## Final Project Report to the NYS IPM Program, Agricultural IPM 2003-2004

# Project Title: Evaluation of a potato leafhopper (PLH) resistant alfalfa cultivar effects on PLH injury in alfalfa: grass mixed stands with and without insecticide.

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**Type of Grant:** Pest-resistant crops

**Project Location:** Nationally

**Abstract:** The combination of a resistant cultivar and a grass resulted in significantly better PLH control than did the resistant cultivar alone or the grass alone. The resistant cultivar had 36% fewer PLH than the susceptible cultivar; however, the number of PLH was significantly higher than for the plots that were sprayed with insecticide (average less than 1 PLH per sub-plot). The untreated plot with the lowest PLH damage score was the resistant alfalfa/grass mixture (score = 1.8), whereas the resistant cultivar alone scored 2.4 and the susceptible cultivar alone and with grass averaged 3.5.

## Background and Justification:

Forages are one of New York States most important crop production assets. In addition to 560K acres of alfalfa, 1.1 million acres of "other hay" crops including alfalfa/grass combinations contribute to NY's agricultural economy (NYS NASS). It is estimated that at least two-thirds of the alfalfa seedings in New York State include a perennial forage grass, most often timothy or orchardgrass. Mixed seedings are grown for a couple of reasons. First, clear seeded alfalfa will not persist on moderately to poorly drained soils that are common in New York. In addition, many producers include a grass in the mixture to speed hay drying.

Potato leafhopper is the most damaging insect pest of alfalfa in the Northeast, causing risk to new seeding establishment and survival, and to established stands during mid-to-late summer. Protecting alfalfa from yield and quality losses associated with potato leafhopper (PLH) injury is a primary focus of NY alfalfa IPM. Several insecticides are registered to control PLH in clear seeded alfalfa (Cornell Field Crop Guide). Unfortunately, many insecticides currently registered for alfalfa bear the restriction "Apply only to fields planted to pure stands of alfalfa" and as such are not appropriately labeled for mixed stands of alfalfa/clover/grasses. This limitation became painfully obvious in 2000 when crops were subjected to an armyworm epidemic in many areas of the US. In NY, an estimated 460K acres of alfalfa/clover/grass mixed stands are at potential risk from PLH and other insects. To help producers minimize risk from insects in these crop mixtures, NYS Department of Environmental Conservation (DEC) and USEPA issued a Crisis Exemption for the use of the insecticide Warrior to control PLH in mixed alfalfa/grass stands in 2002 and 2003.

Management techniques that reduce PLH damage to alfalfa include harvesting forage early, planting PLH-resistant alfalfa, and planting grass as a companion crop to the alfalfa. In a year of severe PLH infestations, early forage harvest alone will not control insect populations, and frequent harvest can weaken alfalfa, making it susceptible to winter injury.

Potato leafhopper-resistant alfalfa cultivars first became commercially available in 1997 and offer producers a degree of relief from PLH damage. Hansen et al.(2002), have shown that recent PLH-resistant alfalfa cultivars, while not immune to PLH, are indeed very effective at reducing PLH damage symptoms, were superior in feed quality than many of the conventional alfalfa cultivars tested, and were well adapted to NY growing conditions. Currently, seed costs of these cultivars are comparable to conventional alfalfa cultivars.

In mixtures of conventional alfalfa with grass, PLH populations were reduced compared to alfalfa monocultures, but not below economic thresholds (DeGooyer et al., 1999). Research reported by Roda et al. (1997a), found that numbers of adult PLH were reduced by 22-48% in alfalfa/grass mixtures of either smooth bromegrass or orchardgrass. Smooth bromegrass and orchardgrass intercrops, planted at high densities, ca. 78% alfalfa, had consistently lower numbers of adult PLH. Mixtures of alfalfa with timothy showed both increases and decreases in PLH populations compared to alfalfa alone. The authors hypothesized that overall lower percentages of timothy, 94% alfalfa, in the stand compared with bromegrass and orchardgrass may have contributed to this variability. Further research showed that PLH emigration resulted from physical contact with grass (Roda et al., 1997b). Also, monocotyledonous plants such as grasses and sedges do not sustain the development of PLH nymphs (Lamp et al., 1994).

Research data are lacking on the potential of PLH-resistant alfalfa/grass mixtures to minimize yield and quality losses due to PLH damage. Data to document this impact would help further our understanding, provide documentation for EPA, and be valuable in outreach efforts.

## Objectives:

1. Compare PLH populations and damage, forage yield and quality in the seeding year of a clear-seeded conventional alfalfa cultivar, and a PLH resistant alfalfa cultivar each alone and in combination with timothy grass at two harvests.
2. Compare the above combinations for yield, and agronomic characteristics when insecticides have eliminated PLH, when PLH have been treated according to Cornell recommended PLH thresholds, and not treated with an insecticide.
3. Share results of this study in extension outreach opportunities throughout NY.
4. Compare PLH-resistant and susceptible alfalfa varieties for stand survival, in the second production year.

## Procedure:

1. The trial was established in late April on a 3-acre field at the Cornell Thompson Research Farm in Freeville, NY. The main plots were a Pioneer conventional alfalfa cultivar (5454) and a Pioneer potato leafhopper resistant alfalfa cultivar (53H81) seeded alone and with 'Chazy' timothy. Timothy was chosen over orchardgrass for this experiment because timothy is less competitive with alfalfa compared to orchardgrass when the alfalfa is managed on a three-harvest system. For central-NY, three harvests per season are recommended. Plots were seeded with a grain drill at seeding rates of 18 lb/A alfalfa alone and 16 lb/A alfalfa plus 4 lb/A timothy. Subplots were spray treatments of: untreated; low insecticide (LI) – 1.25 fl oz/ac Warrior (Zeneca Ag Products, Wilmington, DE); high insecticide (HI) – 1.6 fl oz/ac Baythroid (Bayer Crop Protection Products, Kansas City, MO). The sub-plots were replicated four times within each main plot. The main plots were not replicated.
2. The plots established in spite of excess soil moisture following seeding. The alfalfa seedlings were stressed from water-logged soils. Broad-leaved weeds were controlled by an application of Butyrac (Rhône-Poulenc, RTP, NC) in mid-June.
3. The sub-plots were swept using standard NYS alfalfa IPM practices (20 sweeps per plot) on July 17, July 29, August 18, August 27, and September 8 (1, 2, 6, 7, and 9 weeks after the first spray treatment on July 6). Insecticide spray treatments were applied when warranted by field monitoring detecting

potato leafhopper (PLH) populations reaching NYS IPM action thresholds (Cornell Field Crop Guide).

4. Alfalfa and alfalfa/grass LI and HI plots were insecticide treated on July 6 and again on August 24 using an ATV mounted $CO_2$ insecticide boom sprayer. Research samples for quality and yield were taken on July 23 and the whole field was mowed on July 31. Since the alfalfa was short in height from moisture stress and PLH feeding in some plots, the sub-plots were hand-sampled for yield and quality. For second harvest, research samples for yield were harvested with a Carter flail mower on October 9.
5. On July 23, grids (1 foot by 3 feet) were randomly placed in each sub-plot (2 grids in alfalfa alone plots and 1 grid in alfalfa/timothy plots). All the forage within each grid was cut with nippers. For the alfalfa sub-plots, the samples were scored for PLH damage (1 to 5 scale where 1 = no apparent damage and 5 = severe damage), measured for average plant height (cm), washed free of soil, placed in paper bags, and dried in ovens at 55 degrees C. The two samples per sub-plot were weighed after about 7 days of drying. The samples were combined and ground in a two stage grinding process (Wiley mill, then Udy mill (1 mm screen)). For the alfalfa/timothy sub-plots, the grid sample was separated into timothy and alfalfa, placed in separate paper bags, dried, and weighed after about 7 days of drying. A second sample of 200-300 grams fresh weight alfalfa was taken from the alfalfa/timothy sub-plots. These samples were scored for PLH damage (1 to 5 scale as above), measured for plant height, washed free of soil particles, placed in paper bags and oven-dried. The alfalfa samples were ground for forage quality analyses. In addition, the grass sub-samples from the grid samples were also ground for forage quality analyses.
6. For forage quality analyses, the ground samples were put through a FOSS model 5000 Near Infrared Reflectance (NIR) machine. Percent crude protein and percent neutral detergent fiber were predicted by the legume hay equation for alfalfa samples and by the grass hay equations for the grass samples purchased with the NIR machine. Only three alfalfa samples were outliers, and these were omitted from the data set.

The field experiment was designed such that comparisons within each plot (alfalfa or alfalfa/timothy mixture, PLH-resistant or conventional alfalfa) among untreated, LI, and HI treatments could be tested for statistical significance. Any comparisons between plots are confounded by location in the field and are for observational purposes only.

In this establishment year, all plots and sub-plots were compared on a per area basis either for yield or number of PLH.

## Results and Discussion:

At harvest 1, the PLH-resistant alfalfa/timothy plot averaged 7% alfalfa and 93% timothy, and the conventional alfalfa/timothy plot averaged 12% alfalfa and 88% timothy (Table 1). The percent alfalfa in the alfalfa/timothy mixtures was low because the alfalfa was stressed from excess soil moisture. It is expected in the first production year, that the percent alfalfa will increase as a proportion of the mixture.

### PLH Populations

In 2003, potato leafhopper populations exceeded action threshold in many areas of central NY. In Freeville, PLH populations reached threshold requiring insecticide treatment July 6 and August 23. The decision to treat was made when greater than 50% of the subplots reached action threshold. The lower insecticide (LI) treatment was the lowest labeled rate of Warrior. The higher (HI) insecticide treatment was the higher labeled rate of Baythroid, which has a longer active residual effectiveness than Warrior. Summed over the five sweep dates, the alfalfa/timothy plots averaged 10 adult PLH and 6 PLH nymphs, whereas the alfalfa plots averaged 46 adult PLH and 18 nymphs (Table 2). For the alfalfa/ timothy plots, the PLH counts were 64% adults and 36% nymphs. For the alfalfa plots, the PLH counts were 72%

adults and 28% nymphs. Even though nymphs cannot survive on grass, there were 8% more nymphs in the alfalfa/timothy plots than in the alfalfa plots. The total number of PLH (adults + nymphs) were used for data analyses and discussion of results (See Appendix 1 for sweep data on adult PLH and Appendix 2 for sweep data on PLH nymphs).

On July 14 or week 1 after the first spray treatment on July 6 (Wk1), the untreated sub-plots for the resistant alfalfa alone, conventional alfalfa alone, and conventional alfalfa/timothy mixture averaged 42 PLH per sweep set, whereas the untreated resistant alfalfa/timothy mixture sub-plots averaged 3 PLH per sweep set (Figure 1). The combination of a resistant cultivar and timothy resulted in significantly lower PLH counts than for the PLH-resistant cultivar alone or the conventional alfalfa/timothy mixture. For the alfalfa plots, the untreated PLH-resistant alfalfa averaged 38 PLH and the untreated conventional alfalfa averaged 59 PLH. Thus the resistant cultivar had 36% fewer PLH than the conventional cultivar, however, the number of PLH was significantly higher than for the plots that were sprayed with insecticide (average <1 PLH per sub-plot).

On July 29 or week 2 after spraying, the PLH populations decreased significantly in the untreated sub-plots, perhaps due to heavy rains. The field was mowed on July 31. By August 18 or week 6 after spraying, the numbers of PLH increased for all treatments within plots. Eighteen days after mowing and 4 days after the second spray treatment (week 7 after the first spray treatment), the untreated sub-plots for the PLH-resistant alfalfa alone, and conventional and PLH-resistant alfalfa/timothy mixtures averaged 4 PLH per sweep set, whereas the untreated conventional alfalfa sub-plot averaged 31 PLH per sweep set. During the second growth cycle, the resistant cultivar averaged fewer PLH per 20 sweeps than during the first growth cycle. Growing the conventional cultivar with a grass resulted in a 96% decrease in the number of PLH per sweep set compared to growing the conventional cultivar alone.

By September 8 (week 9 after the first spray treatment) in the untreated sub-plots, the average number of PLH per sweep set for both the PLH-resistant and conventional alfalfa alone was up to 32, and the average number of PLH for alfalfa/timothy mixtures was significantly lower at 1.25 PLH per sweep set. Thus in late summer when PLH populations were declining, the PLH seemed to be deterred more by the grass mixtures than by the resistant alfalfa cultivar.

**PLH damage scores**

The untreated plot with the lowest PLH damage score was the resistant alfalfa/timothy mixture (score = 1.8), whereas the PLH-resistant cultivar alone scored 2.4 and the conventional cultivar alone and with timothy averaged 3.5 (Table 3). The treated plots had scores ranging from 1.1 to 1.7, with the exception of the conventional alfalfa/timothy mixture that had a score of 2.4. It is possible that spraying the alfalfa/timothy mixture was less effective in killing PLH due to interception of the insecticide by the grass.

**Yield**

For harvest 1 and harvest 2 yields, the overall F-tests for differences among spray treatments were not significant for any plot (Table 3). At harvest 1, the alfalfa/timothy mixtures yielded more than the alfalfa alone (1.36 vs. 0.54 T/A) (Table 4). The PLH-resistant alfalfa yielded more than the conventional alfalfa (0.75 vs. 0.33 T/A). At harvest 2, the alfalfa plots yielded similarly (1.43 T/A for the PLH-resistant alfalfa and 1.46 T/A for the conventional alfalfa). The plot with the highest yield was the conventional alfalfa/timothy plot (1.73 T/A) and the plot with the lowest yield was the PLH-resistant alfalfa/grass mixture (1.11 T/A). Since the plots were not replicated, the differences in yield may be due to location in the field. Totaled over the two harvests, the plot with the highest yield was the conventional alfalfa/grass mixture (3.32 T/A) which was located in the driest part of the field.

## Quality
Protein concentration will be the only forage quality component discussed since the NIRS has better predictability with nitrogen fractions than fiber fractions. Averaged over spray treatments, the plots ranked from highest to lowest protein concentration in the alfalfa as: conventional alfalfa, PLH-resistant alfalfa, PLH-resistant alfalfa/timothy mixture, and conventional alfalfa/timothy mixture. Factors affecting the ranking were likely the amount of stunting from PLH damage, amount of leaf loss prior to harvest, and shading from grass canopy. The overall F-test for protein concentration was not significant for PLH-resistant alfalfa and for conventional alfalfa/timothy mixture. For both PLH-resistant alfalfa/timothy mixture and conventional alfalfa, the untreated sub-plots averaged 21.3% protein and the sprayed plots averaged 23.5% protein. Reducing PLH damage by insecticide application resulted in forage with higher protein concentration.

Protein concentrations of alfalfa/timothy mixture plots were significantly lower than for alfalfa plots alone (Table 5). Spray treatments had no effect on percent protein of the alfalfa/timothy mixture plots.

## Conclusions
On a land area basis, the PLH-resistant alfalfa/timothy plot had the lowest number of PLH across six sweep dates and the lowest amount of PLH damage on the alfalfa portion of the mixture. These results are consistent with those observed by Roda et al. (1997a). By contrast, in our seeding year trials alfalfa represented only 5 – 18% of plot composition, far less than the 78 – 94% reported in the Roda studies, i.e. the timothy component of the alfalfa/timothy mixture was dominant over the alfalfa. Within the plots, the insecticide applications reduced the number of PLH in the alfalfa alone plots more than in the alfalfa/timothy mixture plots. This is in part because there was significantly less alfalfa and fewer PLH in the alfalfa/timothy mixture plots. Future research in production years will focus on data collected on a land area basis and also on data on an alfalfa stem basis.

## References:
Cornell Guide for Integrated Field Crop Management. 2003. Cornell University, Ithaca

DeGooyer, T.A., L.P. Pedigo, and M.E. Rice. 1999. Effect of Alfalfa-Grass Intercrops on Insect Populations. Environmental Entomology 28:703-709.

Hansen, J.L., J.E. Miller-Garvin, J.K. Waldron, and D.R. Viands. Reducing Damage from Potato leafhoppers on Seedling Alfalfa Stands in New York: A Comparison of Potato Leafhopper-Resistant and Susceptible Alfalfa. NYS LFC/IPM Reports 1997 (#317), 1998 (#318) 1999 (#319), 2000 (#320).

Hansen, J.L., J.E. Miller-Garvin, J.K. Waldron, and D.R. Viands. 2002. Comparison of Potato Leafhopper-Resistant and Susceptible Alfalfa in New York. Crop Sci. 42:1155–1163.

NYS NASS (New York Agricultural Statistics) Annual Bulletin, 2003. Albany, NY.

Roda, A.L., D.A. Landis, and M.L. Coggins. 1997a. Forage Grasses Elicit Emigration of Adult Potato Leafhopper (Homoptera: Cicadellidae) from Alfalfa-Grass Mixtures. Environmental Entomology 26:745-753.

Roda, A.L., D.A. Landis, and J.R. Miller. 1997b. Contact-Induced Emigration of Potato Leafhopper (Homoptera: Cicadellidae) from Alfalfa-Forage Grass Mixtures. Environmental Entomology 26:754-762.

Table 1: Percent alfalfa and percent timothy in the alfalfa/timothy mixture plots at Harvest 1 on July 23.

| | Resistant Alfalfa | | Conventional Alfalfa | |
|---|---|---|---|---|
| | %Alfalfa | %Timothy | %Alfalfa | %Timothy |
| Untreated | 6 | 94 | 8 | 92 |
| Low Insecticide | 5 | 96 | 10 | 90 |
| High Insecticide | 11 | 89 | 18 | 82 |
| Average | 7 | 93 | 12 | 88 |

Table 2: Total number of Potato leafhopper insects summed over 5 sweep dates.
Sweep dates were July 17, July 29, August 18, August 27, and Sept. 8.

| Plot | Sub-plot | No. of Adults | No. of Nymphs | Adults+Nymphs |
|---|---|---|---|---|
| Resistant Alf.+Timothy | Untreated | 5 | 2 | 7 |
| | Low Insecticide | 8 | 2 | 10 |
| | High Insecticide | 3 | 1 | 3 |
| | Avg. over Sub-plots | 5 | 2 | 7 |
| | % Adult/nymphs | 78% | 22% | |
| Conventional Alf.+Timothy | Untreated | 18 | 24 | 41 |
| | Low Insecticide | 20 | 4 | 24 |
| | High Insecticide | 9 | 2 | 11 |
| | Avg. over Sub-plots | 15 | 10 | 25 |
| | % Adult/nymphs | 61% | 39% | |
| Avg. Alfalfa + Timothy | Avg. over Sub-plots | 10 | 6 | 16 |
| | % Adult/nymphs | 64% | 36% | |
| Resistant Alfalfa | Untreated | 82 | 35 | 117 |
| | Low Insecticide | 25 | 11 | 36 |
| | High Insecticide | 15 | 4 | 19 |
| | Avg. over Sub-plots | 41 | 17 | 57 |
| | % Adult/nymphs | 71% | 29% | |
| Conventional Alfalfa | Untreated | 102 | 48 | 150 |
| | Low Insecticide | 25 | 4 | 29 |
| | High Insecticide | 24 | 5 | 29 |
| | Avg. over Sub-plots | 50 | 19 | 69 |
| | % Adult/nymphs | 73% | 27% | |
| Avg. Alfalfa | Avg. over Sub-plots | 46 | 18 | 63 |
| | % Adult/nymphs | 72% | 28% | |

Table 3: Yield, PLH damage score, percent protein and neutral detergent fiber (NDF) for each plot at Freeville trial.

**Susceptible Alfalfa**

| | Harvest 1 on July 23 for alfalfa only | | | | | Harvest 2 - Oct. 9 |
|---|---|---|---|---|---|---|
| | Pl. Height (cm) | H1-T/A of Alfalfa | PLH Score | % Protein | % NDF | T/A of Alfalfa+Grass |
| UNTREATED | | | | | | |
| LI | 15 | 0.32 | 3.3 | 22.1 | 34.3 | 1.40 |
| HI | 17 | 0.30 | 1.6 | 24.3 | 34.5 | 1.62 |
| Average | 20 | 0.38 | 1.8 | 25.0 | 37.2 | 1.36 |
| | 17 | 0.33 | 2.2 | 23.8 | 35.3 | 1.46 |
| F-test | * | NS | * | * | * | NS |
| LSD (.05) | 3 | 0.11 | 1.0 | 1.7 | 2.0 | 0.66 |

**Resistant Alfalfa**

| | Harvest 1 on July 23 for alfalfa only | | | | | Harvest 2 - Oct. 9 |
|---|---|---|---|---|---|---|
| | Pl. Height (cm) | H1-T/A of Alfalfa | PLH Score | % Protein | % NDF | T/A of Alfalfa+Grass |
| UNTREATED | 24 | 0.72 | 2.4 | 21.8 | 36.4 | 1.40 |
| LI | 29 | 0.74 | 1.5 | 23.6 | 38.9 | 1.48 |
| HI | 28 | 0.80 | 1.4 | 23.8 | 38.7 | 1.40 |
| Average | 27 | 0.75 | 1.8 | 23.0 | 38.0 | 1.43 |
| F-test | * | NS | ** | NS | * | NS |
| LSD (.05) | 4 | 0.30 | 0.5 | 2.5 | 2.0 | 0.36 |

**Susceptible Alfalfa + Timothy**

| | Harvest 1 on July 23 for alfalfa only | | | | | Harvest 2 - Oct. 9 |
|---|---|---|---|---|---|---|
| | Pl. Height (cm) | H1-T/A of Alfalfa | PLH Score | % Protein | % NDF | T/A of Alfalfa+Grass |
| UNTREATED | 34 | 0.14 | 3.6 | 19.2 | 38.0 | 1.62 |
| LI | 37 | 0.17 | 2.3 | 18.9 | 40.5 | 1.69 |
| HI | 33 | 0.26 | 2.5 | 18.8 | 40.1 | 1.86 |
| Average | 35 | 0.19 | 2.8 | 19.0 | 39.5 | 1.73 |
| F-test | NS | NS | NS | NS | NS | NS |
| LSD (.05) | 11 | 0.25 | 2.6 | 3.4 | 3.4 | 0.46 |

**Resistant Alfalfa + Timothy**

| | Harvest 1 on July 23 for alfalfa only | | | | | Harvest 2 - Oct. 9 |
|---|---|---|---|---|---|---|
| | Pl. Height (cm) | H1-T/A of Alfalfa | PLH Score | % Protein | % NDF | T/A of Alfalfa+Grass |
| UNTREATED | | | | | | |
| LI | 25 | 0.08 | 1.8 | 20.4 | 32.7 | 1.19 |
| HI | 25 | 0.06 | 1.1 | 22.8 | 33.0 | 1.24 |
| Average | 25 | 0.10 | 1.0 | 21.9 | 33.2 | 0.90 |
| | 25 | 0.08 | 1.3 | 21.7 | 33.0 | 1.11 |
| F-test | NS | NS | ** | * | NS | NS |
| LSD (.05) | 7 | 0.08 | 0.2 | 1.7 | 1.9 | 0.69 |

Insecticide treatments were applied on July 6 and August 23. Low Insecticide (LI) = 1.25 fl oz/ac Warrior in 15 gal water. High Insecticide (HI) = 1.6 fl oz/ac Baythroid in 15 gal water.

Table 4: Forage yields at Harvest 1 (July 23) and at Harvest 2 (Oct. 9), averaged over spray treatments.

| Conventional Alfalfa | Yield Tons/Acre |
|---|---|
| Harvest 1 | 0.33 |
| Harvest 2 | 1.46 |
| Total Season Yield | 1.79 |

| Resistant Alfalfa | Yield Tons/Acre |
|---|---|
| Harvest 1 | 0.75 |
| Harvest 2 | 1.43 |
| Total Season Yield | 2.18 |

| Conventional Alfalfa + Timothy | Yield Tons/Acre |
|---|---|
| Harvest 1 | 1.59 |
| Harvest 2 | 1.73 |
| Total Season Yield | 3.32 |

| Resistant Alfalfa + Timothy | Yield Tons/Acre |
|---|---|
| Harvest 1 | 1.12 |
| Harvest 2 | 1.11 |
| Total Season Yield | 2.23 |

Table 5: Forage Quality at Harvest 1.

| **Conventional Alfalfa** | Harvest 1 on July 23 | |
| --- | --- | --- |
| | % Protein | % NDF |
| UNTREATED | 22.1 | 34.3 |
| LI | 24.3 | 34.5 |
| HI | 25.0 | 37.2 |
| Average | 23.8 | 35.3 |
| F-test | * | * |
| LSD (.05) | 1.7 | 2.0 |
| **PLH-Resistant Alfalfa** | | |
| | % Protein | % NDF |
| UNTREATED | 21.8 | 36.4 |
| LI | 23.6 | 38.9 |
| HI | 23.8 | 38.7 |
| Average | 23.0 | 38.0 |
| F-test | NS | * |
| LSD (.05) | 2.5 | 2.0 |
| **Conventional Alfalfa + Timothy** | | |
| | % Protein | % NDF |
| UNTREATED | 10.2 | 56.7 |
| LI | 10.5 | 56.1 |
| HI | 11.9 | 53.3 |
| Average | 10.9 | 55.3 |
| F-test | NS | NS |
| LSD (.05) | 3.6 | 6.9 |
| **PLH-Resistant Alfalfa + Timothy** | | |
| | % Protein | % NDF |
| UNTREATED | 11.1 | 54.8 |
| LI | 9.6 | 49.7 |
| HI | 11.8 | 50.4 |
| Average | 10.8 | 51.6 |
| F-test | NS | NS |
| LSD (.05) | 2.8 | 4.2 |

Spray treatments were applied on July 6.
Low Insecticide (LI)=1.25 fl oz/ac Warrior in 15 gal water.
High Insecticide (HI)=1.6 fl oz/ac Baythroid in 15 gal water.