BIOAG PROJECT PROGRESS OR FINAL REPORT TEMPLATE

TITLE: USING THE BIOINTENSIVE TECHNIQUE OF INTERCROPPING TEFF (ERAGROSTIS TEF) INTO TIMOTHY TO IMPROVE THE ECONOMIC SUSTAINABILITY OF TIMOTHY

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KEY WORDS – TIMOTHY, TEFF, INTERCROPPING, FERTILITY, FORAGE QUALITY

ABSTRACT

We address the 2013 BioAg's priority area of livestock feed costs and quality which is critical to producers sustainability. Timothy is a perennial cool-season grass but often stands are taken out of production after the first hay harvest due to higher profitability by growing annual grain crops. For timothy profitability to increase summer production must increase. This interdisciplinary project is focused on summer month production and quality increases by intercropping with a warm season annual grass, teff [*Eragrostis tef (Zucc.) Trotter*] and by determining methods for measuring in-season economic nitrogen rate. Our project's goal is to conduct and disseminate timothy hay production, quality and economic results intercropped with teff and to determine critical levels for tissue testing and chlorophyll measurements in timothy to determine in season optimum nitrogen rate for sustainable hay production. The Washington State Hay Growers Association has partially funded this new concept and has already committed funding a second year of work. Specifically, this proposal investigates intercropping timothy and teff for high quality, sustainable yield while estimating N uptake using BioAg intensive methods. Our proposal will promote a sustainable management system using the BioAg Intensive practice of intercropping using the disciplines of forages, soil science, animal nutrition and economics. After making a presentation to 33 growers at the Kittitas Timothy Hay Growers Association explaining what chlorophyll testing and showing first year results from this study 85% of timothy growers responded that chlorophyll testing for in-season nitrogen testing had a place on their farm. Adoption of in-season nitrogen testing could be fast as Anderson Hay Company is very excited about these techniques. Anderson Hay company has more influence on timothy hay production than anyone one entity as they are the largest manager and exporter of timothy hay.

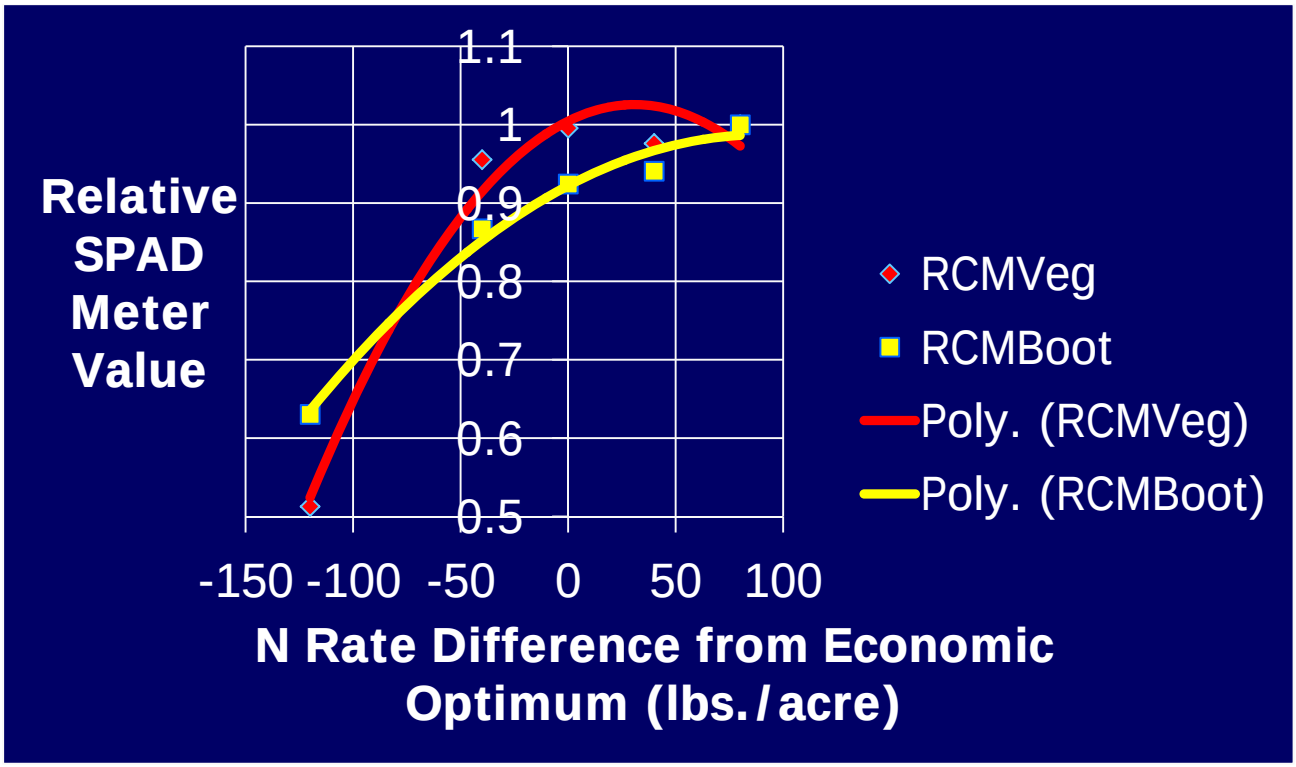
PROJECT DESCRIPTION

This project is being conducted to determine the optimum nitrogen rate for timothy, teff and the intercrop mix and to determine in-season nitrogen rate adjustment. We will also determine if timothy/teff intercropped hay is of acceptable quality by using near infrared reflectance spectroscopy (NIRS) and in situ digestibility. We will compare N fertilizer use efficiency of treatments by using N^{15}-labeled urea. It will also compare economic viability of timothy, teff and the intercropped mix.

OUTPUTS

- Results from the first year experiment using a chlorophyll meter at two growth stages predicts additional nitrogen required to optimize hay economics of first cutting timothy. This data shows that chlorophyll measurements can be successful in predicting how much nitrogen is needed, if any, in-season. These results are derived from timothy leaf chorophyll measurements taken at two stages. The first stage is when the timothy is only 6 inches (15 cm)tall in a vegetative stage

(RCMVeg) and when the timothy plants were in boot stage about 26 inches (65 cm). The optimum relative SPAD™ meter value was different depending on the plant stage. This work is very exciting in that we will be able to help producers adjust the nitrogen rate during the season for each cutting as the season progresses.



- Figure 1. Relationship between economic N rate in pounds per acre and relative SPAD meter value at two growth stages (Vegetative 6" height, Boot stage 26" height). Relative SPAD meter value is the field value at time of measurement divided by heavy fertilized control.

- The intercropping of teff into timothy was not successful this year as we expected. The teff emerged but was not able to compete with the rapid regrowth from second cutting timothy. We think the key for success is holding backwater for a week, like farmers typically do, before cutting to facilitate harvest and then cut the timothy at one inch (1 cm) height. Both techniques will reduce growth speed of timothy allowing teff to be more competitive during establishment.

WORK COMPLETED:

- First year field experiments at both Prosser and Othello locations were completed and data is compiled and some of the analysis has been completed. A detailed list of significant dates is below.
- The experiment was planted in August of 2012 at both Prosser and Othello.
- Spring fertilization of the experiments occurred on March 12 and March 19 in 2013 for Prosser and Othello, respectively.
- Broadleaf weeds were controlled at Prosser on March 25th.
- First cutting vegetative stage chlorophyll meter and tissue samples were taken on May 6th at Prosser and subplots were fertilized on May 7th.

- First cutting boot stage chlorophyll meter and tissue samples were taken on May 13th at Prosser and subplots were fertilized on May 14th.
- First cutting of timothy at Othello occurred on May 28th and was interseeded on May 31st.
- First cutting of timothy at Pasco occurred on June 3rd and was interseeded on June 7th.
- Second cutting vegetative chlorophyll meter and tissue samples were taken on July 8th at Prosser and subplots were fertilized on July 9th.
- Second cutting boot stage chlorophyll meter and tissue samples were taken on June 15th at Prosser and subplots were fertilized on June 16th.
- Second cutting occurred on July 23rd at Othello and was fertilized on July 24th.
- Second cutting occurred on July 29th at Prosser and was fertilized on August 2nd.
- Third cutting vegetative chlorophyll meter and tissue samples were taken on August 19th at Prosser and subplots were fertilized on August 20th.
- Third cutting boot stage chlorophyll meter and tissue samples were taken on August 26th at Prosser and subplots were fertilized on August 27th.
- Third cutting of timothy at Othello occurred on Sept. 12th.
- Third cutting of timothy at Prosser occurred on September 17th.
- Soil samples were collected before fertilization of each cutting and after the last cutting .
- N^{15} application occurred after first harvest and subsamples collected at each harvest.

Since the Washington State Hay Growers Association partially funded the field experiment, the 2014 studies were planted on August 12th at Othello and August 14th at Prosser.

Below are the fertilizer rates and timings used in the study. N^{15} was applied to the middle rate for each treatment.

Fertilizer Rates		**N Rates Lbs. N per acre**				
				N15 plots		
Timothy	Early March	0	80	120	160	200
Timothy	After 1st Cutting	0	40	60	80	100
Timothy	After 2nd Cutting	0	40	60	80	100
Timothy – Total N Rate	Total	0	160	240	320	400
Teff	Early March	0	0	0	0	0
Teff	At planting time	0	40	60	80	100
Teff	After 1st Cutting	0	40	60	80	100
Teff – Total N Rate	Total	0	80	120	160	200
Timothy prior to Intercropping	Early March	0	80	120	160	200
Intercropping	After 1st Cutting	0	40	60	80	100
Intercropping	After 2nd Cutting	0	40	60	80	100
Intercropping – Total N Rate	Total	0	160	240	320	400

- Publications, Handouts, Other Text & Web Products: These products are in process of being developed. The first will be published in the Washington State Hay Growers Hay Expo Proceedings in January 2014.

- Outreach & Education Activities: Presentations of timothy yields and methods for in-season nitrogen adjustment was given to the Kittitas Timothy Hay Growers Annual Meeting on December 17, 2012 and will be given at the Washington State Hay Growers Hay Expo on January 15, 2014.

IMPACTS

- Short-Term: At the Kittitas Timothy Hay Growers Association increased knowledge of chlorophyll testing and how to use this technology increased by 31% and 85% of timothy growers responded that chlorophyll testing for in-season nitrogen testing had a place on their farm.
- Intermediate-Term: After the research has occurred we expect changes in culture practices in timothy either by intercropping or adjusting nitrogen rate or tools to adjust in season nitrogen rate.
- Long-Term: After adoption of practices expected results include improvements in economic wellbeing and environmental conditions of timothy hay fields by defining and adjusting nitrogen rate.

ADDITIONAL FUNDING APPLIED FOR / SECURED – Second year funding has been secured from the Washington State Hay Growers Association. This commitment suggests the importance to the industry by the association and that it is important that WSU partner with industry supported projects.

GRADUATE STUDENTS FUNDED - NONE

RECOMMENDATIONS FOR FUTURE RESEARCH – Second year funding will be allocated for continuation of this well designed, focused and producer driven project. It is critical timothy hay growers use WSU research based information when making decisions on nitrogen rates for economics and for environmental protection of all water sources. This research provides that needed information for improving nitrogen rates and help confirm the first years critical values for in-season adjustment.

To make biointensive cropping successful, it is important not to despair on the first attempt. We have evaluated all methods employed and defined a new strategy for increasing the competitiveness of teff. It is an important output to know what didn't work and develop logical alternatives. We also learned the cost of invitro testing is higher than originally quoted so treatment selection of for complete testing was difficult. We underestimated the labor required from planting, sampling, harvesting, grinding and data handling / write-up. This is part of the learning processes but we're learning fast!