Evaluating Twin Row Corn Silage Production 2010-2013

Midwest Forage Association (MFA) – Midwest Forage Research Proposal (MFRP) Report

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Rationale for the Project

Corn silage production is a major part of any successful forage operation in Wisconsin. As the #1 producing corn silage state in the nation, farmers are constantly looking for ways to increase silage yield and quality. In Outagamie County alone, more than 1/3 (35.0%) of the 74,300 acres planted to corn in 2014 were harvested as silage. Wisconsin leads the nation in corn silage production with an average of 910,000 acres harvested during the 2014 and 2015 growing seasons. The total amount of silage harvested annually in the state averaged 17,320,000 tons during this two-year span. This resulted in an on-farm yield of 19.0 tons per acre. (National Agricultural Statistics Service, NASS). In an effort to increase yield, row spacing and population are two management factors that may directly affect forage yield and quality. This Midwest Forage Research Proposal (MFRP) submitted on behalf of the Outagamie Forage Council (OFC) addressed the following questions…Does twin row corn silage production provide greater returns than traditional single 30-inch rows in Wisconsin? At what population is the greatest return per acre achieved? Milk per Ton and Milk per Acre were used to determine which row spacing method and population producers can expect to see the greatest returns.

Over the past 20 years, row spacing for corn has changed from 38-inch to 30-inch and now to something narrower. A more recent development has been the sale of planters with “30-inch twin” rows (two rows 8 inches apart on 30-inch centers). As rows become narrower, other equipment modifications often need to be considered. However, in the case with twin rows, producers do not have to change their harvest equipment. Traditional 30-inch row heads can be used to harvest twin rows. Proponents of twin rows claim narrow row yield benefits with minimal or no equipment modification. Popular press articles found in agricultural media have producer testimonials indicating as much as a 25-28% yield increases using twin row planting.
Evaluating the Results from 2010-2013

During the course of this project, we observed corn grain prices increase substantially from a little more than $5.00 per bushel in 2010 to almost $7.00 in 2013. As a result, corn silage prices increased substantially as well, with multiple producers reporting selling high quality corn silage for $45 per wet ton in 2010 to as much as $80 per wet ton in 2013. Recently, prices have been more modest with markets reflecting a cash price closer to $3.50 bushel and silage at $35-$45/ton. While prices have returned to lower levels, corn silage continues to be an important economic crop in Wisconsin and anywhere the dairy industry is thriving. Because producers need to be able to get comparable value from their silage acres as their corn grain acres, he/she must do everything in their ability to get the greatest return per acre. Row spacing and population are two of those variables that seem to receive a great amount of attention from farmers and the popular press. This project examined the effects of row spacing and plant population in the East Central part of the state of Wisconsin, which harvests a much greater percentage (39.6%) of its corn as forage/silage than the rest of the state as a whole at 24.4% (NASS).

Wayne Posbrig – Rose Lawn (Shawano County) hosted the first twin row corn demonstration plot in 2010. The initial results indicated that based on yield harvested from that site in the 40,000 twin row treatments, that there may be the potential to demonstrate some significant differences in dry matter yield. The Outagamie Forage Council covered the costs associated with planting, harvesting, and testing this plot. From 2011-2013 the Midwest Forage Association (MFA) helped fund a local forage research proposal in partnership with the Outagamie County Forage Council that evaluated twin rows versus single rows in an effort to determine if there were indeed yield or quality differences in corn silage grown in twin rows as opposed to single rows. Four farms hosted twin row corn silage research plots in 2011, with three sites being harvested successfully. In 2012, two farms participated; however, due to the impacts of the drought, we were only able to collect data from one location. In 2013, two sites were planted and harvested. In this project we not only were comparing single rows to twin rows, but, we also tried to answer the question that all producers often ask – “What population should I be planting my corn at?”

The trial examined 30,000; 35,000; and 40,000 planting populations in both twin rows and single rows from 2010-2013. Plots were harvested, weighed, and samples collected for each replication. Dry matter (DM) yields were determined and Milk per Ton (MPT) values calculated using Neutral Detergent Fiber Digestibility (NDFd). The results were interesting and illustrate the importance of multiple replications and multiple sites over multiple years (and growing conditions). Once the field data was collected, a statistical analysis on each of the individual sites evaluating the impact of Row Spacing – RS (twin vs. single), Plant Density – PD (30,000, 35,000, and 40,000) and the combined interaction of the two factors PD X RS on the final results. The analysis also included a summary of the seven combined sites. Means were separated using Least Significant Difference (LSD) at 0.10 probability level. The following information was derived from Table 4. Plant Density and Row Spacing Effects on Corn Silage Yield and Quality (Means over all locations, 2010-2013).

| Table 1. Row Spacing (RS) Means Combined Across All Environments 2010-2013 |
|-----------------------------|------------------|------------------|------------------|
| Row Spacing (RS) Single vs. Twin | DM Yields – Tons per acre | Mean MPT- lbs milk /T | Mean MPA - lbs milk /A |
| Single 30-inch             | 7.4              | 3,118            | 23,093           |
| Twin 30 -inch             | 7.3              | 3,122            | 22,945           |
Table 2. Plant Density (PD) Means Combined Across All Environments 2010-2013

<table>
<thead>
<tr>
<th>Target Plant Density - Plants per Acre</th>
<th>DM Yields – Tons per acre</th>
<th>Mean MPT - lbs milk /T</th>
<th>Mean MPA - lbs milk /A</th>
</tr>
</thead>
<tbody>
<tr>
<td>30,000</td>
<td>7.1</td>
<td>3,185</td>
<td>22,610</td>
</tr>
<tr>
<td>35,000</td>
<td>7.5</td>
<td>3,112</td>
<td>23,293</td>
</tr>
<tr>
<td>40,000</td>
<td>7.5</td>
<td>3,063</td>
<td>23,153</td>
</tr>
</tbody>
</table>

Table 3. Plant Density (PD) X Row Spacing (RS) Means Combined Across All Environments 2010-2013

<table>
<thead>
<tr>
<th>RS (Single or Twin) and PD (30, 35, and 40,000 plants per acre)</th>
<th>DM Yields – Tons per acre</th>
<th>Mean MPT - lbs milk /T</th>
<th>Mean MPA - lbs milk /A</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-inch Single Rows 30,000 Planting Rate</td>
<td>7.2</td>
<td>3,182</td>
<td>22,983</td>
</tr>
<tr>
<td>30-inch Single Rows 35,000 Planting Rate</td>
<td>7.5</td>
<td>3,132</td>
<td>23,693</td>
</tr>
<tr>
<td>30-inch Single Rows 40,000 Planting Rate</td>
<td>7.4</td>
<td>3,039</td>
<td>22,602</td>
</tr>
<tr>
<td>30-inch Twin Rows 30,000 Planting Rate</td>
<td>6.9</td>
<td>3,188</td>
<td>22,237</td>
</tr>
<tr>
<td>30-inch Twin Rows 35,000 Planting Rate</td>
<td>7.4</td>
<td>3,091</td>
<td>22,893</td>
</tr>
<tr>
<td>30-inch Twin Rows 40,000 Planting Rate</td>
<td>7.6</td>
<td>3,087</td>
<td>23,704</td>
</tr>
</tbody>
</table>
The following objectives were identified to provide producers with an answer upon project completion. They included the following:

1) To determine whether or not twin rows increased yield over single 30-inch rows.

2) To determine if there was a quality difference between row spacing and plant density treatments. Planting rates of 30,000, 35,000, and 40,000 were evaluated. If there are differences, then we can calculate the cost of the additional seed used to determine whether or not the observed yield or quality increase was greater than the additional input cost (seed) required to achieve it.

3) The third objective was to share the findings with other area forage council members, not only those in the Outagamie Forage Council, but in the East Central region of Wisconsin, including the Midwest Forage Association Symposium/Annual Meeting.

Row Spacing (RS) – (Objective #1)
Using the mean/average over all seven locations, Row Spacing (RS) twin vs. single was statistically significant in only one category – Harvest Plant Density (plants per acre). The 30-inch twin row plantings resulted in 615 more plants per acre at harvest than the same planting population rate for the 30-inch single rows. While this did prove to be a statistically significant difference, it may not be biologically significant enough to have an impact on final yield.

Row Spacing did not have a significant impact on the following: Dry Matter (DM) yield, Moisture (at harvest), Crude Protein (CP), Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF), \textit{In vitro} Digestibility, Starch, NDFD, MPT, and MPA.

Plant Density (PD) – (Objective #2)
Plant Density (PD), did not statistically impact Moisture, ADF, NDF, Starch, NDFD or MPA, but it did prove to have an influence on other measurements. Averaged over seven sites, the 35,000 (7.5 tons) and 40,000 (7.5 tons) planting populations were 0.4 tons DM higher in yield than the 30,000 (7.1 tons) planting population. Dry Matter yield was not the only measurement impacted by field plant populations.

Lower populations often result in improved quality. The 30,000 planting population had greater CP (7.9) than both the 35,000 (7.7%) and 40,000 (7.6%). For \textit{in vitro} digestibility, the 30,000 planting population proved to be statistically higher (81.1%) than either the 35,000 (80.1%) or 40,000 (79.8%) planting rates. For MPT, the 30,000 planting population was statistically higher (3,185 lbs milk/T) than both the 35,000 planting population (3,112 lbs milk/T) and the 40,000 planting population (3,063 lbs milk/T). The higher MPT means observed with the lower planting populations suggest producers consider the yield and quality trade-off between MPT and MPA.

PD X RS – (Objective #2)
Few PD X RS interactions were detected for forage yield and quality measurements.

In summary, RS has very little effect on corn silage yield and quality, while PD was often a significant factor in corn silage yield and quality.
Sharing Findings with Other Forage Council Members and Producers – (Objective #3)

This research information was shared at two MFA Affiliates in February, 2013. First at the Chippewa Valley Forage Council Seminar & Annual Meeting and then the Central Wisconsin Forage Council (CWC) Educational & Annual Meeting. A full evaluation of the participants knowledge of the impact of Row Spacing (RS) and Plant Density (PD) was given measuring attendees knowledge before the presentation, and then following. Participants identified a significant increase in their understanding of the impact that RS and PD have on overall corn silage yield and quality. More importantly, CWC Advisor, and Clark County Crops & Soils Agent, Richard Halopka followed up by indicating that “Kevin’s topic brought people in after the corn planter meeting in Longwood. One farmer commented that he was told he had to order the planter today for twin rows, after hearing Kevin’s presentation he thought he would consider a conventional planter or just continue using his. We had 29 people attend this year the best attendance since I’ve been in the county.” – Richard Halopka, 2-6-13 email communication to all speakers on the CWC Educational & Annual Meeting agenda.

The statewide Regional Corn Conferences provided me an opportunity to share the findings at the January 17, 2012 located in Seymour, Wisconsin.

In addition, this research was shared by Kevin Jarek with all of his statewide peers and colleagues at the Agriculture and Natural Resources Education (ANRE) State Conference in Madison in October 2013.

The results of this research effort have also been shared at events co-hosted with Fox Valley Technical College (FVTC) and the Farm Management Production staff has shared this information with their adult students.

The results of this project have also been published widely by the agricultural media including the Wisconsin State Farmer, Country Today, and more…

The Wisconsin Agriculturist published the results in their magazine in March 2012 at http://magissues.farmprogress.com/WSA/WSA03Mar12/wsa048.pdf

The American Agriculturist published results from this work as well in April 2012. Please visit http://magissues.farmprogress.com/AMA/AMA04Apr12/ama040.pdf to view the article.

Progressive Forage published the results of this study in the April 2013 Edition of their publication… please visit http://www.progressiveforage.com/forage-production/planting/evaluating-twin-row-corn-silage-production.

The results of this effort were also published internationally in the Progressive Dairyman, Canadian Issue in January 2014. While I was sent a clip sheet from the publisher thanking me for the contribution, I have not been able to locate a link to the article. I have the hard copy if there is ever any question.

Last but, not least, a white paper Evaluating Twin-Row Corn Silage Production (updated) which contains ALL of the individual site results statistically analyzed is available for any and all who are interested in the topic of twin-row corn silage production.
Budget Notes

In 2011, I underestimated the costs of testing samples by more than $500 (actually testing was in excess of $2,600) and the Outagamie County Forage Council picked up the difference between our MFRP allocation and the balance. In 2012, due to the fact that we had fewer sites harvested and a slightly lower cost per sample for testing, the total cost for testing came in at $1,808.40. As a result, we had approximately the same amount we were short in 2011, as a surplus in 2012 (approximately $500). Over the two years, it has been basically a zero balance…what has been allocated for testing for this particular project over the two years of 2011 and 2012 has been spent on that identified expense. In 2013 we worked out an arrangement with the Marshfield Soil and Forage Laboratory where they adjusted their rates to match the funding we received for the project. The Outagamie Forage Council has provided the difference between what was spent versus what was received due to the late filing of this report.

Final Thoughts

It should be noted that studies conducted by other companies/institutions have shown different results. However, the more extensive my literature review became when searching out additional sites, the more I found myself corroborating a conclusion reached by Dr. Joe Lauer, UW-Madison/UW-Extension Corn Agronomist back in 2007. In an interview, Dr. Lauer stated that his observations were that “half the time 30-inch rows will beat narrow or twin rows and the other half of the time twin or narrow rows will beat 30-inch rows”. After looking at this effort over multiple sites, over multiple years, I would tend to agree with him. If there was a way to sum up the observations of this particular study of twin rows based on the research conducted in East Central Wisconsin, it would maybe be best put this way… the use of twin rows was not observed to have a substantial impact on corn silage yield or quality, while there were individual replications where increases were observed, when multiple treatments and multiple locations were combined, consistent, statistically significant results demonstrating an increase in either silage yield or silage quality were not observed. It is important to note that planting corn silage in twin rows does not negatively impact silage yields or quality; we simply did not observe some of the double digit differences in East Central Wisconsin that have been cited in studies that have been conducted in other locations across the United States.

Acknowledgements

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