Creating Management Zones for Nutrient Application Decisions in a Bermuda Grass Hay Field

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ABSTRACT

Precision agriculture or ‘precision ag’ dictates an investment in technologies, adding additional costs to the producer. This is why most precision ag has focused on larger farms with traditional row crops. To date, precision ag has not been used as much on smaller farms commonly found in the Piedmont region of the Southeast or enterprises with less profit margin than row crops, i.e., forages. This can be seen in the growth of precision or variable-rate application services in the Coastal Plain vs. the Piedmont.

The land and herd management (LHM) team at the USDA-ARS J. Phil Campbell Sr., Research Center, Watkinsville GA, was motivated by increasing fertilizer prices and a flat research budget to improve efficiencies of fertilizer applications supporting the Center’s research herd of 200 Angus cows. The objective was to develop a practical means for site-specific nutrient applications for hay production, using low cost precision ag tools and equipment/services readily available to forage producers in the Piedmont.

The Center has 1183 acres consisting of woods, ponds, administrative areas, crops, and pastures that support a cow/calf herd. The South Unit has 77 acres that has been harvested for hay three or four times a year since 1993. In summer, the field is a mixture of warm season grasses: 60% bermudagrass [*Cynodon dactylon* (L.) Pers.], 30% Johnson grass [*Sorghum halepense* (L.) Pers.], and 10% large crabgrass [*Digitaria sanquinalis* (L.) Scop]. In spring the field is predominantly ryegrass [*Lolium multiflorum* (Lam.)]. The principal soil type is a Cecil sandy loam with a Pacolet stony sandy loam on slopes.

Since 1993, cultural practices treated the field uniformly; sampling annually for pH, P, and K. Six composite samples were taken across the field; each composite consisting of 20 random sub-samples taken with a hand-held probe (6-in depth). Samples were analyzed at the University of Georgia (UGA), College of Agricultural & Environmental Sciences’ (CAES) Agricultural & Environmental Services Laboratory (AESL). Soil test results, averaged for the six composite samples, were used for determining/applying lime and fertilizer requirements. From 2001-2007, mean fertilizer rates were 180 lbs N/ac/yr, 30 lbs P/ac/yr, and 120 lbs K/ac/yr. During this time, funding constraints prevented applying total nutrient needs called for in soil tests. Weeds and pests were controlled according to UGA Extension recommendations.

In spring 2007, bulk soil electrical conductivity (EC) data was collected at 0-1ft (0-30 cm) and 0-3ft (0-90cm) using a Veris® model 3100 Soil EC Mapping System. This data was used with aerial photographs, first-order soil surveys, and historical field information to determine preliminary Management Zones for soil sampling. Areas of the field were evaluated for soil type

and texture as indicated by the soil survey and EC maps. This combined with the field manager's knowledge of previous yields identified sampling sites reflecting the spatial variability of the field while minimizing the number of samples needed. Twenty-seven sites were established and five subsamples were taken with a hand-held probe to a depth of 6-in within a 15ft circle at each site and composited. Samples were analyzed at the UGA CAES AESL.

Using soil test results, separate site-specific maps were created for P and K requirements. Because of little variation in pH within the field, a uniform application of lime (1 ton/ac) was applied in January 2007. Three zones were developed for P and K needs in order to minimize applicator trips based on custom fertilizer blends. Each sampling site was linked with the prescribed blend for that zone (22-0-20, 17-17-17, or 21-7-15), resulting in a fertilizer prescription map (fig. 1). Using a handheld GPS receiver, application areas were outlined with marking flags for the applicator.

There was greater spatial variability for soil test K compared to P and lime requirements. Due to funding constraints in 2007 we were unable to apply the total required amounts of P and K. Even so, making a single fertilizer application based on field-average soil test values vs. our prescription-blend variable rate application would have resulted in P being over-applied by 12%. At a cost of $1.74/lb P, this inefficient over-application would have cost $307.46. Thus, we believe our practical method for applying fertilizer using non-variable rate equipment will allow us to more efficiently manage fertilizer applications in the future. We also speculate that the use of soils and manager-knowledge data to determine geo-referenced sites for soil samples will improve the precision of nutrient need determinations over time.

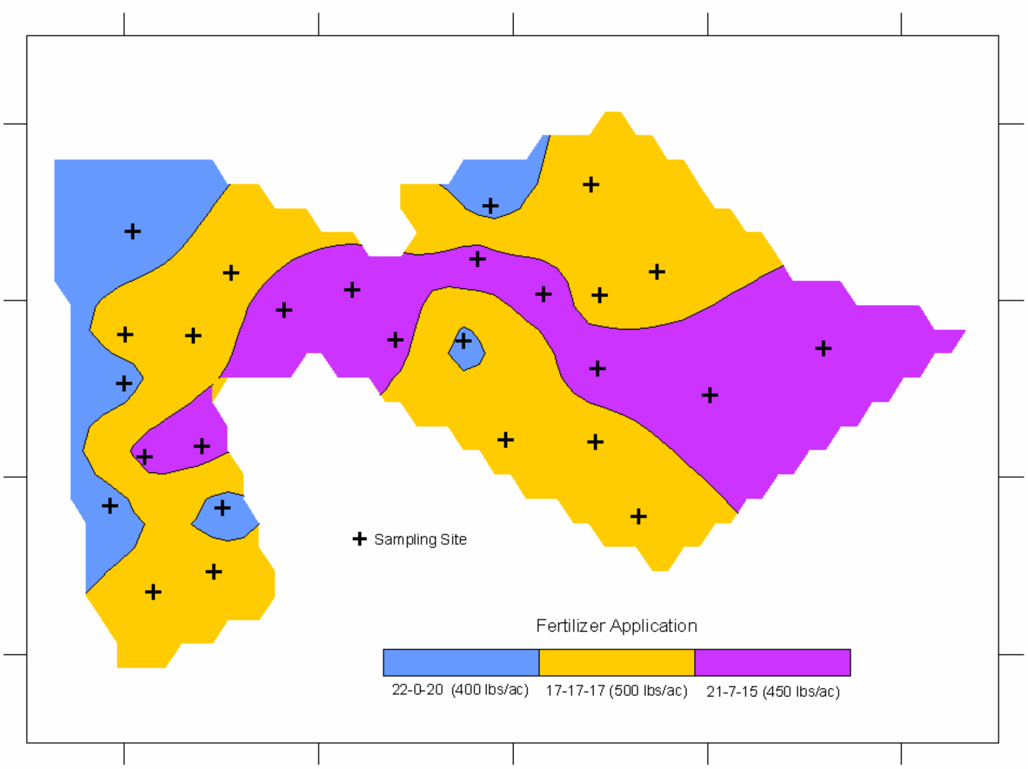

Figure 1. Map of hay field showing areas for applying different fertilizer blends.