PRACTICAL INTERPRETATIONS OF SOIL INFORMATION TO MAINTAIN HIGH ALFALFA YIELDS

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ABSTRACT

Soil analysis has proven to be a reliable indicator of nutrient status for most crops. Phosphorus is the primary fertilizer nutrient applied to alfalfa. Proper calibration of the Olsen Bicarbonate Method phosphorus [2] test is essential to maintaining sufficient phosphorus levels in alfalfa for high production. The purpose of this paper is to describe a program to maintain adequate phosphate without over-fertilizing or sacrificing yield potential.

Key Words: Alfalfa, Fertility, Olsen P Soil Test, Management.

INTRODUCTION

The Palo Verde Valley is located in the Southern California Desert. It was formed in the flood plain of the Colorado River as alluvium removed from what is now the Grand Canyon. The valley is surface flood irrigated by a series of canals supplied by a diversion dam on the North end. The irrigation district has a "flow through" system returning any unused water back to the Colorado River.

Alfalfa is usually planted in the fall and grown as a perennial crop for 3 to 5 years. Normally, the first 2 years produce the highest yields. Some fields may yield as high as 14 tons/ac, with a valley average of 9.6 tons per acre on 43,555 planted acres [8].

The soils are generally light in texture except for old oxbow sloughs left by the Colorado River where deep clay deposits are left. The pH is moderately alkaline (pHe 7.3-7.8) in fields that have been intensively farmed and highly alkaline in fields that are recently claimed from the desert (pHe >8.5). They are highly buffered by calcium carbonate (lime) which generally comprises 3 to 15 percent of the soil matrix. Irrigation water quality is good, with moderately high level of salts (ECw 1.48 dS/cm). The water has an SAR of 6.1 and high bicarbonate (2.9 meq/l)[5]. Fields may be irrigated 16 times per year with 65 inches of water per year to maintain adequate soil moisture for good yields.

Traditional phosphate fertility programs for alfalfa have been based on various factors. To calculate the amount of fertilizer required growers consider: i. amounts of phosphorus removed by the crop; ii. expected yields; iii. soil texture; iv. phosphorus efficiency; and v. market value of the crop.

Prior to 1991, "Canned" or standard alfalfa fertility programs utilized by growers included an application of 200 to 400 lbs of 11-52-0 dry fertilizer (mono ammonium phosphate) applied prior to planting. Then, applications of 200 lbs 11-52-0/ac were applied in the spring and again in the fall each year for the life of the alfalfa stand. The cost of this program is $93.12/ac per year including spreading [3]. Since 1991, liquid phosphate fertilizers have been applied in the irrigation water.

Lighter, more frequent fertilizer applications such as 60 to 120 lbs 10-34-0/ac (20-40 lb P2O5/ac) are applied two to four times over the growing season. The cost of this program ranges from $32.00 to $63.50/ac per year.

The Western Fertilizer Handbook [6] states that "...soil and plant tissue analysis are the farmers best guides to the wise and efficient use of fertilizers and soil amendments". In this paper, we will discuss our "in house" research used to calibrate a soil test as the primary predictor of the amounts of phosphorus needed to maintain excellent yields of alfalfa.

METHODS

Two sites were selected to compare different fertilization systems on alfalfa.

At the Arizona site, soils were sampled in each plot in 2 locations to a depth of 12 inches prior to planting. The soils have a consistent loam texture with an Saturation Percentage (SP)[2] range of 35 to 45. Bicarbonate P levels ranged from 4 to 9 and had a median of 6. This would be considered in the very low P sufficiency range for alfalfa by Arizona standards [7] and marginal by California Standards [4]. Three fertilizer treatments were replicated and randomized in large plots across the field. One treatment was all liquid fertilizer applied in the first two irrigations (64 lbs P2O5 as 10-34-0/ac total), one was all dry fertilizer banded with the seed (104 lbs P2O5 as 11-52-0/ac) and the last was a combination dry banded (52 lbs P2O5 as 11-52-0/ac) and water run in the germination water (32 lbs P2O5 as 10-34-0/ac). Soils were sampled four times over the growing season. Additional applications of liquid fertilizer were water applied to plots when the soil tests indicated phosphorus was below the high range so that soil P levels would be nearly equal.

The California site had three treatments. Preplant soil tests were collected to a depth of 12 inches. The soils have a consistent loam texture with an SP range of 40 to 45. Bicarbonate P levels ranged from 10 to 20 and had a median of 13. This would be considered in the low to medium P sufficiency range for alfalfa by Arizona Standards [7] and in the adequate range by California Standards [4]. Three preplant fertilizer treatments were replicated in large plots across the field. One treatment was 40 lbs P2O5 as 10-34-0/ac sprayed on the field preplant, another was 80 lbs P2O5 as 10-34-0/ac, and the last was all dry fertilizer 208 lbs P2O5 as 11-52-0 broadcast. After application the fertilizer was listed into 40 inch beds. Soils were sampled over the growing season. Additional applications of fertilizer were applied to plots where the soil phosphorus was below the high range so that soil P levels would be nearly equal.

RESULTS

In the Arizona trial, yields were collected and ranged from 10.97 to 11.71 tons of harvested alfalfa per acre over the first 6 cuttings with 2 harvests remaining (TABLE 1). Alfalfa hay yields resulting from the 3 treatments were not significantly different from one another. This indicates dry, granular and liquid P fertilizers are equally effective in maintaining high hay yields. Phosphorus rates were lower with the liquid 10-34-0, indicating higher fertilizer use efficiency. Fertilizer costs ranged from a low of $24.48/ac/year for the all liquid program to $42.80/ac/year for the preplant dry fertilizer plots.

The California trial showed yields from 6.39 to 7.32 tons of harvested alfalfa per acre over the first 4 cuttings (TABLE 2). The plots had been grazed by sheep during the time that normally is used for the first two cuttings and yield data is not available. Alfalfa hay yields resulting from the 3 treatments were not significantly different from each other. This indicates dry, granular and liquid P fertilizers are equally effective in maintaining high hay yields. Phosphorus rates were lower with the liquid 10-34-0, indicating higher fertilizer use efficiency. Fertilizer costs of the all liquid program ranged from a low of $26.09/ac/year to $61.48/ac/year for the dry fertilizer plots.

CONCLUSION

Soil testing is a reliable tool for predicting phosphate needs for preplant and established high yield alfalfa[7]. We utilize a practical soil testing program for alfalfa to monitor Bicarbonate P levels in the soil. Preplant soils are sampled to a depth of 12 inches. Established fields are sampled to a depth of three inches several times per year and fertilizer is applied per soil analysis. The soil tests are calibrated as follows: 2-6 ppm P very low, 7-11 ppm P low, 12-15 ppm P adequate, and greater than 15 ppm P high. Since there were no significant differences in yield the lower cost fertilizer systems are more efficient. Large broadcast applications of dry fertilizers tend not to be efficient. Light frequent irrigation applied treatments based upon soil P levels are the most efficient and economical means of maintaining high yield alfalfa production.

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