AGRICULTURAL RESEARCH FOUNDATION
FINAL REPORT
FUNDING CYCLE 2020 – 2022

TITLE: Hemp cover cropping for dryland wheat farmers: opportunities for disease suppression and increased yield*

*Data will be complete after harvest 2022, at which time the ARF will be provided a manuscript of the publication.

RESEARCH LEADER: Christina Hagerty

COOPERATORS: Don Wysocki and Govinda Shrestha

SUMMARY/ABSTRACT: Crop diversification is very low in the rainfall-limited, $2 billion-dollar wheat industry of the dryland PNW. The predominate cropping scheme is defined by the winter wheat – summer fallow system where fields are planted to winter wheat in year 1, left fallow for increased water infiltration in year 2, and planted to winter wheat again in year 3. Lack of crop diversification can deplete soil of organic matter and nutrients, all while favoring the build-up of soil borne diseases. As wheat is harvested from fields biennially, soil can be robbed of nutrients, leading to soil health degradation over time. Cover crops can be used within a standard rotation and are used primarily to provide protection against soil erosion, incorporate nutrients, and to break cycles of soilborne disease. With the decriminalization of industrial hemp in the 2018 Farm Bill, industrial hemp and derived products are one of the fastest growing sectors of the agricultural economy. Research at Oregon State University must keep pace with the rapid growth of the hemp market and we must support opportunities for producers to increase on-farm profitability by diversifying with hemp. In this study, we investigated the potential of a hemp cover crop incorporated in the dryland wheat rotation to increase profitability for farmers. The study is the result of a needs assessment with local dryland wheat producers interested in growing hemp. There is great interest in the grower community of the dryland PNW in growing hemp, however lack of research on hemp leads to potential missed opportunities that could improve disease control and wheat cash crop profitability. Growers want to know if incorporating hemp into the dryland wheat production strategy will function to reduce soilborne diseases of wheat, and thus, improve wheat yields. Preliminary evidence suggests that hemp may suppress soilborne disease.

OBJECTIVES:

<u>Objective 1:</u> measure soil borne disease in winter wheat following summer fallow; hemp, mustard, and barley cover crops.

Objective 2: measure yield of winter wheat following summer fallow; hemp, mustard, and barley cover crops.

PROCEDURES:

Greenhouse: A cover crop simulation study was established in the greenhouse in winter 2020-21. The experiment was conducted in 4.5L plastic pots, with unsterilized locally collected field soil as the growing media. Cover crop treatments included: barley cv. 'Alba', *Brassic juncea* cv. blend 'Caliente Rojo', and hemp cv. 'X59', and a fallow control. All treatments were replicated ten times in a randomized complete block design. Barley treatments were planted with nine seeds per pot at a depth of 2.5cm. Mustard treatments were planted with 2 pinches of seed per pot at a depth of 1cm. Hemp treatments were planted with nine seeds per pot at a depth of 2.5cm. All treatments were thinned to five plants per pot after emergence. Fallow control pots were left unplanted. Cover crop simulation treatments were grown for five weeks and then terminated by cutting plants at the soil surface. Biomass was weighed and cover crop residue was cut into ~2.5cm pieces as to simulate a cover crop mechanical destruction. Residue was spread evenly across the soil surface of its original pot. Pots continued to be watered for one week. After one week, each pot was planted with five seeds of winter wheat cv. 'Stephens'. Pots were inoculated by making five evenly spaced 2.5cm holes into the soil surface with a pencil. 1/8th tsp of Fusarium millet inoculum, consisting of equal parts *F. pseudograminearum* and *F. culmorum* was sprinkled on the soil surface and lightly incorporated. Each pot was fertilized with three Jobe's fertilizer spikes (13-4-6 NPK). Winter wheat was grown in the greenhouse for eight weeks. After eight weeks, wheat plants were removed from the soil in effort to keep crown and roots near crown intact as much as possible. Roots and crowns of plants were washed to remove excess soil. Total number of plants and number of plants showing crown rot symptoms were recorded. Each plant was then rated on a 0 (healthy) to 4 (dead) scale. Green foliage was removed from the crowns and placed into a paper bag and dried for dry biomass recording (figure 1). *Year 2 of the greenhouse study is currently underway.*

Field: In spring 2020 cover crops were planted at the Columbia Basin Ag. Research Center using a no-till plot drill. Treatments included Winter barley cv. 'Little Friend' at a seeding rate of 90 kg/ha, high CBD hemp cv. 'NWG2730' at a rate of 10.6 kg/ha, low CBD hemp cv. 'NWG452' at a rate of 6.7 kg/ha, mustard cv. Blend 'Caliente Rojo' was applied at a rate of 11.2 kg/ha. No nitrogen was applied. Fusarium Inoculum was applied at a rate of 63 kg/ha to every other pass, such that half the plots were inoculated at cover crop seeding in a strip design. Due to a late spring frost, 95% mortality occurred in the mustard plots. In effort to recover this treatment comparison, pelletized 'Pescadero Gold' mustard seed meal (Farm Fuel Inc. Watsonville, CA) was applied at a rate of 2247 kg/ha. Cover crops were terminated with glyphosate after 10 weeks of growth. Prior to crop destruction, biomass samples of each cover crop were obtained by taking a 1m section in two rows if the hemp and barley plots. Plots were managed as chemical fallow and planted to winter wheat in Autumn 2020. Plots were uniformly planted to cv. 'Stephens' winter wheat. Yield of the winter wheat cash crop was evaluated (figure 2). *Year 2 of the field study is currently underway.*

SIGNIFICANT ACCOMPLISHMENTS:

Significant accomplishments are encompassed in the boxplots below. Preliminary greenhouse results (figure 1) suggest hemp may have biofumigant properties. Preliminary field results (figure 2) agree with greenhouse data. Field data also suggest high CBD hemp may have increased biofumigant properties compared to low CBD hemp.

We also added a new collaborator on this project, Dr. Govinda Shrestha, Hemp Extension Specialist. He has provided invaluable expertise and will play a significant role in preparing this manuscript.

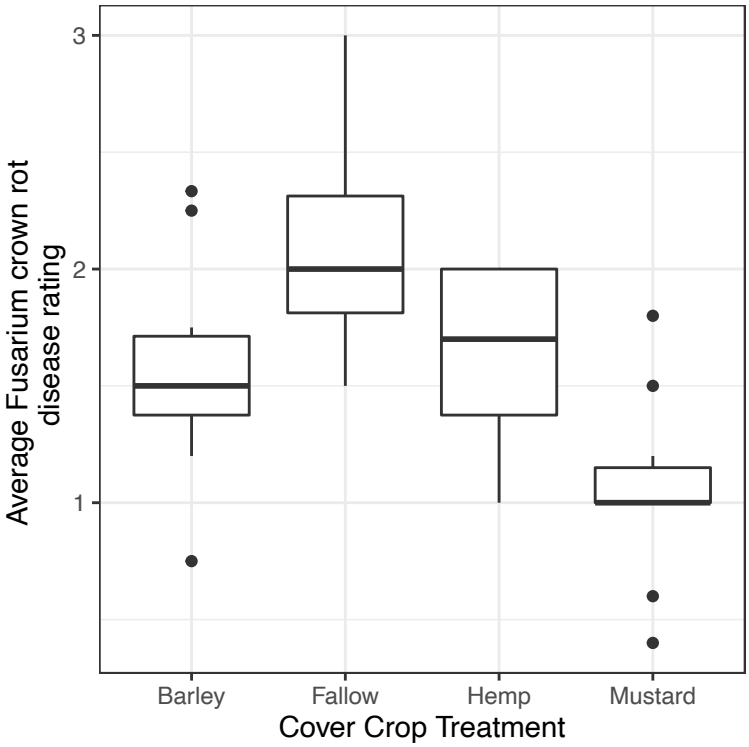

Figure 1. Boxplot of average disease rating of a cover crop greenhouse simulation of *F. culmorum* and *F. pseudograminearum* inoculated winter wheat following barley, fallow (control), hemp, and mustard cover crops. Ten replications.

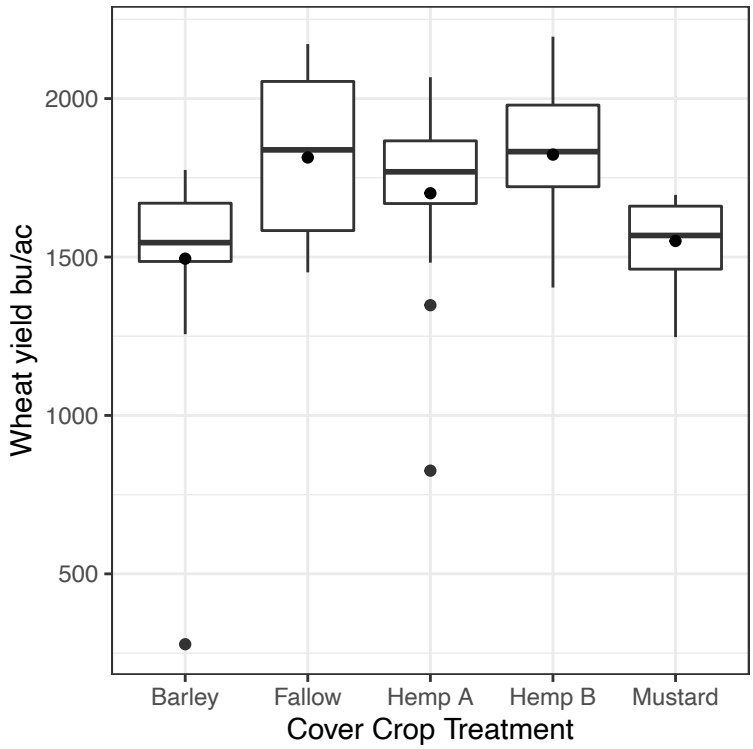

Figure 2. Boxplot of winter wheat cash crop yield following barley, fallow (control), hemp A (low CBD hemp), and hemp B (high CBD), and mustard cover crops. Eight replications.

BENEFITS & IMPACT:

Profit margins of dryland wheat in Oregon are extremely thin. Soilborne diseases of wheat are particularly challenging to control, as genetic resistance is limited, and fungicide applications are not effective. Any potential to limit soilborne disease is a profitability opportunity for farmers. After completion of this study, we will be able to inform growers if incorporating hemp into the dryland wheat production strategy will function to reduce soilborne diseases of wheat, and thus, improve wheat yields.

Complete data from this project will be available after harvest 2022. ARF will be provided with the complete manuscript of this project, upon completion.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

$0

FUTURE FUNDING POSSIBILITIES:

We hope the Oregon Hemp Commission will have an RFP soon. If so, we plan to apply in collaboration with the GHIC.