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Use of NPK liquids in managing irrigated alfalfa cropping systems

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Commercial alfalfa harvest.

Alfalfa continues to be world-class leader for feed value for North American production agriculture, especially in the Intermountain West. Alfalfa yield will always depend on the amount and quality of irrigation water in the desert areas of this geography; however, proper nutrition related to available fertility is of primary importance. This unique study explores the potential of addressing in-season applications of low-salt liquid NPK delivered to alfalfa at the right time within a growing season and between cuttings.

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Alfalfa continues to be world-class leader for feed value for North American production agriculture, especially in the Intermountain West. Acre numbers, while not at historical highs, are still high enough to be either the largest or second largest cropping areas in each of the states in this region. Forages including alfalfa are enjoying some of the greatest economic returns that have been observed for many years.

A lot of this is related to changes in population in these areas as well as diets of international customers and markets. There continues to be a growth in dairy markets

with larger and larger dairy operations looking for both high quality feed for milk production as well as for livestock at feed yards. All of these contributing factors have pushed the price of alfalfa well beyond expectations from just a few years ago. These changes are bound to get producers' attention and lead to questions regarding strategies to increase production.

Tissue samples were collected for each truckload of hay to determine tissue concentrations of NPK and feed quality for each year of field trials.

Yield of all crops, including alfalfa, will always depend on the amount and quality of irrigation water in the desert areas of this geography; however, proper nutrition related to available fertility is of primary importance. This is especially true for P fertilizer use as growers push for high yields and high relative feed value while also being conscientious of environmental constraints. "Phosphorus is the most common fertilizer input for alfalfa across the western U.S.," says Dr. Glenn Shewmaker, Extension Forage Specialist and Professor at the University of Idaho. "It is essential for optimum alfalfa production and quality but may also create concerns for the environment."

Potassium is also a nutrient that is heavily used by rapid-growing alfalfa, and in many growing conditions, needs to be managed similar to P fertilizer. In the authors' experience, if P and K are both limiting, it is best to first apply phosphorus and resolve that as a limiting nutrient before applying potassium. In many production fields, although P and K may test adequate in the soil, there may very well be factors that limit the ability to access these primary nutrients in a timely matter to maximize yield and improve alfalfa quality.

Timing and Form of Nutrient Delivery to Alfalfa

This unique study explores the potential of addressing in-season applications of low-salt liquid NPK delivered to alfalfa at the right time within a growing season and between cuttings. Many times, growers and researchers only focus on dosage or rate of nutrients applied when other parts of nutrient management criteria should also be explored; in this case, timing and form of nutrient delivery.

Foliar applications of low-salt NPK fertilizers were applied to established irrigated alfalfa during the 2012, 2013, and into the 2014 growing season. Applications were made when the regrowth was about 6 to 8 inches tall. In 2012, applications were made with a commercial sprayer between the second and third cuttings. The NPK liquid applications at this time were 3–18–18. Rates of applications included a total of 0, 2.5, or 5.0 gal/ac for each cutting. Irrigation was allowed to be stopped for 24 hours to assure adequate drying on the foliage of the alfalfa. Each treatment was laid out with anticipation of harvest and determining yields.

Applications of foliar nutrients applied in season increased yields during the 2012 season for each of the cuttings. These yield improvements were able to deliver an economic improvement for the forage being used. “It looks like these applications are something we should be pursuing,” says Kent Frisch who is the farm manager for this area for Simplot. “However, the system needs changing for ease of applications.” Therefore, changes were made in subsequent years to address the farmer's concerns. Trials of the in-season applications were expanded to three pivots.

Each pivot was 120 ac and included treatments of 3–18–18 (NPK) applied by aircraft, 6–24–6 applied through the center pivot, and the grower standard practice where no additional nutrients were applied. Liquid NPK was applied when the crop had a regrowth of 6 to 8 inches. Rates included 3, 5, and 5 gal/ac for each of the respective

cuttings.

Each pivot was harvested with commercial swathers with each truck weighed with hay quality samples removed for quality analysis. There were about 600 trucks weighed and sampled, providing a very good evaluation of treatment responses. The main objective of the Simplot alfalfa is for livestock feed, and so it was all green-chopped with a moisture content of 65%. The 2013 trials indicate a very positive response to in-season NPK applications. Improvements in nutrient content of P and K were both remarkable (Figures **1** and **2**). It is interesting to note the changes in tissue concentration and removal from relatively low applications for both P and K. As much as three times removal of these nutrients was observed compared with the application totals. While not shown in this article, there was an improvement in relative forage quality, which could be attributed directly to increased nutrient uptake as a result of these in-season low-salt NPK fluid fertilizers being applied.

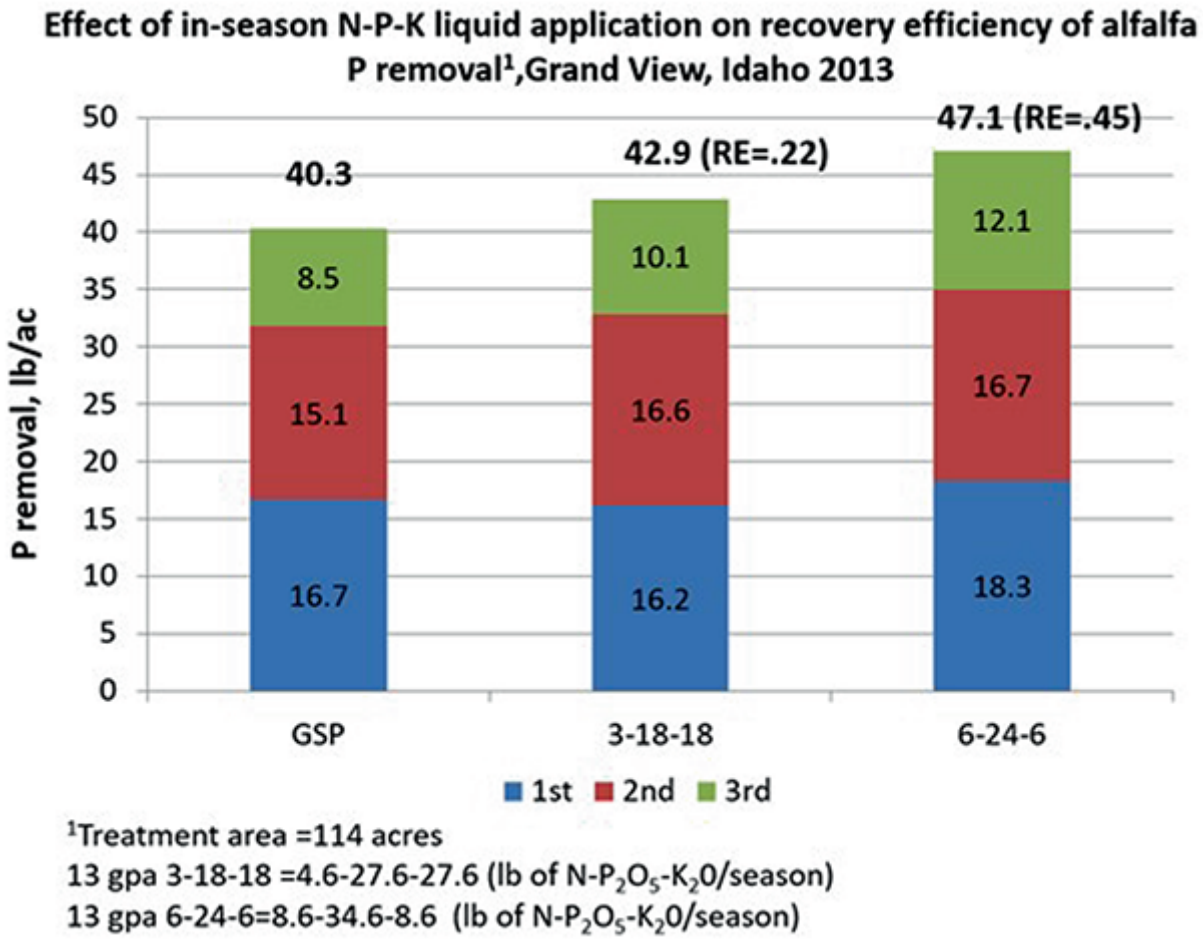

Figure 1, *Phosphorus recovery from in-season applications of NPK fluid fertilizer to irrigated alfalfa.*

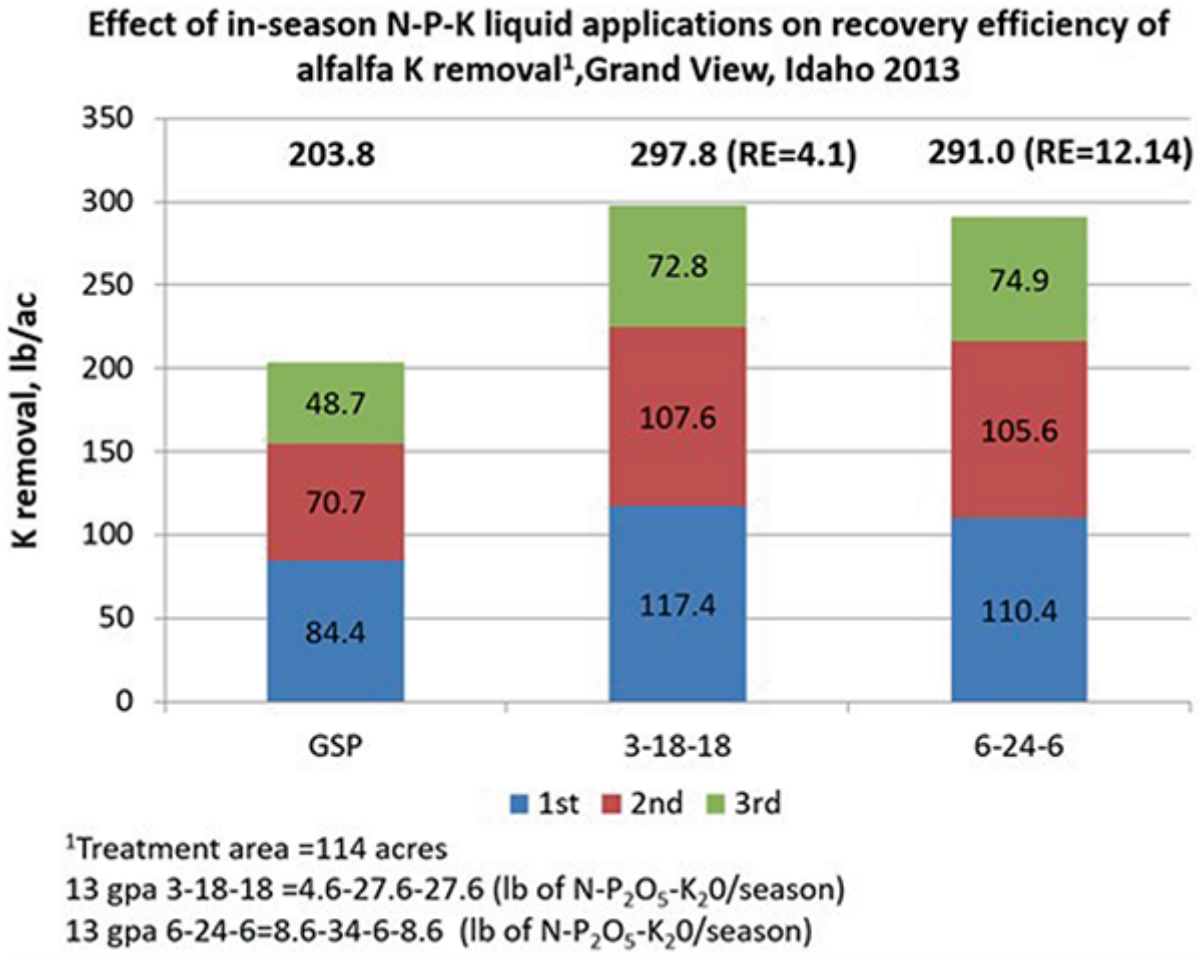

Figure 2, *Potassium uptake and recovery from in-season applications of NPK fluid fertilizer to irrigated alfalfa.*

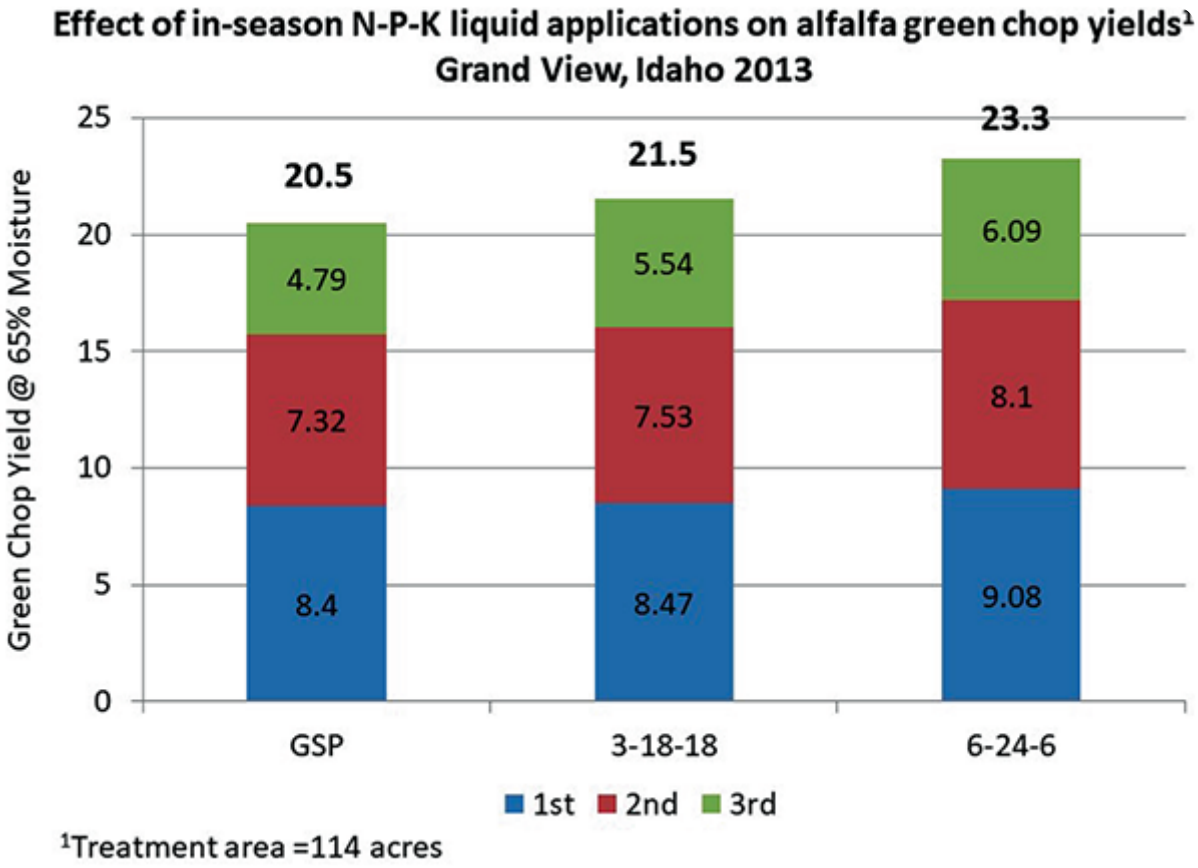

Figure 3, *Yield improvements with application of liquid NPK to established alfalfa (65% moisture). GSP, grower standard practice.*

Yield improvements were positive for both the 3–18–18 and the 6–24–6 treatments. However, the applications applied through the center-pivot tended to be higher. Improvements of yields were impressive with 6–24–6 providing more than a 3 ton (at 65% moisture) improvement at 23.3 tons over the grower standard practice of 20.5 tons. Improvements with these types of applications for both years have encouraged the cooperating farm managers to incorporate these applications into many of their alfalfa fields for the future. “If we can consistently see these types of responses, and the materials can improve our alfalfa production benefits to costs by at least a 2:1, our alfalfa production will be seeing more of these applications,” Frisch says.

Improvements in relative feed quality were also positively influenced, especially with the 3–18–18 applications. This may have been related to the higher concentration of

tissue K that resulted from this particular NPK low-salt foliar application. The positive nature of improvements to alfalfa production with in-season applications of NPK liquids is a great example of addressing the current needs for growers and crop advisers.

Because of this very involved set of data conducted on these large fields and the positive measurable responses (to meet the 2:1 economic returns), almost 8,000 acres of alfalfa being irrigated by center pivot are currently receiving similar in-season applications of 6–24–6 being injected through pivots.

More nutrient management

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