

## Evaluation of glandular-haired, potato leafhopper resistant alfalfa for organic farming systems

In the northern and eastern portions of the U.S., the primary insect problem in alfalfa is the potato leafhopper (PLH). A piercing-sucking insect, the leafhopper secretes toxic saliva into the plant which interferes with phloem transfer. This injury results in leaves that are yellowed (known as "hopperburn") and plants that are often greatly stunted.

PLH is a yearly pest on alfalfa, mostly during the second and third cuttings and usually ranging from a moderate to a severe problem. Using well-established economic thresholds, conventional farmers take action when PLH densities reach prescribed levels—when the number of adult and immature PLH in a 10-sweep sample is equal or greater than the height of the alfalfa. For example, on 8-inch alfalfa, the threshold is 8 or more leafhoppers. There are no known organic insecticides that offer acceptable control and organic producers often suffer significant crop loss during either of the growth cycles if leafhopper populations are high.

This study evaluated the potential of glandular-haired, PLH resistant alfalfa varieties in an organic system. Varieties with resistance to PLH were initially released in 1997. Early released varieties were not sufficiently resistant, only containing about 30% resistant plants. At that time, their performance was considered poor and few growers took to using them. Since then, newer, more advanced varieties have been released that have much higher levels of resistance, between 70-80% resistant plants. In studies from conventional systems, the most recent advanced generation alfalfa lines have shown outstanding resistance and yield compared with non-resistant varieties. Indeed, we have been able to raise the PLH thresholds on the resistant varieties at least 3 times the level of non-resistant lines. Again, using 8-inch alfalfa as an example,

the threshold on these new resistant lines would be 24 leafhoppers per 10-sweep sample.

Although numerous researchers continue to examine the exact mechanism of PLH resistance in alfalfa, the reason is still unclear. We know it is because of the glandular hairs that these lines possess, but no one is sure if it's antixenosis, a behavioral effect, or antibiosis, a mortality factor.

### Objectives

Objectives of this study were to determine whether glandular-haired, PLH resistant alfalfa can be produced organically in areas with significant PLH pressure; whether PLH resistant alfalfa can reduce PLH density; and to demonstrate the ability of glandular-haired, PLH resistant alfalfa to produce a higher yield of alfalfa with less PLH injury to organic growers.

### Materials and Methods

Three varieties of alfalfa were planted in fall 2004, in 20 x 150 ft plots on certified organic research land operated by the Ohio Agricultural Research and Development Center near Wooster, Ohio:

- **Great Harvest** (an organically produced, non-PLH resistant variety);

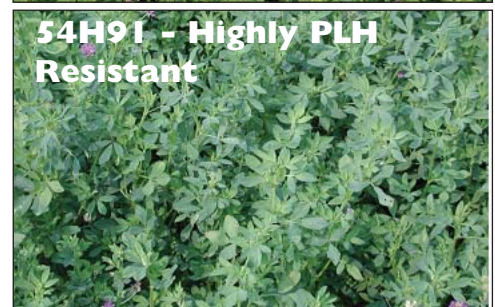
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**Great Harvest - PLH Susceptible**



**Predator - Moderately PLH Resistant**



**54H91 - Highly PLH Resistant**

The above photos show the condition of alfalfa varieties on July 20, 2006. The PLH susceptible variety Great Harvest shows considerable "hopperburn" while the resistant varieties, particularly Pioneer 54H91, show little PLH damage.

### Project Notes

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**Project location:** OARDC, Wooster, OH (certified organic)

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- **Doebler Predator**, a third generation resistant variety referred to as a moderately resistant line (Res-M); and
- **Pioneer 54H91**, a recently released, fourth generation line considered highly resistant (Res-H).

Pioneer 54H91 was planted with and without Bio-Seed-Gard (BSG), an OMRI-certified seed treatment. The organic producer who supplied us with Doebler Predator seed asked us to treat half the 54H91 (the more resistant line) to see if it provided an additional advantage. BSG is a dry blend of microorganisms including *Mycorrhiza* and *Trichoderma* to support soil life for nutrient cycling in the root rhizosphere.

A number of problems occurred at the beginning of this study that affected the research. Because of insufficient leafhopper densities during 2005 to obtain meaningful results the first year of the study, a non-funded extension was obtained to continue the experiment the following year. In addition, the number of replications was reduced from four to two due to insufficient seed, and thus no data analyses were done.

In 2006, alfalfa was sampled weekly for potato leafhopper following the first alfalfa cutting when PLH are known to occur.

**Key Results**

During the second cutting in July 2006, extremely high leafhopper populations developed. Sampling from 5 July through 25 July showed the development of the population:

**July 5:** Adults collected were similar in all treatments with an average around 38 PLH per 10-sweep sample in 8-inch alfalfa. All treatments were considered above threshold, including the resistant alfalfa. Few nymphs were collected on this date.

**July 14:** Populations were similar to those on the first sampling date. Yellowing began to be seen in the susceptible alfalfa, but not the resistant.

**July 19:** Adult populations on the resistant alfalfa varieties began to fall, rang-

ing from about 19 PLH on 54H91 with BSG, to 25 PLH on the other two resistant treatments, to 40 on the susceptible line. The populations on resistant varieties by this time were below the threshold of 3 times normal, which on 15-inch alfalfa would be 45 PLH per sample. The numbers on the susceptible were well above threshold.

**July 25:** When the alfalfa was about 25 inches tall (at least on the resistant alfalfa), the number of adult PLH was similar on all varieties, ranging between 21 and 31 per sample. However, nymph densities rose dramatically, with a low of 10 nymphs per sample on 54H91 with BSG and 37 nymphs on the susceptible. Adding adults and nymphs, the susceptible averaged about 62 total PLH while the highest resistant treatment was 32 total PLH. Again, with the differences in thresholds, the susceptible alfalfa was well over threshold while the resistant alfalfa was below threshold.

The presence of more PLH on the susceptible variety corresponded to higher injury ratings and plant stunting (Table 1). The susceptible variety had levels of injury exemplified by extreme yellowing (80-90% yellow) and stunting. The plant height for the susceptible was only 15 inches on July 26. This compared to both 54H91 treatments with only slight yellowing (5-10% yellow). This amount of yellowing was most likely from the 10-20% of the non-resistant individual plants present in the mixture. The two 54H91 treatments were about 25 inches in height. Predator, the less resistant variety, had some yellowing (30-40%), with an average height of 21 inches, a few inches less than 54H91. (It should be noted that a more advanced generation variety of Predator has since come on the market with higher levels of resistance.) There appeared to be no differences between 54H91 with and without BSG.

These were very high potato leafhopper populations, much higher than normal during this second cutting. All samples were over threshold for non-PLH resistant alfalfa, and on July 5, probably higher than the 3 times threshold for glandular-haired alfalfa. However, note that while susceptible alfalfa was greatly stunted and yellow, we still had good height and less injury with resistant alfalfa. There were fewer adults by July 19 on resistant alfalfa, and fewer nymphs on the resistant material.

Following harvest of this growth cycle, leafhoppers did not reach high levels again, remaining < 8 PLH per sample.

**Conclusions and Discussion**

We were able to show the ability of advanced generation, glandular-haired potato leafhopper resistant alfalfa to produce a much better crop than regular, non-resistant alfalfa. This improvement was demonstrated by the near total lack of leafhopper injury (yellowing) and plants attaining between 25 and 30 inches in height (the normal height at harvest), while the non-resistant alfalfa was very stunted, at best 15 inches in height, and nearly entirely yellowed. The literature indicates that quality is much lower in PLH damaged alfalfa, and past experience has been that most growers, conventional or organic, would not have bothered to harvest this yellow, stunted alfalfa. This is evidence that PLH resistant alfalfa has a use in organic alfalfa production. ☘

**Table 1. Potato leafhopper (PLH) injury ratings (on two dates) and plant height near harvest maturity on organically grown alfalfa during the second cutting 2006.**

Variety	PLH	Injury Ratings*		Plant Height July 26
		July 17	Aug 3	
Great Harvest	Sus	6.5	9.0	15"
54H91 w BSG	Res-H	0.5	1.0	26"
54H91 w/o BSG	Res-H	1.0	1.5	25"
Doebler Predator	Res-M	2.5	3.5	21"

\* Injury rating: 0 = no injury observed to 10 = completely yellowed and stunted  
 Sus = susceptible variety, Res-H = highly resistant variety, Res-M = moderately resistant variety