

## Foliar fungicides in alfalfa production

Brian Lang, Extension Field Agronomist, Iowa State University; Kenneth Pecinovsky, Farm Superintendent, Iowa State University Northeast Research Farm

### Introduction

Within the last few years, EPA approved pesticide labels for a few foliar fungicide products for use in alfalfa production. However, university research regarding potential economic benefits of these products are extremely limited. In addition, aggressive salesmanship recommending multiple applications per season raises concerns with proper stewardship for these products to insure long-term effectiveness.

To initiate efforts addressing the potential economic benefits of using foliar fungicides in alfalfa production, we conducted eight site years of research trials from 2011 to 2013 at the ISU Northeast Research Farm, Nashua, Iowa. While additional research is needed for a more complete understanding on the use of foliar fungicides in alfalfa production, the purpose of this report is to provide the preliminary information we have at this time. Future conclusions may vary as more research results become available from additional trials, other locations and treatments, and the influence of different climatic conditions on the use of foliar fungicides in alfalfa production.

### Methods

Four trial sites of alfalfa were direct seeded with a Brillion seeder at the ISU Northeast Research Farm in 2011 and 2012, on land in soybean production the previous years. The eight site years of foliar fungicide research trials included two trials in the establishment seasons of 2011 and 2012, and in six trials on established stands in 2012 and 2013. The trials had either 4 or 6 replications in a randomized complete block design.

Treatments used in various trials included:

1. Timing of fungicide applications made at either 3 to 4 inches of growth or 6 to 8 inches of growth.
2. Two varieties compared in the two new seeding trials and in two of the six established stand trials.
3. Fungicide applications compared prior to first or second crop for new seedings, and prior to first, second, third, or fourth crop for established stands. A few treatments consisted of multiple applications per season: prior to first and third crops, or prior to first, second and third crops.
4. Comparison of fungicide products, but not all products compared in all trials. The products included:
  - a. Headline SC at 6 oz/ac (Group 11, Quinone outside inhibitor)
  - b. Quadris Flowable at 10 oz/ac (Group 11, Quinone outside inhibitor)
  - c. Fontelis at 24 oz/ac (Group 7, Succinate dehydrogenase inhibitor)
  - d. Champ WG copper hydroxide at 12 oz/ac (Group M, Multisite activity)

Disease evaluations were conducted prior to each harvest. In 2011 and 2012, the method used was to assess the percent leaflets with or without the presence of foliar disease. In 2013 the method used was to assess percent leaf loss and percent disease severity.

Plots were harvested with a self-propelled flail chopper with mounted weigh hopper. Dry matter was determined from subsamples collected at harvest and oven dried. For some trials, composite subsamples were collected from treatments and analyzed for forage quality.

Seasonal temperatures and rainfall were near normal from the spring of 2011 through May 2012, after which temperatures were above normal and rainfall was 50% below normal causing a drought through the rest of the 2012 season. In 2013, temperature and rainfall was above normal in spring, then cooler and drier than normal for the rest of the season. Figures 1 and 2 provide accumulated seasonal alfalfa growing degree days and rainfall for 2011, 2012 and 2013.

## Results and discussion

### *New seedings*

The only fungicide used for the trials on new seedings was Headline SC. Disease incidence was similar for first and second crop in 2011 and for first crop in 2012, but was notably higher for second crop in 2012. With second crop in both years yielding better than first crop, which is typical for new seedings, the net profitability for a fungicide application was considerably better when applied ahead of second crop rather than ahead of first crop. It is logical to assume that disease presence and its potential impact on a crop would not be as high for first crop since this is a new seeding established on land rotated from a different crop. There would be minimal alfalfa leaf litter to act as a disease inoculum source from which to infect the new stand. By second crop, more alfalfa leaf litter on the ground is likely to act as an inoculum source to potentially contribute to disease infestations.

Since foliar fungicides only protect what they land on, an application at 6 to 8 inches of growth should offer more coverage and protection to alfalfa than for an application at 3 to 4 inches of growth. However, in 2011 and 2012, timing of fungicide applications at either 3 to 4 inches of growth or 6 to 8 inches of growth resulted in no significant differences in disease evaluations or yield responses. Throughout the trials, numerically there was a trend for better disease control and higher yields with applications delayed to 6 to 8 inches of growth, but statistical analysis showed no advantage. If this holds true with additional research, it suggests a rather flexible application window for foliar fungicide use in alfalfa production.

Forage quality analysis showed little difference between the untreated control and any of the fungicide treatments for either variety or timing of application.

Net profit for a fungicide application was minimal for applications ahead of first crop, but for second crop it averaged \$21 per acre for Variety 2 and \$5 per acre for Variety 1. Both varieties had similar disease incidence ratings, but Variety 2 consistently showed a higher yield response to a foliar fungicide application than for Variety 1. It is reasonable to expect some varieties to respond differently to fungicide applications, however, I think it unreasonable to expect the industry to screen varieties for this potential difference... which varieties, locations, cuttings and under what weather conditions would they be tested?

### *Established stands comparing two varieties*

The two fungicide trials on established stands only using Headline SC compared two varieties, the 3 to 4-inch versus 6 to 8-inch growth heights, and applications ahead of first, second, third or fourth crops. In 2011, disease incidence for the untreated control was at least twice as high for first crop harvest then for second, third or fourth crop harvests. In 2012, leaf retention of the untreated control was about 18% lower for first crop harvest compared to second, third and fourth crop harvests. Percent yield response of a fungicide application ahead of first crop harvest for both varieties and both years was roughly double that of yield responses to applications ahead of the other crop harvests during the season. In turn, net profitability was best for applications ahead of first crop harvest, then for any other single treatment, with an average of \$24 per acre for Variety 1 and \$44 per acre for Variety 2. Another treatment in these trials was to apply fungicide ahead of both first and third crop harvests. This increased net profit over the single application ahead of first crop harvest for Variety 2 in 2013, but made no change in profitability for Variety 2 in 2012 or for Variety 1 in either year.

Timing of fungicide applications at 3 to 4 inches of growth or 6 to 8 inches of growth were only compared in second crop in 2012 and third crop in 2013. In 2012, there was no difference with the timing of applications with regard to disease infestation or yield response for either variety. In 2013, there was a small advantage in yield response for the 6 to 8-inch timing over the 3 to 4-inch timing of application. However, waiting for 6 to 8 inches of growth for the application ahead of second, third or fourth crop harvests, followed by the required 14 day pre-harvest Interval (PHI), will often find fields starting to flower before the PHI is up. This could be a problem for those on 30-day cutting intervals. This is not a problem with applications at 6 to 8 inches of growth ahead of first crop harvest.

Composite subsamples from harvested plots of the different treatments were analyzed for forage quality. As with the new seeding trials, in the established stand trials the forage quality analysis showed little difference between the untreated control and any of the fungicide treatments for either variety or timing of application.

As mentioned earlier, the net profitability was best for applications ahead of first crop harvest, then for any other single treatment, with an average of \$24 per acre for Variety 1 and \$44 per acre for Variety 2. Net profit for fungicides applied ahead of other cuttings was somewhat marginal. The average net profit from fungicide

applications ahead of second, third and fourth crops for 2012 were \$2.50, \$3.00, and -\$1.00 per acre respectively. The average net profit from fungicide applications ahead of second, third and fourth crops for 2013 were \$11.00, \$2.00, and -\$1.00 per acre respectively.

### ***Established stands comparing Headline SC, Quadris and Champ***

Another trial that was conducted in both 2012 and 2013 compared the fungicides Headline SC, Quadris and Champ. In 2012, applications were made ahead of second, third and fourth crop, or just second and fourth crop. In 2013, applications were made ahead of first, second and third crop in 2013. Two varieties were compared in 2012, but only one variety was used in 2013.

Unfortunately, we started late in 2012 and missed the opportunity to treat ahead of first crop. In addition, the drought in 2012 significantly affected this trial. Headline SC and Quadris responded similarly to both varieties and in both years. Champ was less affective. In 2012, there was very little yield response to any of the fungicide applications in this trial. Headline SC and Quadris averaged a net profit of \$3.00 per acre when applied ahead of second and fourth crops, but averaged a net loss of -\$16.00 per acre when applied ahead of all three crops. Champ averaged a net loss of -\$37.00 per acre for both timing treatments. Champ provided reductions in disease incidence, but it was not clear as to why that did not correspond to a yield response. In 2013, with a wet spring, net profits averaged \$72 per acre for Headline SC and Quadris applications ahead of first crop, and \$24 per acre for Champ. Net profits for applications ahead both second and third crops averaged \$8 per acre for Headline SC and Quadris, and net loss of -\$28.00 per acre for Champ. Unfortunately the Group M copper hydroxide product does not appear to offer a viable alternative to the Group 11 products of Headline and Quadris.

Proper stewardship of this technology demands chemical families in addition to Group 11 products from which to select, especially when considering multiple applications of fungicide on the same field in the same season.

### ***Established stand comparing Headline SC and Fontelis***

A trial conducted in 2013 compared Headline SC and Fontelis. The trial only encompasses one year and one location, so I will not publish the results yet. However, I will briefly discuss the trial during my presentation at the conference. In general, the Group 7 Fontelis product appears to be competitive with the Group 11 products of Headline and Quadris especially for the summertime harvests, thus offering a different chemical family to use in rotation when applying more than one fungicide application during the season.

### ***The “High Yield” alfalfa trial... including a fungicide treatment***

Another alfalfa trial that began in 2013 and will continue through 2015, was nicknamed the “High Yield” Trial. The trial compares a sequential addition of treatments including Iowa State University recommended P and K fertilizer rates, higher P and K fertilizer rates, and a few foliar products including a fungicide. This paper will just include the fungicide response, although the other treatments will be briefly discussed during the presentation.

Headline fungicide was applied ahead of first, second and third crops during the trial. A fourth crop was also harvested. Seasonal total dry matter yields for 2013 were 6.8 ton per acre for the control and 7.5 ton per acre for the Headline treatment. As with the trials discussed previously in this paper, the greatest yield response in this trial was with first crop, providing a 13% yield increase with a net profit of \$52 per acre. Second and third crop yield responses were 6% and 9% respectively, and net profits of zero and \$14 per acre respectively. Significant differences in leaf retention and disease severity for the control versus the fungicide treated plots were found in first, second and third crops.

Forage quality analysis was conducted on the first crop harvest only. As with the trials discussed previously in this paper, no significant improvement in forage quality resulted from the fungicide application. At this time, there is also no significant advantage from the fungicide applications with regard to plants per square foot or stems per square foot.

Overall seasonal net profit from the fungicide applications in this trial over the control was \$78 per acre. This trial will continue for 2 more years.

### ***Stewardship***

Just as with the decisions we make to apply fungicides on corn and soybeans, we need to choose our opportunities as to where the probability of economic returns is the most beneficial. To apply fungicides to alfalfa without much

thought to harvest schedule and environmental conditions is not economically or environmentally sound. The issue of stewardship and fungicide use is critical for long-term viability of this management tool.

In general, the labels of Headline and Quadris state that they can be applied up to three times per season. However, these labels also provide recommendations on stewardship which suggests that these products should not necessarily be used that frequently.

For example, the Quadris label states: “Do not apply more than two sequential applications of Quadris or other Group 11 fungicides before alternating with a fungicide that is not in Group 11. The Headline supplemental label for alfalfa states: “Do not make more than three applications of Headline per year. Refer to the Headline fungicide main label for complete Directions for Use and all applicable restrictions and precautions.” The main label states: “When using Group 11 fungicides as a solo product, the number of applications should be no more than one-third of the total number of fungicide application per season.”

At this time, the only other fungicides labeled for alfalfa that are not a Group 11 fungicide is copper hydroxide, a Group M fungicide, and Fontelis, a Group 7 fungicide.

So far our research results' with copper hydroxide has been disappointing, but Fontelis could be a viable option. More research is warranted.

## Conclusions

In established stands, first crop has the highest yield potential of any cutting during a given season. It grows for a longer period of time than for growth between other cutting intervals, and it grows under environmental conditions typically more favorable for leaf disease development in alfalfa. Thus, an application prior to first crop versus any other crop should be the most profitable. Our trials strongly support this assumption. Consistency of net profitability is more questionable when fungicide applications are used ahead of crop harvests in the summer months, especially if weather conditions are less favorable for disease development.

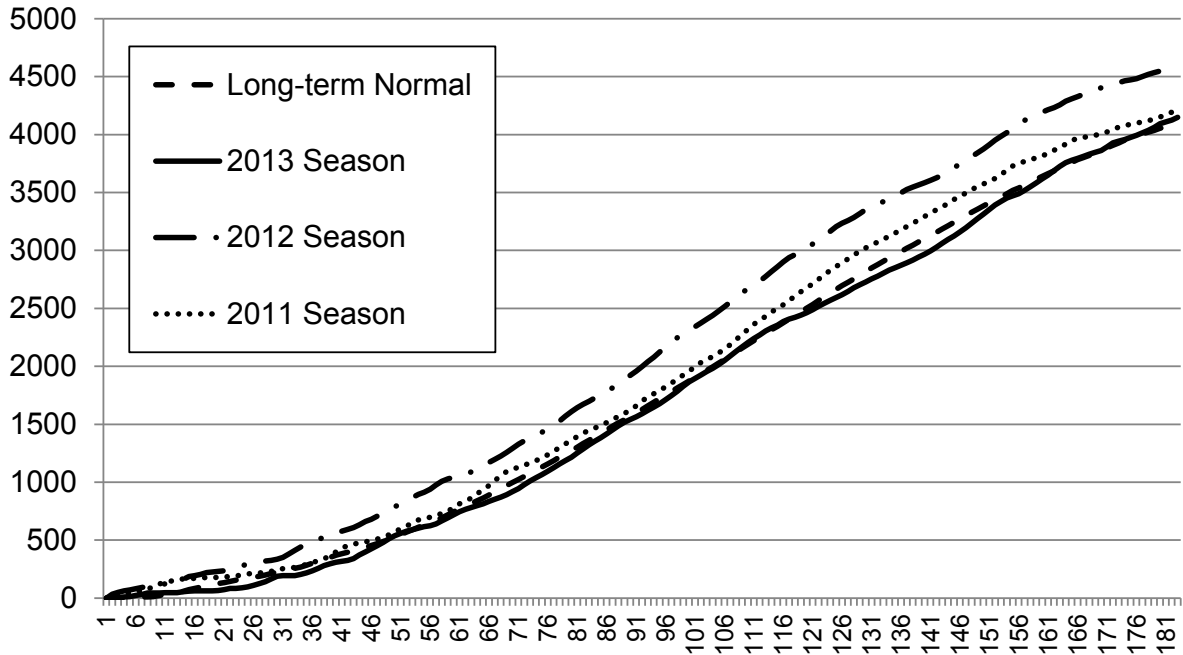
In new seedings, the most favorable economic response to fungicide applications was to apply ahead of second crop, rather than ahead of first crop. However, in our trials we only found a small, inconsistent economic advantage when treating ahead second crop. There may not be much buildup of disease inoculum in the seeding year of the stand to justify a fungicide application.

It is reasonable to assume that if foliar fungicide applications reduce disease infestations and improve leaf retention, they should result in higher forage quality at harvest. However, forage quality analysis from our trials do not support this, even though leaf disease assessments and visual observations provide evidence of less disease and better leaf retention (Figure 3). We have also observed taller growth from plots treated with foliar fungicides. From a forage quality perspective, it may be that the greater leaf retention is offset by the taller growth maintaining a similar leaf to stem ratio and thus similar forage quality compared to the untreated forage.

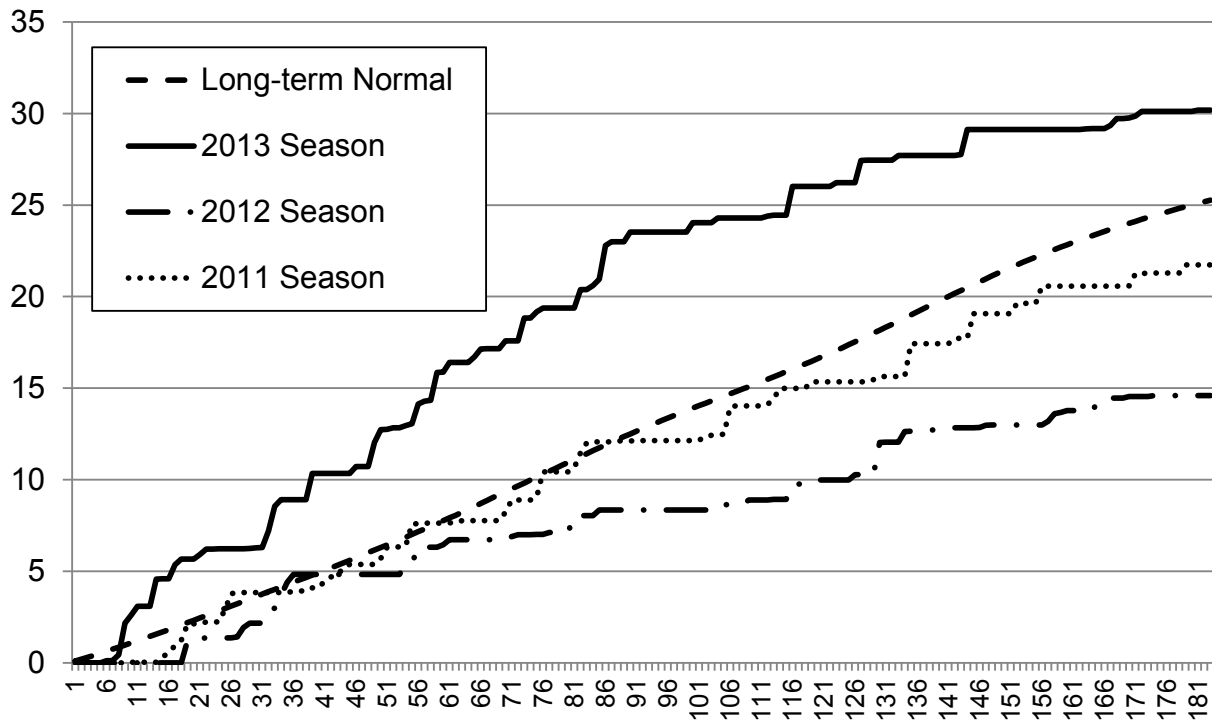
Research with foliar fungicides on alfalfa will continue in 2014 at the ISU Northeast Research Farm, Nashua. Management factors regarding single, sequential, or alternating applications during the season, product rate, choice of products, applications of products in new seedings versus established stands, and varietal responses to fungicides all require additional research. This paper provides a starting point addressing some of these factors. In addition, many of those using or intending to use this technology would also benefit from a more complete understanding of proper stewardship of fungicide use in alfalfa production.

## Acknowledgements

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**Figure 1.** Accumulated alfalfa growing degree days (base 41°F) from April 1 (day 1) to September 30 (day 183) at the ISU Northeast Research Farm, Nashua.



**Figure 2.** Accumulated rainfall (inches) from April 1 (day 1) to September 30 (day 183) at the ISU Northeast Research Farm, Nashua.



**Figure 3.** The alfalfa shoots above were randomly collected from untreated and fungicide treated research plots. The shoots above the yardstick are from fungicide treated plots, and show more leaf retention and growth height than for the shoots below the yardstick collected from untreated control plots.