Forage Nitrate Analysis: What Method to Use?

E. Meccage[1*], Z. Miller[2], and D. Peterson[1]

[1]Department of Animal and Range Sciences, Montana State University, Bozeman, MT 59717 and
[2]Western Agricultural Research Center, Montana State University, Corvallis, MT 59828

IMPACT STATEMENT

Utilizing tests to determine nitrate accumulation in forage is an important tool for producers. This publication outlines the protocols and efficacy of the Nitrate QuikTest, Nitrate Strip Test, and Commercial Laboratory Analysis.

SUMMARY

Nitrate toxicity is a serious concern for many producers in Montana. The large quantity of annual forages grown, coupled with the likelihood of environmental stress during the growing season, increase risk for nitrate accumulation in plants. In order to prevent decreases in animal performance, or even death, an accurate method of nitrate estimation is required. Currently, the most accurate method for nitrate determination is laboratory analysis, however some tests, which are faster and cheaper than commercial analysis, have been developed. Therefore, this study was designed to evaluate two common qualitative nitrate testing methods, the Nitrate Strip Test and the Nitrate QuikTest. The objective of the study was to compare these tests to a laboratory analysis and determine their accuracy in order to provide producers with more nitrate testing options. Compared to commercial testing, the Nitrate Strip Test was more accurate than the Nitrate QuikTest, matching commercial lab analysis results 77% of the time. The Nitrate QuikTest was slightly less accurate, correctly estimating whether nitrates were present 69% of the time. However, the Strip Test had far more false negatives, whereas the QuikTest had far more false positives. Overall, the Nitrate Strip Test appears to be a better method of estimation compared to the Nitrate QuikTest, while commercial lab analysis still remains the gold standard.

INTRODUCTION

All ranches rely on forages such as native range, introduced pasture, or hay to feed their livestock. Many livestock enterprises in Montana use a combination of several types of forages, including some that have the potential to contain toxic levels of nitrates (NO_3^-). Nitrate toxicity associated with feeding forages reduces an animal's ability to transport oxygen in the blood, and can significantly decrease animal performance. Ruminants like cattle, sheep, and goats are more prone to NO_3^- toxicity than non-ruminants such as horses and pigs.

The gold standard for nitrate testing is quantitative testing via a commercial laboratory. However, commercial testing is costly and time-consuming, creating delays in harvest schedule, which can affect forage quality. To help producers minimize delays in their harvest schedule, there is currently a qualitative NO_3^- test available called the Nitrate QuikTest. This test is designed to give a qualitative estimate of nitrate levels in-field, prior to harvest. However, the test can only be administered by trained personnel due to the caustic solution, and is a very subjective test that does not provide any indication of nitrate levels, only presence of nitrates.

A newer test, the Nitrate Strip Test, is now available commercially. This test is similar to a pH strip test where a strip changes color based on the level of nitrates present, and producers can buy the materials online. However, this test has not been verified in-field in Montana. Therefore,

the objective of this research was to evaluate the efficacy of the two tests, the strip test and the QuikTest, and compare their results to a commercial lab analysis.

PROCEDURES

A two-year study was initiated in Montana in 2016. Extension agents from 14 counties throughout Montana volunteered to collect, test, and record samples brought in to their offices. Agents tested all samples that were brought in using the QuikTest, and randomly selected samples to be tested using the strip test. At the request of producer, each agent then verified several of their samples by submission to a commercial testing lab (Midwest Laboratories, Omaha, NE).

All data were recorded over the two field seasons, and were submitted to the MSU Forage Research Lab for analysis. Data were analyzed based on forage species, county of origin, and nitrate test type.

RESULTS AND DISCUSSION

When comparing the Nitrate Quiktest to the commercial lab results, the QuikTest only correctly identified presence of nitrates in 69% of the samples (44/ 64 samples; Figure 1). Of the 31% that were incorrect, 87% of those were false negative, or the Quiktest predicted the forage was safe while the commercial analysis found levels to be high.

The Strip Test did a better job at predicting forage nitrate levels, correctly estimating 73% of the samples (53/ 73 samples) compared to the commercial analyses (Figure 2). Of the 27% that were inaccurate, 45% (12% overall or 9/ 73 samples) of those were false positives, or forages that were evaluated by the strip test to be higher than they were in the commercial analysis. The remaining 15% of tests (11/ 20 samples) were false negative.

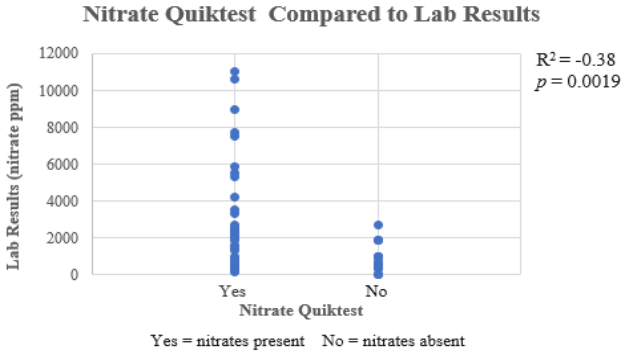

Figure 1. Comparison of Nitrate QuikTest results compared to commercial lab results.

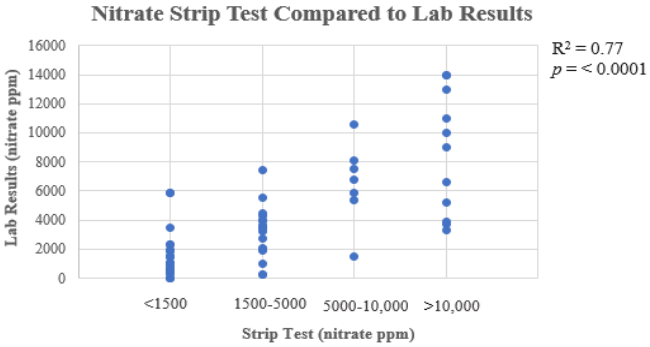

Figure 2. Comparison of nitrate strip test results to commercial lab results.

Due to the uneven number of samples from each species submitted, a thorough statistical analysis of species differences was not possible. However, the largest reported levels from commercial analysis were from oats, weeds, barley, warm-season grass, and surprisingly, silage samples. Care should be taken in interpreting these results, as submissions from those classified as "silage" were limited, and had lower sample numbers compared to other species categories such as oats and barley.

Another interesting result from this study is the comparison between 2016 and 2017 (Figure 3). When all samples were averaged between the two years, 2017 had much higher reported NO_3^- levels (averaging approximately 5000 ppm using the strip test) compared to 2016 (averaging around 3250 ppm using the strip test). This is not surprising as 2017 was a much hotter and drier year compared to 2016 for most of Montana, which is a risk factor for elevated NO_3^- levels.

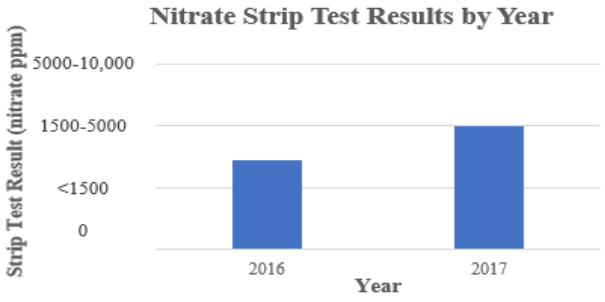

Figure 3. Comparison of nitrate strip test results in 2016 versus 2017.

Overall, authors of this study conclude that the Nitrate Strip Test is an acceptable method of estimating nitrate levels in-field and is more reliable compared to the Nitrate QuikTest. Testing accuracy does depend significantly on the quality of the sample provided, and so with either test, ensure that you are correctly sampling your field or hay stack. However, a laboratory analysis still remains the "gold standard" whenever nitrate toxicity is a concern in your forages.

REFERENCES

Glunk, E.C., K. Olson-Rutz, M. King, D. Wichman, C. Jones. Nitrate Toxicity of Montana Forages. MT200205AG.

*Corresponding author email:
emily.meccage@montana.edu