# ACS Farmer-Driven Research
# Syngenta Quadris + Warrior in Alfalfa
# Trial Results

**Final Report**
*January 13, 2014*

## Contents

## Summary

Crop production advances require tools that can help plants optimize the plant access to nutritional resources during development. Better plant health enables plants to reach genetic potential in multiple environmental conditions. In 2013 farm managers in New York were introduced to an alfalfa pest management program that claimed to improve crop performance by providing a fungicide and insecticide prior to and after first cutting of alfalfa during the growing season. Quadris is a foliar applied fungicide and Warrior is a foliar applied insecticide manufactured by Syngenta and available widely in New York by agricultural retailers. The combined tank mix of Quadris and Warrior has showed promise in company trials and is promoted as a treatment to improve overall plant health. Independent crop consultants from Agricultural Consulting Services (ACS) organized with Sunnyside Farms to collaboratively design and implement a fully replicated trial that would quantify the impact of Syngenta's products when applied on the 2013 alfalfa forage crop. The alfalfa plots treated with Quadris and Warrior in 2013 produced significantly higher yields at second cutting. The trend of higher yields from treated fields continued into third and fourth cuttings however the difference between the control and treated plots was not statistically significant. The second cutting treated plots also displayed significantly less crude protein levels than the untreated control plots.

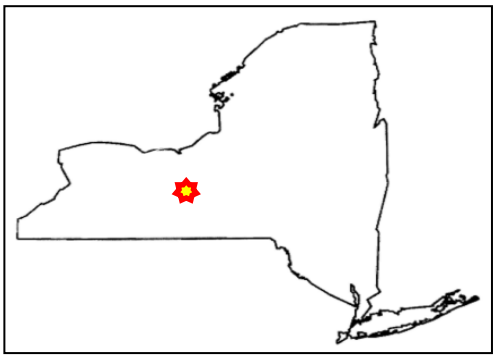

*Figure 1: product labeling from Syngenta*

## Introduction

Crop production advances require tools that can help plants optimize their access to resources under variable growing conditions. Crop production teams are introduced to new products and management techniques every year. Impartial research is hard to find and managers are faced with making a decision to invest in the product based on company trial reports or trial and error or simple check-strip comparison trials. Recent adoption of precision monitoring equipment in agriculture has reduced the cost of implementing statistically sound, replicated research at a field scale. With applications of material being done by Jim Saik of Finger Lakes Agronomics and ACS doing the data collection Sunnyside Farms decided to conduct their own research trials after being introduced to the potential benefits of the Quadris + Warrior tank mix. The Syngenta recommended timings for application of this tank mix in alfalfa are at spring green up (alfalfa coming out of dormancy) and another application to the growing alfalfa plant seven days after cutting or about 6" of re growth. Quadris is marketed as a broad spectrum, preventative fungicide with systemic and curative properties for the control of many important plant diseases. Warrior with Zeon Technology is marketed as a highly active pyrethroid that controls a very broad spectrum of insects. This report compiles the results of Syngenta's two products Quadris and Warrior used in a single tank mix and applied to alfalfa test plots at Sunnyside Farms during the 2013 growing season.

*Figure 2: picture at second cutting showing treated plot right and untreated at left.*

## Materials and Methods



**Research plot location**

The 2013 Syngenta alfalfa trials were led by Sunnyside Farms located in Genoa New York. The plots were planted in Southern Cayuga County in the Town of Venice.

**Treatments on Alfalfa**

For investigating the use of Quadris and Warrior on alfalfa, the research program was designed to identify a response to the products on alfalfa yields and alfalfa forage quality. The tank mix to be applied was recommended by John Bulkley of Syngetna and applied by Jim Saik of Finger Lakes Agronomics. The control treatment consisted of no treatment of fungicides or pesticides.

The 2013 trials on alfalfa forage investigated two treatments; (1) Treated field with 8 oz. Quadris and 3 oz. Warrior seven days following alfalfa harvest or 6" of re growth, applied with a commercial spray rig (2) In the control was no treatment applied but the spray rig was driven through the plots. Two applications of the tank mix were made on the treated fields during the growing season. ACS staff was onsite for every application of material during the project to ensure materials were applied as planned.

There were a planned 12 replications of each treatment for a total of 24 test plots in the research trial. While making the first application of material on June 9$^{th}$ it was clear there wasn't enough room in the field for plots 23 & 24. Of the remaining 22 plots, 13 control plots and 9 treated plots were hand harvested at second cutting and for third and fourth cuttings there were 10 control plots and 7 treated fields. The whole field is a 72 acre, third year alfalfa/grass with greater than 90% alfalfa composition in the stand.

Due to a shortage of available spray rigs to make a material application on alfalfa emerging from dormancy this application had to be delayed until after first cutting. Other demands on ag retailers resources including fertilizer and herbicide applications during this early spring time period would not allow for material applications as planned for this research.

During the first application (following first cutting) the spray rig ran out of material before the last treated field could be sprayed and during the second application (after second cutting) of material a treated field was skipped and a control strip was inadvertently sprayed. These errors were known during the research and documented in the data collection and plots with errors were eliminated from the data points.

At harvest hand sampling was completed within each plot at three random locations and initial weights were recorded. Samples were dried and re measured coming out of the oven as the dry weight. A combined grab sample was pulled from each plot and sent to Dairy One in Ithaca, NY for forage analysis.

(1) **Treated –**8 oz. Quadris and 3 oz. Warrior.
(2) **Control –** No treatment but rig drove through plots.

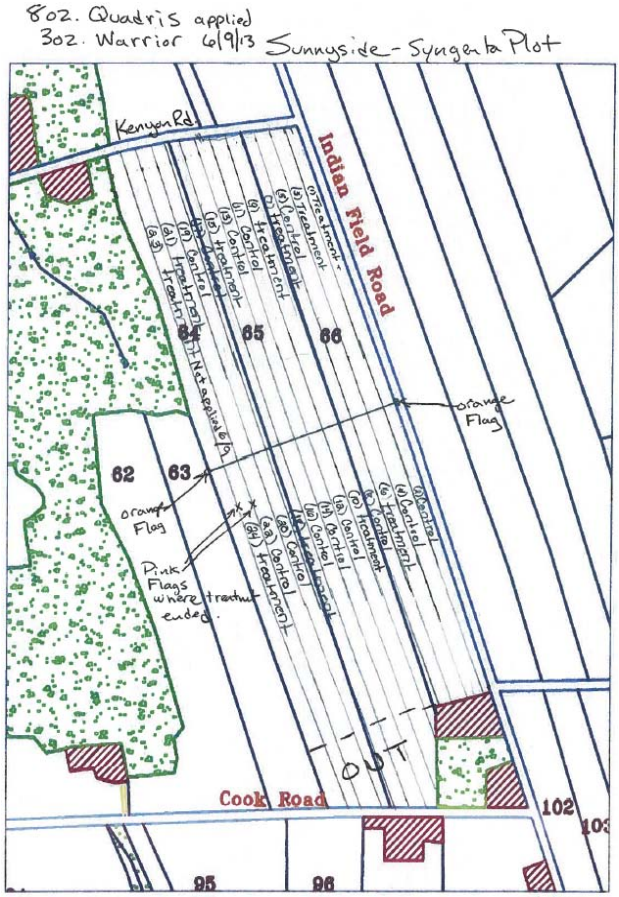



*Figure 3: Test plot layouts*


*Figure 4: Soil types underlying test plot field*

**Field characteristics for alfalfa plots**

Sunnyside's Kenyon Road plot covered deep well-drained Honeoye soils (HnB) with strong associations with less well-drained Lima soils (LtA) in the Northeastern plots (Figure 4).

**Weather Conditions and Implications**

The 2013 season was characterized by extremely high rainfall throughout the season (Figure 5). The above-average rainfall made caused flooding of corn fields and delays in the timely cutting of alfalfa fields. Powdery mildew was observed in the control plots during the hand harvesting of second cutting on July 2nd (Figure 6)

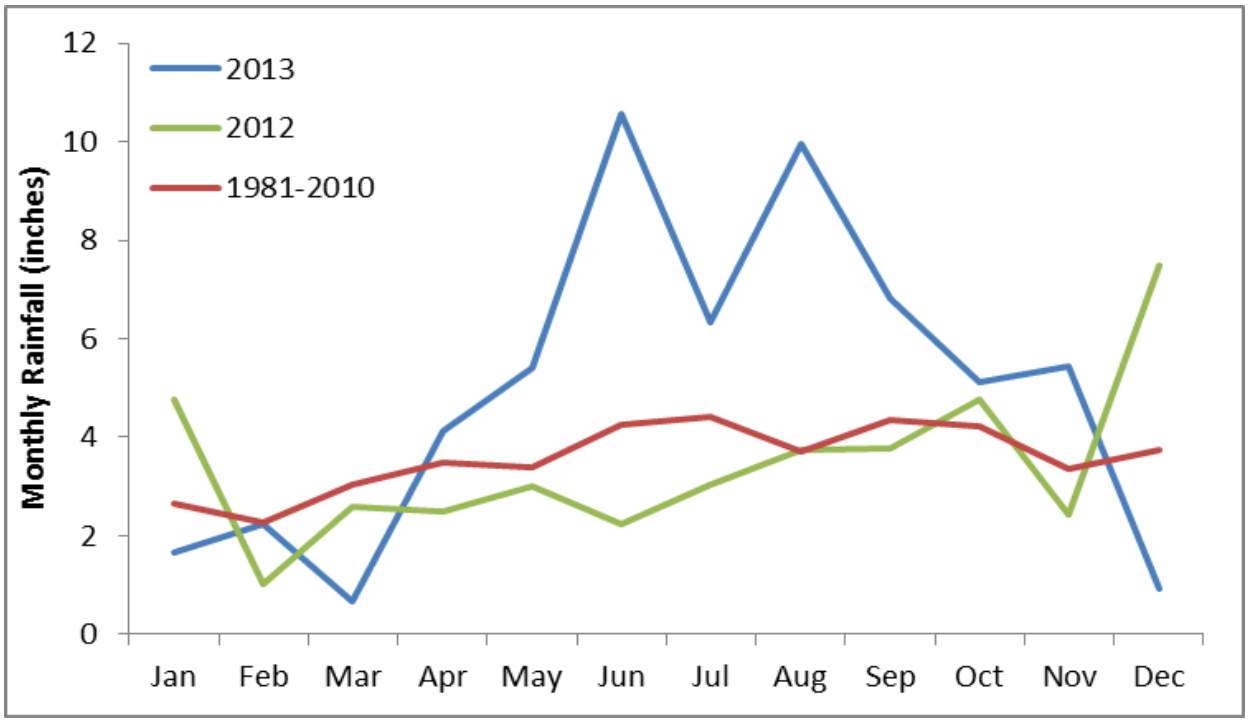



*Figure 5: Rainfall for the 2013 season was characterized by frequent high intensity rain events that accumulated more than average rainfall amounts.*

**Plot Measurements**

Plots were hand harvested as close to the date the farmer planned to make a cutting. ACS was responsible for the hand harvest of test plots, plot wet and dry weights and submitting forage analysis to Dairy One in Ithaca, NY.

Forage quality was measured based on one gallon grab samples of silage taken from the plots after their dry weights were recorded. Each forage sample was analyzed by Dairy One for a basic forage sample which included percent moisture, crude protein (CP), acid detergent fiber, neutral detergent fiber (NDF), phosphorus (P), Potassium (K), $IVTD_{24hrs}$, and $NDFD_{30hrs}$ digestibility. These parameters were used to indicate forage quality.

All plots were measured for each parameter and analyzed for statistical differences by Cornell University Statistical Consulting Unit. A mixed model was used for analysis with 'field' and 'treatment' as fixed effects and 'block-within-field' as a random effect.

*Figure 6: Powdery mildew in alfalfa seen at second cutting.*

**On-Farm Field Day**

A field day was conducted in September to demonstrate to farms how the research was being conducted and to raise awareness about the research and the project. The Quadris + Warrior program from Syngenta was discussed and the field day provided an opportunity to share experiences and information among farm management teams on all aspects of on-farm research in general. Preliminary results from the Syngenta test plot work was presented at this meeting.

*Figure 7: Alfalfa foliar applied field day.*

## Results & Discussion

**Yield analysis 2013**

Yield was measured across 22 plots at second cutting and at 17 plots for third and fourth cuttings. The alfalfa plots treated with Quadris and Warrior had significantly higher yields at second cutting of 1.66 dry tons of alfalfa compared to the 1.34 dry tons per acre in the control (Figures 8 & 9). Not statistically significant, but this trend does continue into third and fourth cuttings with the control plots yielding a combined 2.66 dry tons per acre while the treated plots yielded 2.79 dry tons per acre. When all plots were averaged individually over the three cuttings the control yielded 4.0 dry tons per acre and the treated plots yielded 4.4 dry tons per acre (Figure 10 & 11).

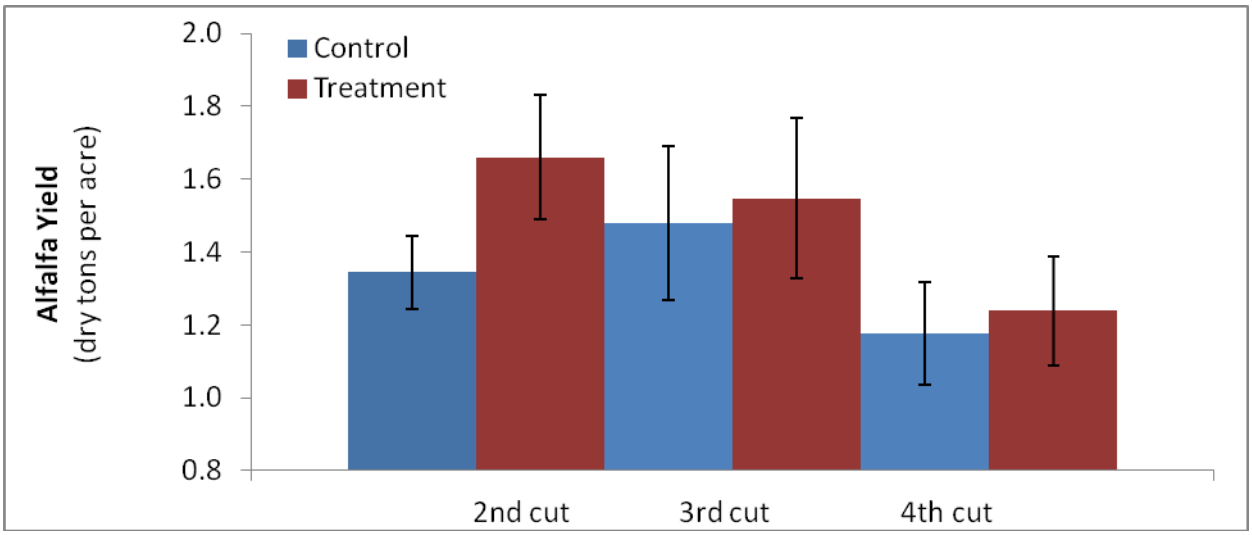



*Figure 8: Average yield per acre by cuttings.*

| | Cut | Average | Standard Deviation | Population |
|---|---|---|---|---|
| **Control** | 2 | 1.34 | 0.10 | n=13 |
| **Treatment** | 2 | 1.66 | 0.17 | n=9 |
| **Control** | 3 | 1.48 | 0.21 | n=10 |
| **Treatment** | 3 | 1.55 | 0.22 | n=7 |
| **Control** | 4 | 1.18 | 0.14 | n=10 |
| **Treatment** | 4 | 1.24 | 0.15 | n=7 |

*Figure 9: Average yield per acre by cuttings.*

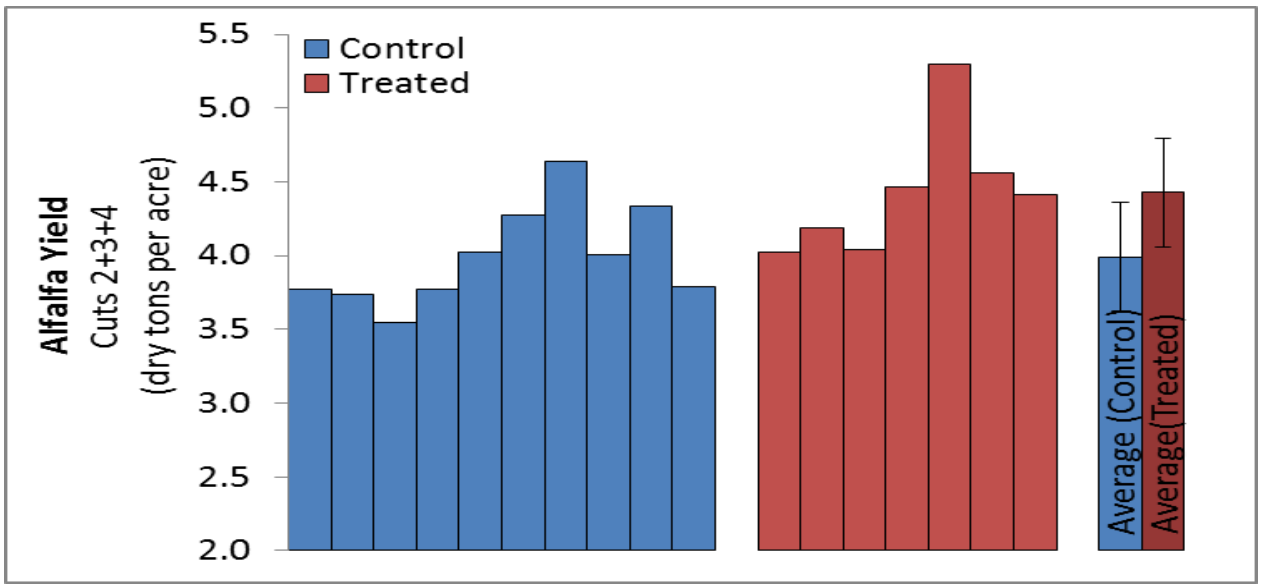



*Figure 10: Total yield for the cuttings that were measured.*

| Control | | Treated | |
|---|---|---|---|
| Plot | Yield Cut 2+3+4 (dry tons per acre) | Plot | Yield Cut 2+3+4 (dry tons per acre) |
| 2 | 3.8 | 1 | 4.0 |
| 4 | 3.5 | 3 | 4.2 |
| 5 | 3.8 | 6 | 4.0 |
| 8 | 4.0 | 7 | 4.5 |
| 11 | 4.3 | 9 | 5.3 |
| 12 | 4.6 | 10 | 4.6 |
| 13 | 4.0 | 21 | 4.4 |
| 14 | 4.3 | | |
| 17 | 3.8 | | |
| 20 | 3.7 | | |
| | | | |
| **Average** | 4.0 | | 4.4 |
| Standard Deviation | 0.34 | | 0.44 |

*Figure 11: Total yield for the cuttings that were measured.*

**Forage Quality – 2013 Analysis**

Each forage sample was analyzed by Dairy One for 8 qualities which included percent moisture, crude protein (CP), acid detergent fiber, neutral detergent fiber (NDF), phosphorus (P), Potassium (K), Relative Feed Value, $IVTD_{24hrs}$, $NDFD_{30hrs}$ digestibility. The second cutting treated plots displayed significantly less crude protein levels than the control plots (Figure 12). By third and fourth cuttings of alfalfa crude protein levels were trending higher in treated fields but the differences in the forage quality values were not significant (Figure 14). Other measures of forage quality NDF, $IVTD_{30hrs}$ were marginally impacted by the Quadris + Warrior as seen in second cutting (Figure 15 &16).

**Crude Protein graphs provided by Cornell Statistical Consulting Unit**

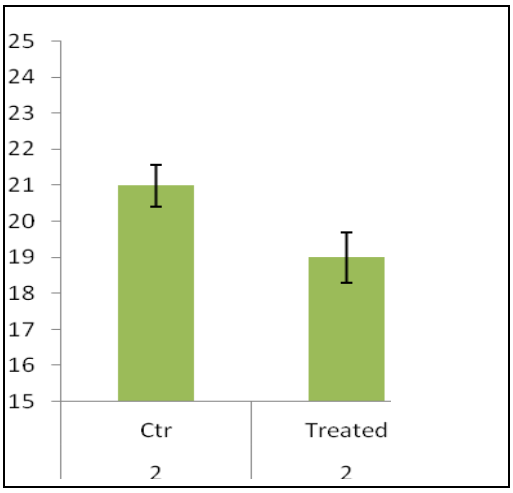



*Figure 12: Crude Protein (CP) at second cutting*

| Cutting | Treatment | Mean | StdDev |
|---|---|---|---|
| 2 | Ctr | 20.9 | 2.3 |
| 2 | Treated | 19.0 | 1.8 |
| 3 | Ctr | 20.0 | 2.0 |
| 3 | Treated | 21.4 | 2.3 |
| 4 | Ctr | 22.9 | 1.3 |
| 4 | Treated | 23.9 | 1.4 |

*Figure 13: Crude Protein (CP) levels at all cuttings*

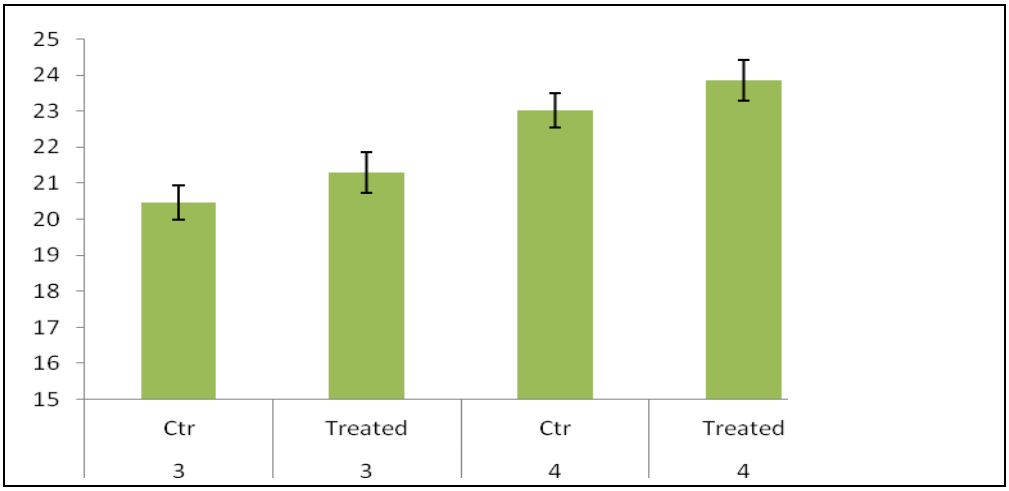



*Figure 14: Crude Protein (CP) levels in third and fourth cuttings*

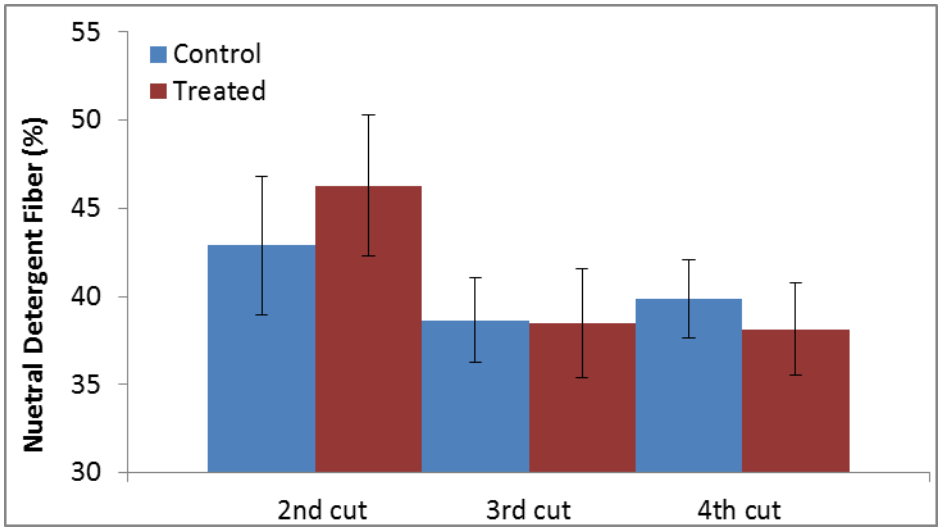



*Figure 15: Nuetral Detergent Fiber (NDF) over three cuttings*

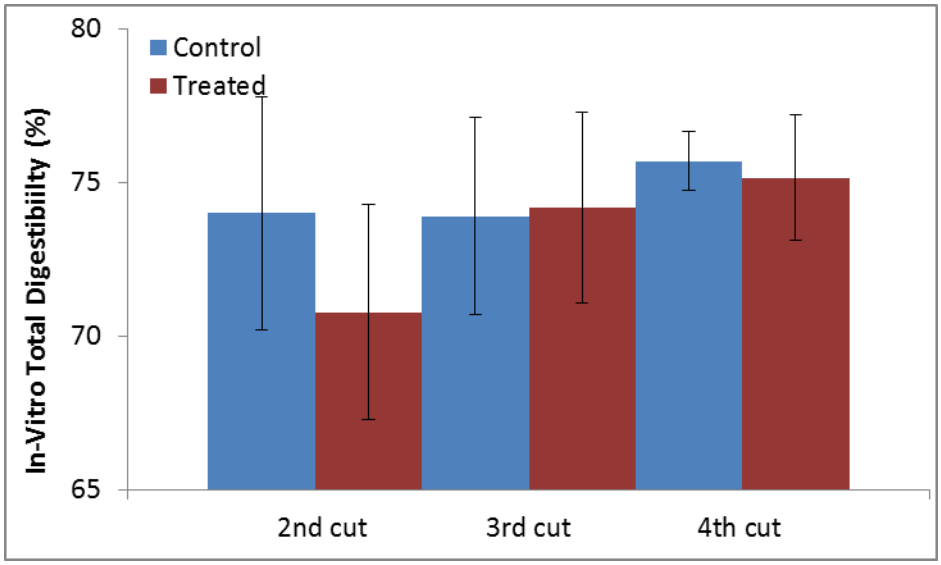



*Figure 16: In-Vitro Total Digestibility (IVTD) over three cuttings*

| Plot | Cutting | Treatment 1 | Treatment 2 | Yield (t/a) | Crude Protein | Acid Detergent Fiber | Neutral Detergent Fiber | Phosp-horus % | Potas-sium | Relative Feed Value | IVTD 30hr | NDFD 30hr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | Treated | Treated | 1.4 | 25.5 | 28.7 | 34.2 | 0.42 | 3 | 181 | 78 | 37 |
| 2 | 3 | control | control | 1.2 | 23.3 | 30.2 | 35.7 | 0.35 | 2.17 | 170 | 77 | 37 |
| 3 | 3 | treated | treated | 1.3 | 24.3 | 29.6 | 35 | 0.39 | 2.78 | 175 | 78 | 38 |
| 4 | 3 | control | control | 1.2 | 19.7 | 32.8 | 38.1 | 0.36 | 2.65 | 155 | 75 | 35 |
| 5 | 3 | control | control | 1.5 | 20.9 | 32.6 | 37.6 | 0.32 | 2.5 | 157 | 74 | 30 |
| 6 | 3 | Treated | Treated | 1.3 | 21.5 | 34.4 | 41.2 | 0.28 | 2.5 | 140 | 71 | 31 |
| 7 | 3 | treated | treated | 1.6 | 20.8 | 33.3 | 39.6 | 0.33 | 2.41 | 148 | 73 | 32 |
| 8 | 3 | control | control | 1.3 | 20.5 | 33 | 37.2 | 0.34 | 2.89 | 158 | 75 | 32 |
| 9 | 3 | treated | treated | 1.9 | 21.7 | 33.8 | 40.6 | 0.33 | 3.06 | 144 | 73 | 34 |
| 10 | 3 | Treated | Treated | 1.5 | 18.8 | 36.1 | 40.7 | 0.37 | 3.29 | 139 | 71 | 28 |
| 11 | 3 | control | control | 1.5 | 21.3 | 33.7 | 38.7 | 0.36 | 2.88 | 151 | 74 | 32 |
| 12 | 3 | control | control | 1.8 | 18.8 | 36.6 | 40.8 | 0.3 | 2.49 | 138 | 70 | 27 |
| 13 | 3 | control | control | 1.5 | 18.6 | 37 | 42.2 | 0.35 | 3.08 | 132 | 71 | 30 |
| 14 | 3 | control | control | 1.7 | 18.5 | 35.4 | 39.4 | 0.33 | 3.05 | 145 | 72 | 29 |
| 15 | 3 | Treated | control | 1.5 | 18.9 | 37.5 | 42.5 | 0.38 | 3.3 | 131 | 69 | 27 |
| 16 | 3 | control | Treated | 1.6 | 20.5 | 33 | 37.9 | 0.34 | 2.64 | 155 | 74 | 31 |
| 17 | 3 | control | control | 1.3 | 21.3 | 32.8 | 37.5 | 0.35 | 2.6 | 157 | 76 | 35 |
| 18 | 3 | Treated | control | 1.5 | 21.6 | 30.4 | 36.6 | 0.36 | 2.97 | 166 | 83 | 53 |
| 19 | 3 | control | Treated | 1.5 | 21.5 | 34.2 | 38.9 | 0.28 | 2.96 | 149 | 76 | 37 |
| 20 | 3 | control | control | 1.6 | 20.4 | 28.7 | 35.3 | 0.36 | 2.67 | 175 | 80 | 44 |
| 21 | 3 | Treated | Treated | 1.8 | 19.1 | 35.7 | 40.4 | 0.32 | 2.74 | 141 | 72 | 30 |
| 22 | 3 | control | Treated | 1.6 | 19.9 | 34.3 | 39.3 | 0.31 | 2.22 | 147 | 73 | 31 |
| 1 | 2 | Treated |  | 1.5 | 18.4 | 38 | 48.9 | 0.34 | 2.65 | 113 | 67 | 33 |
| 2 | 2 | control |  | 1.3 | 25.1 | 28.4 | 36.9 | 0.4 | 3.1 | 169 | 80 | 46 |
| 3 | 2 | treated |  | 1.6 | 16.6 | 41.4 | 52.2 | 0.3 | 2.38 | 101 | 64 | 30 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 2 | control | | 1.3 | 20.3 | 34.7 | 41.5 | 0.38 | 2.47 | 139 | 72 | 34 |
| 5 | 2 | control | | 1.2 | 22.4 | 31.9 | 41.5 | 0.43 | 2.59 | 143 | 75 | 39 |
| 6 | 2 | Treated | | 1.7 | 19.8 | 37.4 | 43 | 0.38 | 3.17 | 129 | 70 | 30 |
| 7 | 2 | treated | | 1.7 | 20.3 | 37.2 | 42.7 | 0.39 | 3.16 | 131 | 72 | 34 |
| 8 | 2 | control | | 1.4 | 18.8 | 38.3 | 46.5 | 0.33 | 2.94 | 118 | 71 | 38 |
| 9 | 2 | treated | | 1.9 | 22.2 | 32.7 | 40.1 | 0.42 | 2.68 | 147 | 75 | 37 |
| 10 | 2 | Treated | | 1.7 | 19.3 | 37.4 | 45.2 | 0.4 | 3.23 | 123 | 71 | 37 |
| 11 | 2 | control | | 1.5 | 18.1 | 39.5 | 48.4 | 0.33 | 2.95 | 112 | 67 | 32 |
| 12 | 2 | control | | 1.5 | 20.1 | 37.4 | 44.4 | 0.4 | 2.85 | 125 | 71 | 35 |
| 13 | 2 | control | | 1.2 | 24.1 | 29.4 | 37.5 | 0.45 | 3.24 | 164 | 79 | 43 |
| 14 | 2 | control | | 1.4 | 17.5 | 40.7 | 49.2 | 0.35 | 2.95 | 108 | 70 | 38 |
| 15 | 2 | Treated | | 1.6 | 16.7 | 41.8 | 49.6 | 0.28 | 2.66 | 106 | 72 | 44 |
| 16 | 2 | control | | 1.4 | 21 | 35.7 | 43.9 | 0.37 | 2.84 | 129 | 75 | 43 |
| 17 | 2 | control | | 1.3 | 20.9 | 35.5 | 44.4 | 0.37 | 2.84 | 128 | 75 | 43 |
| 18 | 2 | Treated | | 1.9 | 19.9 | 36.5 | 49.5 | 0.34 | 3.13 | 114 | 75 | 49 |
| 19 | 2 | control | | 1.4 | 19.7 | 37.9 | 43.5 | 0.29 | 2.82 | 127 | 73 | 37 |
| 20 | 2 | control | | 1.2 | 23.2 | 30.8 | 38.8 | 0.41 | 3.03 | 156 | 77 | 40 |
| 21 | 2 | Treated | | 1.4 | 17.8 | 39.3 | 45.5 | 0.32 | 3.18 | 119 | 71 | 37 |
| 22 | 2 | control | | 1.3 | 21.7 | 33.7 | 41.1 | 0.36 | 2.78 | 142 | 77 | 44 |
| 1 | 4 | Treated | Treated | 1.1 | 23 | 34.8 | 38.7 | 0.33 | 3.25 | 149 | 74 | 34 |
| 2 | 4 | control | control | 1.2 | 24.6 | 33.8 | 39.2 | 0.31 | 2.85 | 148 | 77 | 41 |
| 3 | 4 | treated | treated | 1.3 | 24.7 | 32 | 37.8 | 0.32 | 2.32 | 157 | 74 | 31 |
| 4 | 4 | control | control | 1.0 | 24.7 | 33.4 | 38.6 | 0.3 | 3.09 | 152 | 77 | 40 |
| 5 | 4 | control | control | 1.0 | 25.5 | 30.3 | 35.5 | 0.32 | 2.28 | 171 | 76 | 33 |
| 6 | 4 | Treated | Treated | 1.0 | 25.1 | 30.9 | 36.4 | 0.29 | 3.04 | 166 | 78 | 39 |
| 7 | 4 | treated | treated | 1.2 | 25.3 | 30.2 | 34.6 | 0.32 | 2.7 | 176 | 75 | 28 |
| 8 | 4 | control | control | 1.3 | 23.6 | 35.6 | 39.8 | 0.29 | 3.06 | 143 | 76 | 38 |
| 9 | 4 | treated | treated | 1.5 | 25.6 | 32.2 | 38.3 | 0.34 | 2.94 | 155 | 76 | 37 |
| 10 | 4 | Treated | Treated | 1.4 | 21.5 | 36.7 | 43.1 | 0.29 | 3.1 | 130 | 72 | 36 |
| 11 | 4 | control | control | 1.3 | 23 | 33.2 | 39 | 0.33 | 3.18 | 151 | 75 | 37 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 4 | control | control | 1.3 | 22.8 | 31.7 | 38.8 | 0.26 | 2.74 | 154 | 76 | 39 |
| 13 | 4 | control | control | 1.3 | 22.6 | 34.8 | 42.2 | 0.29 | 3.42 | 136 | 76 | 43 |
| 14 | 4 | control | control | 1.3 | 22.4 | 34.1 | 42.6 | 0.29 | 3.06 | 136 | 74 | 40 |
| 15 | 4 | Treated | control | 1.4 | 22.6 | 35.6 | 41 | 0.29 | 3.16 | 139 | 76 | 41 |
| 16 | 4 | control | Treated | 1.3 | 22.6 | 32.6 | 39.7 | 0.27 | 2.94 | 149 | 77 | 41 |
| 17 | 4 | control | control | 1.2 | 20.8 | 35.1 | 41.9 | 0.25 | 2.53 | 137 | 75 | 39 |
| 18 | 4 | Treated | control | 1.2 | 23.6 | 31.3 | 38.7 | 0.28 | 2.9 | 155 | 76 | 39 |
| 19 | 4 | control | Treated | 1.3 | 21.9 | 32 | 40.9 | 0.27 | 2.84 | 146 | 76 | 41 |
| 20 | 4 | control | control | 0.9 | 22.6 | 32.2 | 41.2 | 0.29 | 2.82 | 144 | 75 | 40 |
| 21 | 4 | Treated | Treated | 1.2 | 23.9 | 32.9 | 38.1 | 0.28 | 2.89 | 154 | 77 | 41 |
| 22 | 4 | control | Treated | 1.3 | 21.5 | 35.9 | 45.7 | 0.3 | 3.1 | 124 | 73 | 41 |

## Preliminary Conclusions

- The Syngenta 2013 Quadris + Warrior Farmer Driven Research results for alfalfa in Central New York did show statistically significant increases in yield for second cutting.
- Although not significant findings, there is a visible trend of increased alfalfa yields that continued for third and fourth cuttings.
- The Quadris + Warrior treated plots showed a statistically significant negative impact on crude protein levels in the alfalfa forage at second cutting.
- By third and fourth cuttings treated fields had no significant impacts on crude protein or other forage quality variables.
- Agronomic research standards are 3 years of research in yield trials. At least two more years of research is needed in alfalfa to draw final conclusion about the impact of the Quadris + Warrior as a foliar treatment for alfalfa fields in New York.
- Where a farm doesn't own their own spray equipment and is dependent on a local ag retailer to make material applications on alfalfa during the growing season it may be difficult to find a spray rig available to make treatments as directed by Syngenta.

## Future Work

Additional work in alfalfa would follow the same protocol as used in 2013.

Summary of requirements a farm would need to participate in the 2014 Farmer Driven Research plots:

- An eagerness to participate in farmer-driven research to explore improved crop yields and forage quality.
- A commitment to getting the best data possible from the research trials put on the farm.
- A commitment to communicating with ACS research managers and farm personnel to gather good results from the research.
- Access to a spray rig to get Syngenta tank mix applied.