eyespot. Adapted varieties with highly effective resistance to Cephalosporium are not available because resistance genes are not known in the bread wheat gene pool. However, we have transferred resistance from wheatgrass into wheat in collaboration with Dr. Steve Jones, and some of these lines are now being used as parents in breeding programs. Winter wheat cultivars and advanced breeding lines are tested for resistance to Cephalosporium stripe and eyespot every year at the Palouse Conservation Field Station and Plant Pathology Farms (results from 2009 were published in the May 2010 issue of Wheat Life). Currently, Tilt and Topsin-M are the only fungicides registered for eyespot; however, we have identified two new fungicides and are testing them in commercial fields near Prescott and Oakesdale, WA to determine their effectiveness in controlling eyespot. The snow molds occur in the north-central wheat-producing area of eastern Washington, where snow cover can persist for up to 150 days and cause complete yield loss in years when they are severe. Disease resistant varieties like Bruehl and Eltan, and early seeding are the best control methods for the snow molds. Development of new varieties and testing of new sources of resistance is ongoing in field plots near Mansfield and Waterville, WA, and in the growth chambers of the Wheat Plant Growth Facility in Pullman. All of this work is part of our long-term goal to improve resistance of winter wheat varieties to these important diseases and thereby reduce yield losses for Washington State wheat growers.

Wheat Head Armyworm Research Project

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In 2007 and 2008, an insect pest, allegedly the wheat head armyworm (WHA) [*Faronta diffusa* (Walker) (Lepidoptera: Noctuidae)], infested winter and spring cereal grains in the Reardan-Davenport area of Lincoln County. Yield loss both years was 35% in WSU spring wheat and barley trials, and 10,000 acres were treated with insecticide to control the pest in 2008. Using Washington Grain Commission funds, a research project was initiated to determine the regional distribution of the pest; its biology, damage, and control.

In 2009 we established 28 trap sites throughout the wheat growing region of eastern Washington, inclusive of Adams, Columbia, Douglas, Franklin, Garfield, Grant, Lincoln, Spokane, Walla Walla, Whitman, and Yakima counties. There were 2 traps per county and 10 in the Reardan-Davenport region. At each site, a trap with a pheromone lure (which attracts the male WHA) was set up, as well as a trap with a feeding attractant lure. These traps were maintained from the third week of May until mid September.

Small numbers of *F. diffusa* males were captured in sex attractant traps at several of the sites with a total of 17 captured for the season. In addition, male *Faronta terrapictalis* Buckett (1969) moths were found in far higher numbers in most of the traps. *F. terrapictalis* is a noctuid moth that is native and widely distributed in temperate western North America. It has no recognized pest status, but is similar to, and may be confused with, the wheat head armyworm moth. The host range of *F. terrapictalis* is unknown. Two other Noctuid moths with possible pest status on grasses were also found.

However, in 2009 no larvae of either *Faronta diffusa* (WHA) or *F. terrapictalis* were found at any of the trap sites, nor in any fields scouted in the Reardan-Davenport area by Ag Link Inc. employees.

It is possible that the damage to wheat in eastern Washington previously attributed to the wheat head armyworm may have been due in part to *F. terrapictalis,* which is referred to locally as the "false wheat head armyworm". Since no *Faronta* larvae were found in fields, none were reared to adults to confirm species identity, population composition, and which of the *Faronta* spp. is the preeminent damaging species in wheat. .

In the 2010 season we will repeat the insect trapping procedures, but will limit them to the area where most moths were found in 2009. If we find no *Faronta spp.,* we will terminate the project in August 2010.

Controlling Wireworms with Neonicotinoid Insecticides in Wheat

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Wireworm (*Limonius* spp.) populations and crop damage have been increasing in both spring and winter wheat (*Triticum aestivum* L.) production across eastern Washington.

After nearly 30 years of use, the pesticide Lindane was withdrawn by the Environmental Protection Agency. Today nearly all spring cereal crop acres throughout eastern Washington are treated for wireworm control with neonicotinoid insecticides such as Cruiser® (thiamethoxam) and Gaucho® (imidacloprid) at rates between 0.190-0.315 oz/cwt. A majority of winter wheat acres are also being treated with these insecticides at similar rates. At these rates, the neonicotinoids are toxic to wireworms but at sub-lethal doses, or in other words they repel or provide some seedling protection only. Two on-farm tests (OFT) were initiated in the spring of 2008 to examine wireworm control with higher than recommended neonicotinoid insecticide applications to find a lethal dose that will reduce wireworm populations and improve yield and economic return over costs. Both OFT's are a RCBD with 4 replications and 10 and 15 acres in size. At Dewald's farm Gaucho at 2.0 oz/cwt had a trend for improved yield, economic return over costs, and reduced wireworm populations and additional research is needed. At Sheffels' farm Cruiser applied at 0.50 and 1.00 oz/cwt has significantly improved yield and economic return over costs compared to applying 0.00 and 0.25 oz/cwt, but has not reduced wireworm populations.

Part 3. Agronomy, Economics, and Sustainability

New Map of Inland Pacific Northwest Dryland and Irrigated Cropping Areas

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We created a new map to show the dryland and irrigated cropping areas of the Inland Pacific Northwest (Fig. 1). The dryland cropping zone is divided into three precipitation regions: (i) low – less than 12 inches annual, (ii) intermediate – 12 to 18 inches annual, and (iii) high – 18 to 24 inches annual. We divided the irrigated cropping zone into four segments depending on whether the source of water was from: (i) the Yakima River Basin Project, (ii) the Columbia Basin Project, (iii) pumped from deep wells, or (iv) other sources, such as pumped directly from the Columbia River or its tributaries.

The Yakima Basin is one of the most intensively irrigated areas in the US. The Yakima River Basin Project was initiated in 1905 and delivers water to 509,000 acres of cropland along 174 miles on both sides of the Yakima River. The Columbia Basin Project began in 1951 following construction of the Grand Coulee Dam on the Columbia River and provides water for 650,000 acres of crops. About 148,000 acres is irrigated from deep wells. Most of these wells were drilled in the 1960s with the intention they would be needed only for 10 or 15 years until the

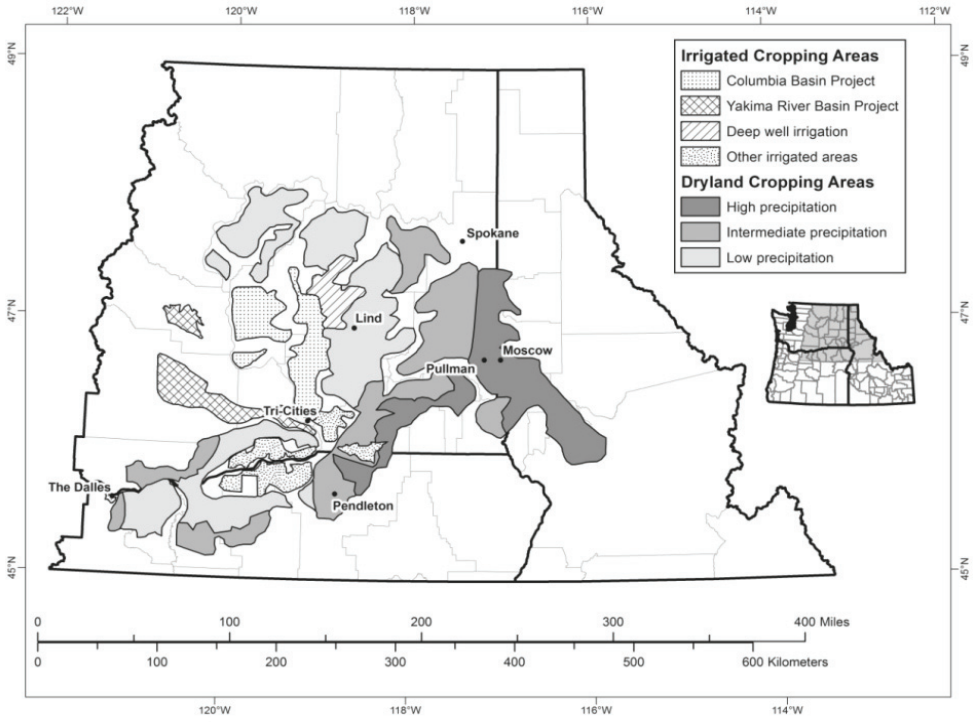

Fig. 1. Map of dryland and irrigated cropping areas in the Inland Pacific Northwest.