with H and L egg densities) and the experiments will be repeated in the second year at different locations in the same field or nearby field with similar environment. The data from current greenhouse trials will be used to select two cultivars (one highly susceptible and one least susceptible cultivars) for each of four major market classes (black, navy, pinto, and kidney). One SCN-resistant and one susceptible soybean cultivar will also be included for a comparison. Measurement of plant population density, plant height, and seed yield will be recorded. Additionally, the resistance or susceptibility of dry bean cultivars to the field SCN population will be assayed in the greenhouse. The HG types of the field SCN populations will be determined. Soil sampling will be conducted at each field plot to determine the nematode reproduction rate. The impact of SCN on yield among different market classes and cultivars will be assessed by comparing yields from the highly SCN-infested and non(low)-infested fields. Objective 2. Evaluate breeding lines and cultivars in fields for impact on SCN reproduction to identify resistant germplasm, and compare their responses to SCN infection in field conditions with greenhouse conditions. 10 dry bean lines including commercial cultivars and NDSU breeding lines previously evaluated in greenhouse conditions will be selected for trials in fields infested with high SCN population density. Resistant and susceptible soybean checks from previous data will also be included. Each line will have 5 replications. If there is sufficient area, the experiment will be established in the same field as Objective 1. The experiments will be repeated in the second year. Similar procedures described in Objective 1 will be followed. However, more focus will be given to nematode egg numbers and reproduction factor for resistance evaluation for field studies, and calculation of female index (FI%) for greenhouse studies. SCN HG typing will also be conducted to confirm the virulence phenotypes of field SCN populations. SCN population dynamics will also be monitored by counting the number of eggs before and after planting. Objective 3. Identify efficacy of select seed treatments on dry bean. Seed-applied nematicides are a rapidly growing and evolving management tool on US soybean, with BASF and Syngenta leading both development and deployment of the technology. This objective will capitalize on knowledge gained from the much larger soybean industry, design experiments and treatment lists so they are relevant to the dry bean production system, and work in partnership with the private sector (BASF and Syngenta) to ensure translation of knowledge and likelihood of adoption of management tools (and support of dry bean growers) is most likely. Experiments will be conducted in field locations with high SCN egg levels, following procedures in objective 1. Efficacy will be evaluated using two susceptible (or moderately susceptible) cultivars in different market classes (such as pinto and kidney) selected from our previous studies. Four commercially available seed treatments products with known or potential efficacy against SCN in soybean will be selected for testing. Two independent and adjacent efficacy trials will be conducted on each cultivar. Trials will be designed as either an RCBD with a minimum of 6-replications, but a paired plot design may be considered if recommended by statisticians. The SCN egg density level will be measured before planting and after harvest and the same seed yield and nematode parameters will be measured as the first objective to identify the best seed treatment for managing the pest population and discover its impact on crop yield. The experiment will be repeated in the second year. Objective 4. Enhance grower's education through field plot demonstrations, Extension publications, grower meetings, YouTube Video, radio broadcasts and leveraged media to increase the awareness and management of SCN on dry bean. Objective 4 will focus on delivering the research advances directly to the farmers, agronomists and agricultural professionals that may utilize and/or adopt it. Results will be disseminated both directly

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(from the university Extension) and indirectly (through company partners, agriculture media, etc.). The research will be showcased to the farmers at Casselton Agronomy Seed Annual Field Day through research plots used also as demonstration plots, and in winter educational events, such as the Northharvest Bean Day and Getting it Right- Dry Beans. The findings will also be used in Extension activities such as Southern Research and Outreach Center Crop Days and Minnesota Agricultural Expo. The research will also be published in leading scientific journals in this field such as Plant Disease and Journal of Nematology or Plant Health Progress. Two Extension publications will be produced, one focusing on the importance of SCN on dry bean (economics, signs, symptoms, general information) and the other focusing on management (results of seed treatment trials, for example). A YouTube Video will be developed and hosted on the universities YouTube channel. Media partners, such as the Red River Farm Radio Network's 'Bean Scene' will also be employed to reach more growers. A demonstration plot, laboratory visit, and greenhouse day will also be planned for the growers to directly observe cutting-edge research and gain firsthand information from the researchers.