

PROJECT NO: New Project

TITLE: The importance of corn and grassy weeds in BYDV spread

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JUSTIFICATION: Barley yellow dwarf virus (BYDV) is an important viral disease of cereal crops, such as wheat, barley, and oats, world-wide. The virus has a broad host range that includes many perennial weeds, forage grasses, and crops such as corn and rice (De Wolf 2010). Different species of cereal aphids are responsible for spreading BYDV; chief among them is the Bird Cherry-Oat Aphid. The Bird Cherry-Oat Aphid was also the predominant species that contributed to the 2012-2013 outbreak of BYDV in central Idaho (Marshall and Rashed 2014).

A survey of BYDV from grasses in northern Idaho pastures showed that a large percentage of common plant species can host BYDV (Ingwell and Bosque-Pérez, unpublished data). Moreover, anecdotal observation during 2012 and 2013 outbreak indicated that some weedy grasses near BYDV-infected winter barley in Burley Idaho, showed reddening/yellowing symptoms typical of BYDV infection. These observations raise the question whether weedy grasses can act as source for BYDV and its aphid vectors. In addition, there are reports of BYDV infection in corn. The symptoms of BYDV in corn are slow to develop and may be hard to detect readily (Marshall and Rashed 2014). A significant factor in BYDV outbreak in Idaho is suggested to be its potential association with increased corn acreage. Corn is also known to be a suitable host of the bird cherry-oat aphid (Halbert et al. 1995). Indeed, recent aerial photography and anecdotal observations suggest that aphid/BYDV incidence is more prevalent in cereal fields on the edges bordering corn circles.

Therefore, it is conceivable to assume that corn and/or natural grassy vegetation surrounding cereal production areas can act as a reservoir for both the virus and its aphid vectors. Moreover, studies are needed to determine transmission success from potential reservoirs to cultivated wheat in order to predict their significance in BYDV epidemiology. Here, we propose to conduct a thorough survey of BYDV incidence and aphid presence, in both corn fields and natural grassy vegetation, and to evaluate their role in disease incidence within wheat fields.

HYPOTHESIS: Increased corn production and presence of local wild grasses impact BYDV epidemiology/spread in central Idaho. This hypothesis will be evaluated through the following objectives:

- I. Conduct a field survey to determine BYDV occurrence in corn and grassy weeds surrounding wheat production areas,
- II. Determine pattern of disease incidence and progress within wheat fields neighboring potential reservoirs (corn and naturally occurring grassy hosts),
- III. Study the efficiency of transmission from corn and two commonly found grassy weeds, downy brome and foxtail, to wheat under controlled greenhouse conditions.

PROCEDURES:

Objective I: Plant sampling will be carried out within, and near, 8 to 10 wheat fields neighboring corn and/or open pastures in Magic Valley, where BYDV has been reported in the past. Collected samples will be tested by ELISA.

Objective II: To study the presence of aphids within corn fields and their movement into wheat, yellow sticky traps will be placed on the edge of the corn fields and within wheat fields in different distances from the edge facing corn-field traps. Traps will be replaced overtime to monitor insect movement from corn into wheat. Number of aphids is expected to rise, if insects started to move into emerging winter wheat fields, as the corn crop matures. Leaf samples will be collected from plants surrounding traps (and therefore different distances from the field edge) to measure the rate of BYDV occurrence in relation to distance from potential reservoirs.

Objective III: To study transmission efficiency, downy brome (*Bromus tectorum*), foxtail (*Setaria* spp.), and corn (*Zea mays* L.) seeds will be individually planted in the greenhouse. Ten viruliferous aphids (*Rhopalosiphum padi*) from a BYDV positive laboratory colony will be used to inoculate weeds and corn plants. Viruliferous aphids will be allowed to feed for a 72-hrs period (inoculation access period or IAP). When the IAP period elapsed, aphids will be removed. Infected plants will be maintained in the greenhouse for a minimum of 4 weeks (26-30 C, 70% RH). Using leaf-clip cages, aphids from a BYDV-free colony will be placed in groups of 3-5 on BYDV infected corn and weeds (see above) for minimum of 72-hr (acquisition access period or AAP). Then, insects will be removed to healthy wheat plants at 3-4 leaf stage for a 72-hr IAP. All of the source plants (BYDV-infected weeds) will be tested for BYDV presence and titer (qPCR). Aphids will then be removed and tested for infection status (virus incidence and titer) individually. After a 4-week period all experimental wheat plants (target plants) will be sampled for BYDV presence. This approach would allow us to evaluate transmission success from potential reservoirs to emerging wheat, first, by quantifying acquisition success from corn, downy brome, and foxtail, and then by determining successful rates of inoculation into wheat.

DURATION: This study is expected to complete within 2 years. Field surveys would start in the spring of 2015 and continue until fall, 2017.

COOPERATION: This project will be conducted in collaboration among Dr. Rashed's, Dr. Hutchinson's, Dr. Marshall's and Dr. Bosque-Pérez's laboratories.

ANTICIPATED BENEFITS/EXPECTED OUTCOMES/INFORMATION TRANSFER:

Results will determine the potential role of corn, and naturally occurring grassy weeds, in BYDV epidemiology in central Idaho. Key host-plant species for BYDV and aphids will be identified. The results of these studies would help growers in their BYDV management decisions. If corn proved to be a significant source of BYDV, then late-season insecticide applications (in corn) may be suggested to reduce aphid numbers and movement. Information on BYDV/aphid presence and prevalence in wild vegetation surrounding wheat production would also help growers to take preventive measures (e.g. seed treatment and/or planting date) to limit damage in high risk areas/years. Results will be communicated to growers and scientific community through cereal schools, CIS publications, conferences and refereed journal publications.

LITERATURE REVIEW:

BYD is one of the most destructive diseases of cereal crops worldwide and its host range includes a wide range of cultivated and non-cultivated grasses (Power et al. 1994). While barley and wheat yields may be severely affected by BYDV infection, alternate hosts such as corn (Halbert et al. 1995) and/or other weedy grasses (Hadi 2009) may play a role as a reservoir of the pathogen in the absence of wheat and barley (Stoner 1977). Knowledge of BYDV ecology and potential reservoirs for the virus and its aphid vectors would help to establish sustainable management practices that are based on removing green bridges, reducing aphid populations, and adjusting planting times.

It has been reported previously that corn residue in the field can increase the incidence of BYDV in North Carolina's winter wheat (Cowger et al. 2010). The occurrence of BYDV in corn and some species of annual weed grasses has also been documented in Europe suggesting their roles as major sources of BYDV affecting winter cereals. Moreover, it has been shown that corn may harbor more aphids, which can colonize wheat fields in early autumn. Such findings also show how manipulations of landscape structure may impact existing agro-ecological equilibriums contributing to pest outbreaks (Vialatte et al. 2006).

REFERENCES:

- Cowger, C. Weisz, R. Anderson, J.M. Horton, J.R. 2010. Maize Debris Increases Barley Yellow Dwarf Virus Severity in North Carolina Winter Wheat. *Agronomy Journal* 102: 688-695.
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- Stoner, W.N. 1977. Barley Yellow Dwarf Virus Infection in Maize. *Phytopathology* 67: 975-981.
- Vialatte, A., Simon, J.C., Dedryver, C. A. Fabre, F., Plantegenest, M. 2006. Tracing Individual Movements of Aphids Reveals Preferential Routes of Population Transfers in Agroecosystems. *Ecological Society of American* 16: 839-844.

IDAHO WHEAT COMMISSION - BUDGET FORM

Allocated by	Idaho Wheat Commission	during FY 2014	\$	-
Allocated by	Idaho Wheat Commission	during FY 2015	\$	-

REQUESTED FY 2016 SUPPORT:

	Salary	Temporary Help	Fringe	Travel	OE	Grad Fees	TOTALS
Idaho Wheat Commission		\$ 4,000	\$ 1,180	\$ 2,400	\$ 2,400	\$ -	9,980

OTHER RESOURCES (not considered cost sharing or match UI (salaries, operating)
\$6,553

TOTAL OTHER RESOURCES \$ 6,553

TOTAL PROJECT ESTIMATE FOR FY 2016:	\$ 9,980 (Requested)	\$ 6,553 (Other)	\$	16,533 (Total)
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BREAKDOWN FOR MULTIPLE SUB-BUDGETS:

	<i>Rashed (/Rashidi)</i>	<i>Hutchinson</i>	<i>Bosque-Perez</i>	<i>Marshall</i>
Salary	\$ -	\$ -	\$ -	\$ -
Temporary Help	\$ 2,000	\$ 2,000	\$ -	\$ -
Fringe Benefits	\$ 590	\$ 590	\$ -	\$ -
Travel	\$ 1,000	\$ 1,000	\$ -	\$ 400
Operating Expenses	\$ 2,000	\$ -	\$ 400	\$ -
Graduate Student Fees	\$ -	\$ -	\$ -	\$ -
TOTALS	\$ 5,590	\$ 3,590	\$ 400	\$ 400
			Total Sub-budgets \$	9,980

10.24.2014 - Version