

IN SEASON MANAGEMENT OF N IN TIMOTHY

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ABSTRACT

Timothy hay is the largest grass hay commodity in Washington State and the majority of hay is exported to Japan and other countries. Very little research work has been done on determining optimum nitrogen rates for this commodity or a tool for in-season adjustment of nitrogen rate.

We hypothesized that in-season nitrogen status of timothy could be assessed using a Soil Plant Analysis Development (SPAD) units or by nitrogen content of leaf samples. A calibration of these parameters would be accomplished so farmers would be able to in-season apply the nitrogen using fertigation. The SPAD meter measures how much of red light at 650 nm (best absorbed by the chlorophyll molecules) is absorbed by the sample and how much transmission of infrared light at 940 nm, at which no absorption occurs and gives a greenness measurement (SPAD unit). These SPAD units are compared to an over-fertilized strip in the field and relative chlorophyll units (RCM) are calculated (SPAD in question/SPAD over fertilized=RCM) averaged over at least 20 measurements. The objective of the research conducted is to calibrate the SPAD meter and tissue testing for nitrogen in timothy and determine their effectiveness.

Research was conducted at two Washington State University Experiment Stations located near Prosser, and Othello, Washington using different nitrogen rates. Results indicate that the vegetative stage (stems 6 inches in length) will be the most accurate time to assess nitrogen status using RCM and leaf tissue nitrogen content. Results also indicated that both tools RCM and tissue testing will be useful tools to predict in-season nitrogen to maximize yield and profit.

Key words: Timothy, hay, nitrogen, SPAD, tissue testing

BACKGROUND

Timothy hay is Washington State's largest and highest priced grass hay commodity. Timothy hay is primarily grown for export to Japan and other countries. We can produce up to 10 ton per acre in 3 cuttings in the lower basin but most farmers use two cuttings and receive around 5 - 7 tons/acre. Very little work has been done on determining optimum nitrogen rates for

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this large commodity. The objective of the research conducted is to calibrate the SPAD meter and tissue testing for nitrogen in timothy and determine their effectiveness on establishment year of timothy hay at Prosser and Othello, WA.

MATERIALS AND METHODS

Nitrogen rates of timothy can be instantaneously assessed in the field using a Soil Plant Analysis Development (SPAD) units to determine optimum fertilization using fertigation. The SPAD meter measures how much of red light at 650 nm (best absorbed by the chlorophyll molecules) is absorbed by the sample and how much transmission of infrared light at 940 nm, at which no absorption occurs and gives a greenness measurement (SPAD unit). These SPAD units are compared to an over fertilized strip in the field and relative chlorophyll units (RCM) are calculated ($\text{field/over fertilized}=\text{RCM}$) for at least 20 measurements. Results for relative chlorophyll measurements are related to the amount of chlorophyll that is in the samples tested which is correlated with the nitrogen status of the field. The cost of a SPAD meter is about \$2,500.

Preliminary nitrogen recommendations at two growth stages 6" tall stem in timothy (RCM Veg.) or approximately 26" tall stem in timothy in early boot (RCM Boot) were calculated for first cutting. First cutting vegetative stage chlorophyll meter and tissue samples were taken on May 6th in 2013 and April 29th in 2014 at Prosser as well as May 1st in Othello. First cutting boot stage chlorophyll meter and tissue samples were taken on May 13th in 2013 and May 5th in 2014 at Prosser and May 8th at Othello in 2014. This work was accomplished with the goal of aiding producers decisions on how to optimize nitrogen rates during the season for each cutting as the season progresses with fertigation.

RESULTS AND DISCUSSION

First cutting timothy hay yield harvested at anthesis peaked around 5 tons per acre with the 80 to 120 lb. nitrogen per acre treatment depending on the year (Figure 1). Optimum nitrogen fertilizer rate will vary depending on how much soil nitrogen was at the beginning of the season. In 2013, the optimum nitrogen fertilizer treatment corresponded with a protein level of 9% in the hay at harvest (Figure 2). In contrast, maximum yield potential in wheat is associated with grain protein about 12.5 percent protein in hard red spring wheat, about 11.5 percent in hard red winter, hard red spring and durum and 10.5 percent in soft white wheat (Brown, et. al.,2005). If the forage protein holds constant at maximum yield, then protein at harvest measurement maybe a useful measurement at the end of the season to determine if adequate fertilizer nitrogen was adequate for yield. SPAD meter readings were taken at two stages, when the stem of the timothy plant was 6 inches in height (Veg.) and at boot stage which was one week later. Results showed that net

income, calculated by multiplying yield times price (\$225/ton) minus cost of fertilizer (used \$0.50 per lb. of N). Net income was maximized at a RCM of 0.85 at the vegetative stage and 0.87 at the boot stage (Figure 3). The R^2 value, which shows how valuable RCM was to predict net income in this experiment, was 0.86 and 0.70 for the vegetative and boot stages, respectively (Figure 4). This data suggests that the relationship to RCM and adjusted profit is more accurate when the SPAD meter readings taken at the vegetative stage rather than the boot stage. Not only will the boot stage SPAD meter readings be less accurate but the regression line developed on adjusted gross income for both vegetative and boot stages shows that errors will be more costly per RCM unit compared to the vegetative stage.

Tissue testing for nitrogen content by using the upper leaves and using it to predict adjusted gross profit had an R^2 value of 0.99 and 0.94 for vegetative and boot stages, respectively. As with RCM leaf tissue content best predicts adjusted gross profit at the vegetative stage but the difference between stages was not as pronounced. Since these measurements were taken one week apart notice how much difference there is in the regression line (Figure 5). The timing of timothy measurements will be important in getting good data for in-season fertilizing.

This data suggest that both RCM and leaf tissue testing for percent nitrogen will assist farmers making decisions for in-season adjustment of nitrogen fertilizer rates.

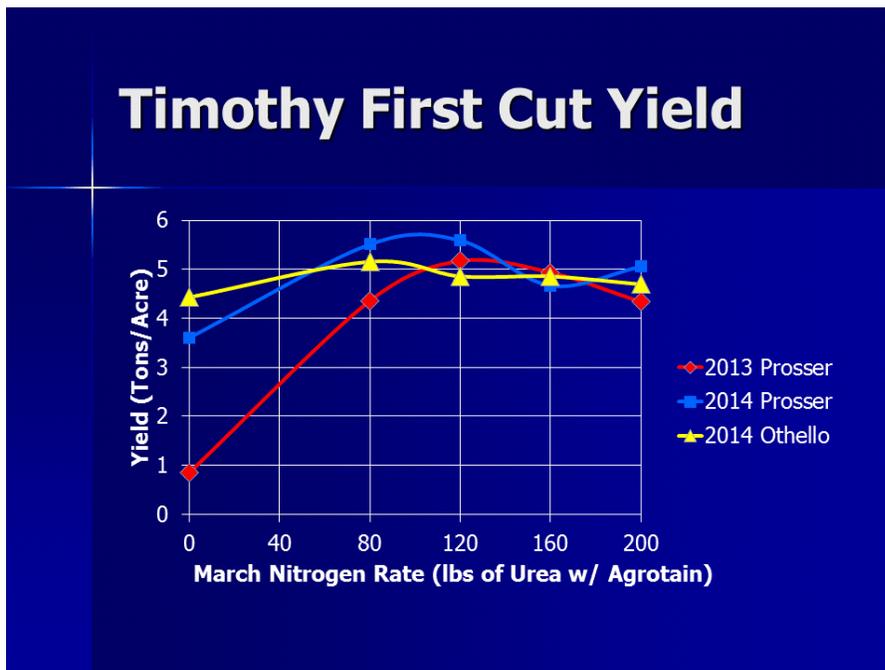


Figure 1. Timothy first cut yield at Prosser and Othello, WA as influenced by March urea nitrogen rate with Agrotain in 2013 and 2014.

Prosser First Cut Timothy Yield and Harvest Protein in 2013

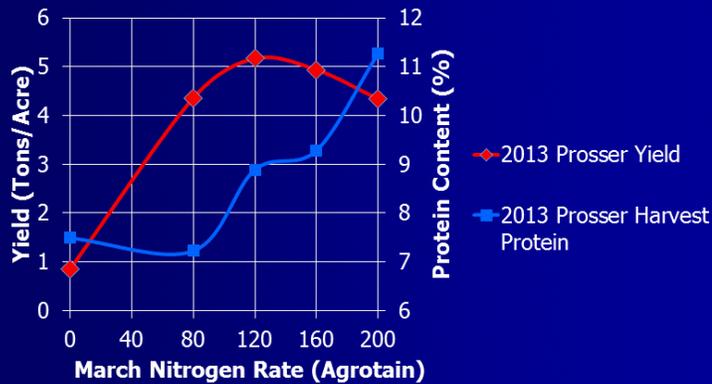
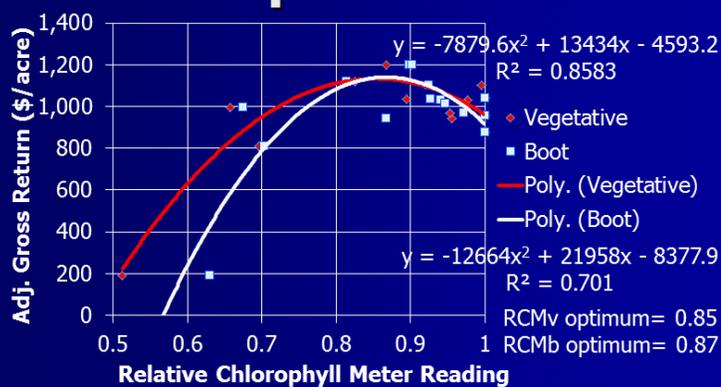


Figure 2. In 2013, the influence between March nitrogen rate applied as Agrotain™ on yield and harvest protein of hay.

RCM veg and boot predicting adjusted gross return after N fertilizer expense for 1st cut



Decreasing RCM 0.5 is a decrease in profit of \$22 & 28 /acre for Veg & Boot, respect.
 Increasing RCM 0.5 is a decrease in profit of \$18 & 36 /acre for Veg & Boot, respect.

Figure 3. Relative chlorophyll meter reading (RCM) predicting adjusted gross returns at the vegetative and boot stage of timothy.

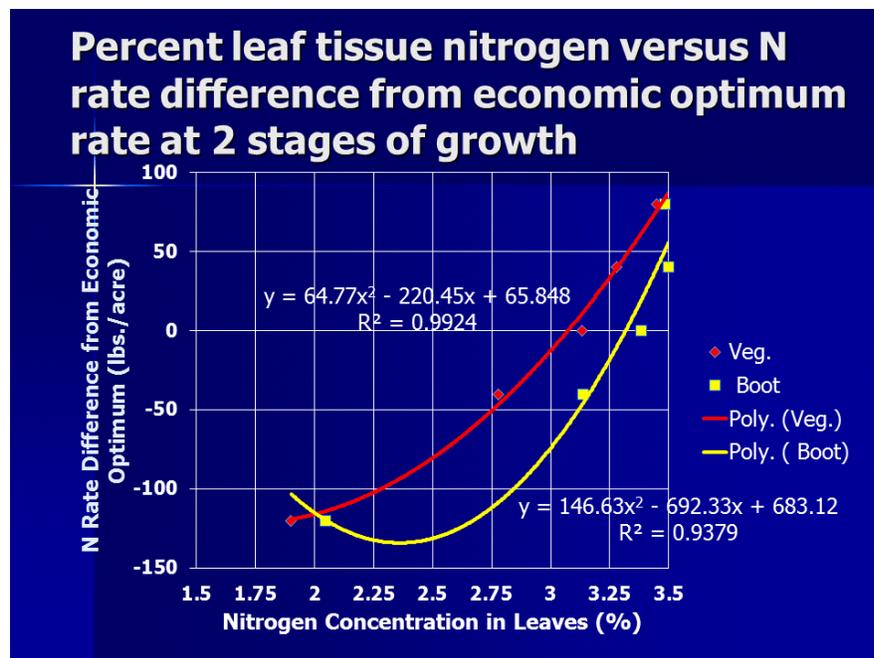


Figure 4. The relationship between optimum economic N rate in pounds per acre and percent leaf tissue nitrogen at two growth stages in 2013 (Vegetative, Boot stage).

REFERENCE

Brown, B., M. Wescott, N. Christensen, B. Pan, and J. Stark. 2005. Nitrogen Management for Hard Wheat Protein Enhancement. University of Idaho. PNW 578.

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