WERA REPORT 2019

WYOMING

Wyoming has nearly 98,000 square miles (62,720,000 acres).

Wyoming's population in 2019 is estimated at 572,381.

110 acres/person.

48 percent of this is federal public lands and nearly 6 percent is managed by the State.

The Wyoming Game and Fish have enrolled over 1,000,921 acres of private land in recreational access.

Invasive grasses are Wyoming's number one pest.

We have many federal, state and private entities working to control invasive weeds.

Combating Invasive weeds with IPM statewide helps carry a stronger IPM message in many other circles.

Scott Schell

University of Wyoming Arthropod Pest Diagnostician
Extension Entomologist
Wyoming State IPM Coordinator
sschell@uwyo.edu

Stated objective: Salary support for the University of Wyoming arthropod diagnostician providing the assistance to Wyoming stakeholders to accomplish the first step in IPM, identification.

Scott promotes IPM to each client contacted through the clinic. The clinic has provided over 500 diagnostic consultations statewide and given management recommendations, based on IPM principles, year to date.

He has presented on entomology topics at 41 different venues around Wyoming in the past year.

The presentations given ranged from elementary school field days, classroom lectures at the Wyoming Boy's School, to agricultural producer meetings.

The diagnostician also provides introductory and advanced entomology training for the Master Gardener program all over Wyoming and participates in the pesticide applicator license training program. He is also queried and interviewed by state newspaper reporters writing articles on arthropods.

We plan to continue our well established IPM based training programs for the people in Wyoming.

Production Agriculture IPM

Represent the University of Wyoming Extension as the ex-officio member to the Wyoming Weed & Pest District Council Executive Committee.

Organized and also presented at the 15th annual Entomology Short Course held on March 19-21, 2019 in Laramie, WY for 21 attendees that work in pest management positions for counties around Wyoming.

Organized, as the current chair of the National Grasshopper Management Board, its annual meeting Feb. 5-6, 2019, in Denver, Colorado.

Presented grasshopper IPM information at 4 public meetings at counties around the Wyoming predicted to have outbreaks in 2019.

Was an invited speaker at the Platter River Valley Cattleman's Association and presented on the topic of cattle ectoparasite IPM.

Public Health IPM

Organized, promoted, and prepared a mosquito IPM workshop in conjunction with City of Laramie and the Wyoming Department of Health for mosquito abatement personnel scheduled for May 21 & 22nd, 2019 in Laramie for 21 attendees. These people were mainly new employees of mosquito abatement districts from all over the state.

Community IPM:

Presented both Basic and Advanced Entomology 3 hour duration trainings for the UW Extension Master Gardener program at 6 locations in Wyoming since Jan.1st, 2019.

Presented sixteen IPM and Beneficial Insect presentations at the locations around the state for audience ranging from grades school students to agricultural producers.

Had a display table at the Laramie Rivers Conservation District's Conservation Expo held on April 13th, 2019 that was well attended by the local public.

Manned a beneficial insect information and display table at the Wyoming Territorial Park's Spring Expo in Laramie on Apr. 27, 2019. The attendance for the program that day was 267 people.

Outcomes:

With some activities there is little opportunity to measure "Outcomes". However, one can safely assume that exposure to IPM training will result in some increase in knowledge versus no exposure at all. This is a positive short term result. With the Master Gardener basic training activities there are post course evaluation given. I receive universal positive feedback that our entomology training is useful and pertinent to the activities and interests of the attendees. Community and youth entomology presentations provide a way to reach an audience that may not know anything about insects at all. This will help provide the audience with a fact based information on which to form their future outlook on insects and pest management and were to source factual information on the subject. The IPM education and outreach efforts of our team have only been made possible through the NIFA, CPPM, EIP funding.

Title**: Alfalfa Weevil Growing-Degree Day Calculator Part 2 – Invalidation of the Harcourt 1981 Model for Wyoming**

Authors: Scott Schell1, Jeremiah Vardiman2 and Blake Hauptman2

Author affiliation: 1 UW Dept. of Ecosystem Science and Management; 2 University of Wyoming Extension

Introduction:

Alfalfa is a very important crop in Wyoming and alfalfa weevil (Hypera postica) is currently its worst insect pest. It is important to know when the best time to survey crop pest populations. Survey too early in the growing season and you are either wasting effort or obtaining false negative data. Survey too late and you may suffer a severe crop loss or miss the best pest stage for control.

Because AW start their damage in an alfalfa crop inconspicuously, as tiny larvae feeding inside the tightly folded leaves of stem tips, it is useful to have tool to predict the best date to sample a crop in order to make management decisions. Plant and insect growth is correlated to environmental temperatures. Temperature data is now freely available online and can be used to predict pest and crop development.

D. Harcourt (1981) developed a growing degree-day (GDD) model based on the minimum known temperature for AW larval development in southern Ontario, Canada. It was found to be a useful predictor for AW seasonal occurrence in the Rocky Mountain region in the early 1990s. It has been made available as a web based application that allows a user to get DD outputs based on temperature data from weather stations closest to their alfalfa fields. However, the accuracy of the Harcourt DD model had not been tested in WY recently.

Objectives:

We continued work on testing the accuracy of the now internet-based Harcourt GDD alfalfa weevil development calculator. If accurate, it will allow alfalfa producers to use their local weather station data to predict alfalfa weevil larval development.

Materials and Methods:

Validation testing of the GDD calculator started in 2017 and was completed in 2018. We compared the Harcourt 1981 GDD model predictions of AW larval developmental stages available at https://pnwpest.org/cgi-bin/ddmodel.us to actual stages observed in pest population samples taken from producers' fields in the Bighorn, Basin, Fremont, Campbell, Crook, and Sheridan counties over the course of 2 growing seasons.

Results and Discussion:

The Harcourt 1981 AW GDD calculator did not accurately predict AW development. The 2017 and 2018 AW samples consistently contained larvae later in development than the model predicted. For example, the same field at the Powell Research and Extension Center had larvae over 200 degree days ahead of the model prediction in both 2017 and 2018.

It is doubtful that the base temperature of 48 F to trigger AW development has changed to a lower temperature since 1981. We tried changing the parameters of the model to start on Jan.1st instead of March 1st. This resulted in little change of DD accumulations at the time of the sampling. This rules out milder winter weather allowing weevil egg to develop then.

One explanation for faster than predicted AW development is made by comparing what we have observed in the samples to what is reported about the pest from more eastern and lower elevation states. In states like Oklahoma, adult AW become active during mild fall weather and will deposit eggs in plant stems then. The eggs can then start accumulating DD (i.e. begin embryonic development) towards hatch. This quote from an Oklahoma State Univ. factsheet on AW may explain what we are now observing in Wyoming- "During fall, adults leave over-summering sites and enter alfalfa fields to feed and deposit eggs in stems of alfalfa plants. Egg deposition occurs from November to the following April when temperatures exceed 40°F." (Mulder P. 2017). It has been observed that the eggs may die in temperatures below 10°F during the winter if there is no snow cover to insulate them. The variability and the severity of the fall and winter weather greatly influences the timing AW populations in Oklahoma. If it is a severe winter, only adult AW survive it to start depositing eggs when temperature warm up. The Oklahoma State Extension service conducts AW egg surveys at 7 sites across the state in mid-February each year (Seuhs, K., 2019). In mild winter years, they can find viable egg densities of over 400 per square foot during the survey.

At this time, we recommend that Wyoming forage alfalfa producers sample their fields for AW starting when the crop is between 10 to 15 inches high with the bucket method as described in the "When and How to Scout" section of this 2018 extension bulletin from NDSU https://www.ag.ndsu.edu/publications/crops/integrated-pest-management-of-alfalfa-weevil-in-north-dakota The sample alfalfa stem tips should be closely examined for the tiny first stage of AW. If damaging numbers of AW are found at this stage of alfalfa growth, all methods of control are available to the grower to use before harvest or extensive damage to the crop is done by the pest.

Contact Information:

Jeremiah Vardiman at jvardima@uwyo.edu or 307-754-8836, or Scott Schell at sschell@uwyo.edu or 307-766-2508

Keywords: alfalfa weevil, growing degree-day calculator, pest management

Derek Scasta, Ph.D.

Assistant Professor and Extension Rangeland Specialist
Department of Ecosystem Science and Management
University of Wyoming
Office: 307-766-2337
jscasta@uwyo.edu

The following four articles by the Horn Fly and Cattle IPM group are available at;
https://www.uwyo.edu/ipm/ag-ipm/horn-fly-cattle-ipm.html

Commingled black and white cows (Bos taurus; Angus and Charolais) in high-elevation rangeland are differentially parasitised by Haematobia irritans
Haematobia irritans parasitism of F1 yak ×beef cattle (Bos grunniens ×Bos taurus) hybrids

Livestock Parasite Management on High-Elevation Rangelands: Ecological Interactions of Climate, Habitat, and Wildlife

Pyric-Herbivory to Manage Horn Flies (Diptera: Muscidae) on Cattle

Rangeland Research Blog: http://wyoextension.org/rangelands4u/ HOST RESISTANCE

(a) We have continued to evaluate horn flies on cows in the Laramie Valley through 2018 and are actively monitoring cows now in the 2019 season. In addition, we have published 2 papers about horn fly parasitism on common cattle breeds (black Angus and Charolais) and on novel bovids bred for mitigating pulmonary hypertension (yak x cattle hybrids).

Calkins, C. M., Scasta, J. D., Smith, T., Stayton, M. M., & Lake, S. L. (2019). Haematobia irritans parasitism of F1 yak× beef cattle (Bos grunniens× Bos taurus) hybrids. Medical and Veterinary Entomology. In Press.

Scasta, J. D., & Smith, T. Commingled black and white cows (Bos taurus; Angus and Charolais) in high-elevation rangeland are differentially parasitised by Haematobia irritans. Animal Production Science. In Press.

(b) We have a graduate student (Craig Calkins – DVM) working on this project. Craig has initiated 3 projects that are central to this project. (1) Individual animal traits and horn fly parasitism: Craig is quantifying individual animal parameters influencing horn fly parasitism (blood biochemistry and coagulation). Craig used iStat point-of-care devices to develop blood profiles of ~160 beef cows. Cows will be ranked and then evaluated over 2019 and 2020 for horn fly parasitism. This will lead to blood coagulation reference values and diagnostic information based on celite and kaoline time to coagulation test procedures. (2) Horn fly parasitism across elevation gradients on working ranches: We are finalizing contacts for 5 ranches ranging in elevation from 4,300' to 8,200' for which we will evaluate horn fly loads on cows during peak (July/August) parasitism periods in 2019 and 2020. (3) State-wide survey of livestock parasite losses and mitigation strategies: We have initiated discussions with affiliated faculty for this survey with plans to administer the survey in the fall of 2019. Affiliated faculty include expertise in Veterinary Science (Parasitology and Epidemiology), Entomology, Range Science, and Animal Science.

The IPM education and outreach efforts of our team have only been made possible through the NIFA, CPPM, EIP funding.

Dan Tekiela

Assistant Professor and Extension Specialist of Invasive Plant Ecology

drtekiela@gmail.com

Department of Plant Science
University of Wyoming

The following articles from the weed IPM group are available at; https://www.uwyo.edu/ipm/ag-ipm/weed-ipm.html

Amaranthus species A current and emerging threat in Wyoming

Integrated approach to Dalmatian toadflax

Manage Weeds by reducing deposits to the seed bank

New invasive annual grasses in Wyoming Medusahead and Ventenata 2018

Powerful EDDMapS app assists invasive species ID triggers quick management

Pseudomonas spp as Bio-herbicides Is this a fit for Wyoming

Use of Pseudomonas fluorescens as a bioherbicide for cheatgrass and other invasive winter annual grass control

Priority: Proper Integration of Bioherbicides Into an Invasive Annual Grass IPM Program

Stated objective: Support the extension of results from current research to regional stakeholders on ways to effectively use bioherbicides in IPM plans against the invasive annual grass, cheatgrass (Bromus tectorum) via workshops, demonstration plots, and extension materials.

Major Project Accomplishments to Date:

The following project outcomes will help reduce the harm that invasive winter annual grasses inflict on rangeland ecosystems. These accomplishments coincide with the impact goals proposed in project's logic model. ⍰ Founding of a regional cheatgrass bioherbicide working group that intends to integrate our findings into a publication intended to be submitted to Rangeland Ecology within the next year. Through this group, we have been able to facilitate communications between stakeholders and regional partners. Conducted a field tour presenting the effect of integrating bioherbicides and synthetic herbicides in Sybille Canyon, WY. The event was well received with total attendance of 48 individuals We monitoring number of attendees at events to track impact. This strong attendance is especially noteworthy due to the remoteness of the location and suggested a high interest in cheatgrass management. During this event we presented on the differences of bioherbicide products available and discussed best management practices when applying them as part of an IPM plan. Here is a link to an article about the event. http://www.uwyo.edu/uw/news/2018/07/solutionsremain-elusive-for-landowners-undergoing-cheatgrass-assault.html

Through our data collection efforts we have identified the best management practices for cheatgrass that can lead to an increased forage production in rangeland ecosystems and increased plant community diversity.

Most importantly, due to findings of this research, Wyoming's Weed and Pest Districts reported effectively budgeting approximately $750,000 in weed management tools that would integrate best with current land management practices. This will lead to more appropriate integration of bioherbicides into current IPM strategies. This also relates directly to my intermediate term impact goal of quantifying the amount of changes in the quantity of herbicide usage.

We plan on continuing in our efforts to accomplish the following goals:

Facilitate communications between stakeholders and regional partners on bioherbicides. Educate stakeholders on the differences between available bioherbicide products. Determine best management practices for applying bioherbicides regionally.

Educate stakeholders on the appropriate integration of bioherbicides into their IPM strategies. Develop regional cheatgrass IPM strategies that will increase forage production in rangeland ecosystems and also increase plant community diversity

The IPM education and outreach efforts of our team have only been made possible through the NIFA, CPPM, EIP funding.

John Connett

Integrated Pest Management Specialist

jconnett@uwyo.edu

307-766-5022

Priority: School IPM Training and Implementation By a "Train-the-Operator" approach

Stated objective: Support extension IPM specialist with the goal of universal adoption and implementation of IPM in all Wyoming schools.

Major Project Accomplishments to Date: Conducted a School Integrated Pest Management (IPM) and pest prevention training seminar for, county and state employees, groundskeepers, and pesticide applicators in Casper, WY (January 2019 with 97 in attendance). Conducted Wyoming School IPM Training and Implementation for school facilities operators at four school locations in the eastern half of Wyoming (October and November 2018, 22 personnel in attendance). Five Wyoming school districts have adopted IPM policies. Several other school districts have adopted non-chemical control tactics combined with IPM education for incidences of bedbugs and fleas that include vacuuming floors and drying clothes and backpacks items instead of spraying for bedbugs and fleas that hitchhike on backpacks. This represents a Condition Change. Met with facilities personnel at three schools on the Wind River Indian Reservation to discuss the fundamentals of school IPM and to provide them with IPM informational materials. Presented a School IPM Information booth at the biannual Wind River Tribal Health Fair (August 2018, 310 adults and 90 students in attendance). Assisted with the delivery of "Stop School Pests" (Now called "The Pest Defense for Healthy Schools") - A National IPM Standard Training and Certificate Program for learning lessons (IPM Training for School Nurses to 3 schools via video conferencing (September 10, 2018, 8 Attendees). Presented Fundamentals of School IPM at the 15th annual Entomology Short Course held on March, 2019 in Laramie, WY for 21 attendees that work in pest management positions in 10 counties. Maintain the Wyoming School IPM webpage https://www.uwyo.edu/ipm/community-ipm/school-ipm.html to have a centralized location for School IPM information and to be able to provide it electronically. Participated in the School IPM 2020 Steering Committee and the Western School IPM Working Group. Taught about School IPM at the University of Wyoming continuing science education training program for Wyoming K -12 school teachers. Helped

school review and update IPM policy. Taught IPM at the Wyoming state conference for school custodians. Worked with several Wyoming hospitals to initiate an IPM program. Provide IPM technical support for the statewide Extension Ag & Horticulture team.

Wyoming Creative Integrated Pest Management Education and Outreach

Stated objective: - Development of IPM topic infographics selected and vetted experts in working in extension to ensure that they are universally pertinent and useful. John Connett and Scott Shell the two specialists working on this priority organize and deliver workshops on IPM to Wyoming stakeholders.

Major Project Accomplishments to Date:

Infographic Project Progress. We have designed and uploaded 32 IPM graphics. These represent half of the graphics we are working on. These graphics include IPM concepts that can be used to educate and promote the foundational aspects of IPM. We are working closely with a professional graphic artist to use imagery and minimal text to make it easy for lay people to understand key IPM principals. These graphics are now going to be vetted by IPM coordinators in 6 other states to ensure that the content is universal and correct.

The infographics products can function for print, social media posts, and as slides in PowerPoint training presentations. Drafts of the first IPM infographics have been used in IPM and biological control topic guest lectures in college classes where they have been effective visual aids.

These graphics will be available in small web version and large size for PowerPoint and print at; https://www.uwyo.edu/ipm/ipm-basics/ipm-info-graphics.html

These style of graphic have been useful in IPM training within Wyoming and can help share IPM training in other areas as well. These infographics will be made freely available for distribution on websites, such as http://ischoolpestmanager.org and https://ipminstitute.org.

Wyoming is continually using an increased amount of IPM strategies to protect the vast land resource on a tight budget. There is a lot of cross over applicability between agricultural IPM and Community IPM. The more Wyoming residents hear the IPM message and training in Urban, Agriculture or school settings, the more the sustainable principles resonant with more people. The key components of IPM are listed at https://www.uwyo.edu/ipm/ipm-basics/index.html

The components are included in training and help stakeholders see how IPM can be tailored to the specific situation, but primarily includes prevention, pest ID and monitoring.

Completed Community Outreach and Workshops. Presented the 15th annual Entomology Short Course held over 3 days in March of 2019 in Laramie for 21 attendees that work in pest management positions in 10 counties around Wyoming. Organized and presented a 2 day workshop called the Mosquito Larval Control and West Nile Virus Prevention Training. Seventeen people new to mosquito control from abatement districts all over Wyoming attended. Provided IPM support to University of Wyoming's Landscaping, Museums, and Residential Facilities departments in Laramie WY. Presented IPM training at the Wind River Family & Community Health Care on the Wind River Indian Reservation (December 2018 and there were 97 adults in attendance). Provided IPM phone and email IPM support for various school district, pest control contractor, Wyoming health department personnel, and other Wyoming State personnel (6,820 total contacts). Secured outside funding for the production of 500 copies of the

“Common Pests Found in Schools, Hospitals, Day cares, and Other Facilities” by C. Colwell and D. Pehlman for distribution in Wyoming. This version of the guides has our Wyoming IPM team contact information to address local pest problems and further training.

Integrated Pest Management is being adopted at various levels of management throughout Wyoming due to our education and outreach efforts combined with the efforts of other state and federal agencies. We meet quarterly with the primary agencies that have weed management responsibilities.

Part of our IPM message has been how IPM can help sustainably solve pest issues safely across many areas including community, agriculture, and natural landscapes. https://www.uwyo.edu/ipm/index.html

We are planning a survey to quantify some of the adoption of IPM practices by school districts and others.

The IPM education and outreach efforts of our team have only been made possible through the NIFA, CPPM, EIP funding.

Jeremiah Vardiman

Northwest Area Agriculture & Horticulture Educator
University of Wyoming Extension
655 E. 5th, Powell, WY 82435
ph: 307-754-8836
jvardima@uwyo.edu

- Alfalfa Weevil control
- Invasive Weeds – Ventanata grass, Medusahead Wildrye, Cheat grass, Palmer Amaranth
- Pesticide Resistance – Glyphosate Resistant Kochia (especially in roundup ready crops like sugar beets)
- Problem Weeds – venice mallow and night shade in dry beans, Russian Olive control
- Vertebrate Pests in Forages – voles, moles, and ground squirrels in perennial forage fields
- Pesticide Education – encouraging and educating on IPM for all pesticide uses.

Karen Panter, Ph.D., C.P.H.

Extension Horticulture Specialist
Plant Sciences – Department 3354
University of Wyoming
1000 East University Avenue
Laramie, WY 82071
Office: 4008 Agriculture
Phone: 307–766-5117
Fax: 307-766-5549
E-mail: kpanter@uwyo.edue

I'm part of our Extension diagnostic team dealing with what's-wrong-with-my-plant issues. IPM is involved in virtually every case. I handled 400+ individual questions in 2018. Most of the problems are cultural or environmental in nature, with some definitely caused by insects or plant pathogens. For the biotic issues, we rely on maintaining plant health; proper pruning, irrigation, fertilization, etc.; occasional other management strategies including labeled pesticides.

Jay Norton

Associate Professor / Extension Soils Specialist

Office: 307-766-5082
Cell: 307-760-5781
I have a couple of cover crop projects that include monitoring weeds in plots:

1. Compost Carryover and Cover Crop Effects on Soil Quality, Profitability, and Cultivar Selection in Organic Dryland Wheat, in collaboration with USU, MSU, and WSU, funded by USDA-OREI;

2. Integrating livestock and cover crops into irrigated crop rotations, in collaboration with Montana State and NRCS, funded by USDA-WSARE.

Jabbour, Randa

Associate Professor Agroecology

PD Institution: University Of Wyoming

Integration Of Early Harvest With Biological Control For Sustainable Alfalfa Production:

CO-PD: Rand, Tatyana A. Institution: Usda-Ars Northern Plains Agricultural Research Laboratory CO-PD: Peairs, Frank Institution: Colorado State University CO-PD: Ritten, John Institution: University Of Wyoming CO-PD: Lee, Brian Institution: University Of Wyoming CO-PD: Islam, M. Anowar Institution: University Of Wyoming

This is an ARDP research (single-function) project. Alfalfa weevil Hypera postica is the most problematic insect pest of alfalfa in our region. Despite widespread release of biological control agents following alfalfa weevil invasion in the 1900's, insecticides remain the most common control strategy. Additionally, "early harvest" of alfalfa is universally touted as a mechanical control for alfalfa weevil in Extension literature. Although alfalfa producers use this management practice often, and sometimes exclusively, few consider it the most effective practice. The minimal existing research lacks specificity regarding timing precision, alignment with weevil and parasitoid phenology, and economic implications. Our overall goal is to improve sustainability of alfalfa production through science-based recommendations for alfalfa weevil IPM that integrates physical and biological control. We will accomplish two objectives: 1) Test how manipulations of harvest timing affect alfalfa weevil, natural enemies, forage yield and quality, and economics; and 2) Identify impacts of on-farm harvest timing and parasitoid abundance on alfalfa weevil. We will achieve these objectives through manipulative experiments, production field sampling coordinated across multiple states, and data-driven economic modeling. This work will improve recommendations for alfalfa weevil IPM and expand alfalfa crop budgets to include non-chemical pest management approaches. This project addresses these Crop

Protection and Pest Management Focus Areas: Plant Protection Tactics and Tools (development of harvest timing tactic, integrated with biological control); Diversified IPM Systems (measure effects of harvest timing across the farming system); and Development of the Next Generation of IPM Scientists (support of graduate and undergraduate students).

William Stump

Assistant Professor Plant Pathology

1, Kyle Webber1 and Wendy Cecil1

Dry-Bean Soil-Borne Disease Management with an Integrated Approach with Tillage, Variety, and In-Furrow Fungicides at PREC

Introduction

Soil-borne dry bean disease such as Rhizoctonia and Fusarium root rot are typically a perennial issue in dry bean production. Disease severity is dependent on environmental conditions, soil compaction, variety, and cropping history, with growers having limited options for control.

Objectives

The objectives are to evaluate an integrated management approach on managing soil-borne disease by combining different tillage options, locally adapted cultivars, and in-furrow fungicides.

Materials and Methods

The study was established in 2018 at the Powell Research and Extension Center (PREC). A randomized complete block design with variety and fungicide treatments in factorial arrangements and tillage as a split plot component was established on 8 June with a Kincaid planter/sprayer. Sub-plots were six rows (22-inch row centers), 20 feet long with a five foot in-row buffer. The conventional tillage treatment included conditioning passes whereas the deep tillage treatment included a deep soil ripping chisel treatment prior to conditioning. Disease due to Rhizoctonia solani and Fusarium spp. was endemic but not quantified. Fungicides were applied in-furrow at planting using labeled rates. The field plot area received fertility, weed control, and irrigation appropriate for dry bean production. All data were collected from the middle 4 rows. Parameters measured included compaction ratings, stand counts, vigor rating, incidence of root rot, NDVI (Normalized Difference Vegetation Index) rating, and bean yield.

Results and Discussion

Tillage treatments did not result in significant differences for soil compaction, but there was a trend in the data of reduced soil compaction with deep tillage. On measured crop stands and disease severity there was no effect of tillage treatment but there was a significant effect of variety on stands. Othello had the greatest stand and Long's Peak the lowest. There was a 100% disease incidence in all sampled plants toward the end of the season. Disease encountered was primarily due to Fusarium species and some Rhizoctonia solani. Fungicide treatments had no significant effect on measured disease but there were significant differences of disease severity between varieties. Othello had the highest amount of disease severity and Sundance had the least (Table 1). Tillage overall had a slight effect on plant vigor

with less overall vigor with deep tillage. Overall vigor was higher for the Headline® fungicide treatment compared to the untreated check. Some differences were noted with the NDVI readings, but they were mainly limited to differences between varieties. Tillage and fungicide had no effect on bean seed yield however, variety did have a significant effect on seed yield. Interestingly, despite having greater disease severity, Othello was the highest yielding and Long's Peak was the lowest.

Acknowledgments

We thank PREC field crews for assistance in plot establishment, maintenance, and termination. The study was supported by the Wyoming Bean Commission.

Contact Information

1Plant Sciences department

William Stump at wstump@uwyo.edu

or 307-766-2062. Keywords: dry bean,

soil-borne disease, tillage

Hemp IPM

Because Hemp can be grown without pesticides for example, CBD for children's seizure medicine, the crop has potential for increased education of the principles of IPM.