

ANNUAL REPORT

PROJECT NO: BJKT10, BDK111, BRK112

TITLE: Managing soil acidity and aluminum toxicity in northern Idaho

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ACCOMPLISHMENTS:

Projects conducted in 2016 included field trials to assess liming products and rates, evaluation of the impact of lime application on nitrogen use efficiency, greenhouse and field trials to examine the impact of liming on soilborne pathogens, and preliminary economic analyses of lime application.

The study to compare liming products and evaluate application rates was conducted for a third consecutive year. At each of the three sites in Winchester and Potlatch, ID as well as Pullman, WA, lime was applied at rates of 500, 1000 or 2000 lbs/A in the fall of 2013. For the 2015-2016 growing season, each site was seeded with both winter wheat and spring pea. Soil samples were collected and are being processed to measure changes in soil chemistry. Agronomic performance and yield data was collected from the trials and these samples are being processed. It is anticipated that treatments containing lime will have increased yields at Potlatch, ID and Pullman, WA compared to the non-limed control. The results of the soil analysis are also pending the return of the results from the soil testing laboratory.

An additional field trial was established at the Plant Science farm east of Moscow to continue assessing the impact of lime application on nitrogen uptake and utilization by wheat plants. Four varieties of winter wheat with varying degrees of tolerance (Brundage 96, Eltan, Madsen and Stephens) were seeded into replicated plots that were either limed or not limed, and included either the recommended rate of nitrogen or no nitrogen application. In addition to collecting yield data, plant tissue and soil samples were collected at harvest in order to measure quantities of nitrogen in the leaf/stem tissue, grain and soil. At the time of this report yield data is not yet available for this trial. Seeding of this trial was delayed in the fall of 2015 in the attempt to manage volunteer winter wheat. As a result the trial was seeded rather late in October of 2015. The late seeding date combined with volunteer winter wheat resulted in lower than anticipated yields.

A greenhouse project was conducted in the spring of 2016 to examine the impact of soil pH on *Fusarium culmorum*, *Rhizoctonia solani* AG-8 and *R. oryzae*. Results were inconclusive, but suggest the *Fusarium* crown rot may increase in severity as the soil pH increases. Soil pH does not appear to significantly influence *Rhizoctonia* species. In addition to the greenhouse work, a field trial was established in the spring of 2016 to assess the influence of lime application on the incidence and severity of *Fusarium* crown rot. Agronomic performance and yield data were collected for the field trial. Samples of the wheat crown were collected after harvest and evaluated

for disease severity. Glee and WB Hartline were selected because they are some of the most susceptible spring wheat varieties grown in the region. Lime tended to cause a slight increase in yield compared to the non-limed control, but this is likely due to a reduction in soluble aluminum. Fusarium crown rot symptoms were more severe in WB Hartline compared to Glee. There was a very low quantity of natural inoculum in the soil and adding inoculum of *F. culmorum* was observed to increase the disease severity for both Glee and WB Hartline. However there did not appear to be a substantial change in disease severity when the soil was limed contrary to the results of the greenhouse experiment. Due to late season rain, this plot was never under drought stress which may account for the low disease severity and lack of response to liming. Further field evaluation will be required to confirm the results of this study.

Yield and disease severity for wheat seeded into plots inoculated with *Fusarium* and limed.

Variety	Fusarium Inoculum	Limed	Yield (bu/A)	Test Weight (lb/bu)	Average Disease Severity (0-3)
Glee	N	N	44	62	0.2
Glee	N	Y	42	62	0.1
Glee	Y	N	39	62	0.7
Glee	Y	Y	41	62	0.7
WB Hartline	N	N	54	60	0.3
WB Hartline	N	Y	56	60	0.3
WB Hartline	Y	N	49	59	1.0
WB Hartline	Y	Y	53	59	0.9

Preliminary models to assess the economic impact of liming were developed this year. Once the remaining yield data is collected from the 2016 field trials, a multi-year economic analysis of the data will be conducted. The model assumes a 5, 15, 25, or 50 dollar per return on the investment of lime and the lime application rate of 1 ton per acre. Based on preliminary analysis, the NuCal fluid limes is the least economical and in most situations would not be a cost effective product for liming. The sugar beet lime or ground limestone applications were economical if the return was a least \$15 per year over a period of 10 years. Although 10 years later reasonable of higher rates of lime, this is probably over representation for the lower rates used in the study.

Investment analysis of applying lime today to receive a 10 year stream of benefits. Assume some interest rate (discount rate) of 6% per year.

Product	Pounds CaCO ₃ /A	+\$5/Year	+\$15/Year	+\$25/Year	+\$50/Year
Sugar beet lime	2000	(-\$45)	\$27	\$97	\$270
Ground limestone	2000	(-\$50)	\$22	\$91	\$265
Liquid lime	2000	(-\$334)	(-\$262)	(-\$193)	(-\$19)

PROJECTIONS:

We will continue to process grain harvest in 2016 and will summarize the results of the soil analyses as soon as they received. Once the data collection is completed a more detailed economic analysis of the study will be completed. Greenhouse and field studies will be continued to examine the impact of soil pH on root and crown pathogens of wheat. This continued work on soilborne pathogens will be part of a new proposal submitted the Idaho wheat commission for FY2018.

The focus of lime application projects is shifting to larger strip trials using higher rates of lime as explained below. Based on the economic models and crop performance for the past 3 years, the new strip trials established in the fall of 2016 were limed using ground limestone from Pioneer Enterprises. Ground limestone is comparable to sugar beet byproduct lime in cost when combining the cost of the material and transportation. Four sites were established with two locations near Potlatch, ID and two locations near Tensed, ID. We are seeking an additional site in the Troy, Deary or Kendrick area. The sites established this fall include 0, 1, 2 and 3 ton/A rates of lime seeded in 100' strips x 8' wide. The lime was incorporated prior to planting and three of the sites were seeded to UI-WSU Huffman. The fourth site will be seeded to a spring crop. At all locations, the crop planted will match the crop being grown commercially in the field. We intend to conduct this study for a minimum of 6 years to more thoroughly evaluate the long term impact and economic feasibility of lime application in northern Idaho.

PUBLICATIONS:

Finkelnburg, D., and Schroeder, K. 2016. Evaluation of high lime rates in large scale strip trials. Pp. 64. In: *2016 Dryland Field Day Abstracts: Highlights of Research Progress*. Idaho Agricultural Experiment Station, Research Bulletin 189.

Schroeder, K., Painter, K., Finkelnburg, D., and Huggins, D. 2016. Crop response and economics of liming in northern Idaho. Pp. 69-70. In: *2016 Dryland Field Day Abstracts: Highlights of Research Progress*. Idaho Agricultural Experiment Station, Research Bulletin 189.