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NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZER RATIO BLENDS FOR TIFTON 85 BERMUDAGRASS PRODUCTION

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Background. Use of a standard blend such as a 3 - 1 - 2 ratio of nitrogen (N) - phosphorus (P as P_2O_5) - potash (K as K_2O) for fertilization of hybrid bermudagrass or other high nutrient-requirement grasses may have originated in the late 1950's near the time that Coastal bermudagrass was developed. The idea behind use of a standard fertilizer nutrient ratio at first seems to be reasonable; however, to those who have studied soil chemistry/fertility and plant nutrition the use of a standard ratio such as 3 - 1 - 2 is not always wise for several reasons. First, plants take up nitrogen as N, but they do not take up P_2O_5 or K_2O . Rather, plants take up phosphorus as H_2PO_4 , HPO_4^- , and PO_4^{--} , depending on pH of the soil in which the plants are growing, and potassium is taken up as K^+ by plants, rather than as K_2O . Second, it is environmentally and economically unwise to apply a standard blend of N, P_2O_5 , and K_2O without knowing which of these nutrients are adequate or deficient in the soil, i.e., without having the soil analyzed. Third, grasses are not 100% efficient at taking up these nutrients as they are applied in fertilizer. Reasonable estimates of uptake efficiency of applied N vary from near 70% at low N application rates to less than 40% at high rates. Nitrogen uptake efficiency also varies depending on the source of N applied, i.e., N applied as urea (46% N) usually is less efficient than N applied as ammonium nitrate (33% N) when both are applied and left on the soil surface for extended periods without rain but with high humidity and temperature or heavy morning dew. Phosphorus uptake efficiency by forage grasses is often less than 30% of what is applied, especially during a dry season when fertilizer containing P is broadcast and not incorporated into the soil, as is the case for nearly all perennial grasses. Reasonable estimates from our research on potash uptake efficiency vary from 75% at best to possibly 60% of what is applied to acid, sandy soils. Fourth, application of a fertilizer blend containing a low level of P to each re-growth of grass when the soil is deficient in P can starve the grass for P throughout the growing season. When a soil is deficient in P, the bulk of the required P should be applied at or before spring initiation of re-growth, rather than splitting the P application for each re-

growth throughout the season. When soil P levels are closer to adequate, split application with N through the season can help maintain good soil P fertility. Despite the admonition for soil testing, fertilizer industry professionals are often faced with the situation where a producer asks them to apply fertilizer without the benefit of soil test data. In this situation, the fertilizer dealer must be familiar with the particular crop's needs for N, P, and K, and if possible, draw from his records of previous soil testing information to develop an appropriate estimated blend for each forage crop and individual field.

Research Findings. Research data for N, P, and K uptake by Tifton 85 bermudagrass at moderate and very high N rates are presented in Table 1, along with plant nutrient ratios developed from these uptake data.

Table 1. Tifton 85 bermudagrass nutrient uptake and projected application ratios. [†]

Nutrient factors	@ 80 lb N/ac/cutting	@ 160 lb N/ac/cutting
	-----lb-----	
N uptake/ton DM	42.6	55.3
P uptake/ton DM	7.7	7.2
as P ₂ O ₅ /ton DM	17.6	16.5
K uptake/ton DM	44.1	43.4
as K ₂ O/ton DM	53.1	52.3
Projected application ratios:	-----Blends-----	
N - P - K	5.5 - 1 - 5.7	7.7 - 1 - 6.0
N - P ₂ O ₅ - K ₂ O	2.4 - 1 - 3.0	3.4 - 1 - 3.2

[†]Data are derived from five harvests in a K rate and source study during one normal rainfall season (2004) at Overton.

Application. Considering only the 80 lb/ac/cutting N rate, the total N, P, and K uptake ratio computes to 5.5 - 1 - 5.7, or 11 - 2 - 11 in whole numbers. Converted to a ratio of N - P₂O₅ - K₂O, these values become 2.4 - 1 - 3.0, or 5 - 2 - 6. This ratio of N - P₂O₅ - K₂O is a starting point that assumes the target soil is deficient in N, P, and K. Remember, this is a crude estimate based on nutrient uptake... it is always best to develop site specific recommendations based on soil test results. Remember too that N, P, and K fertilizers are not taken up by plants at 100% efficiency, and that several soil and environmental factors can affect uptake efficiency. Therefore, application of these nutrients in a ratio based on plant uptake may result in a deficient level of one or more nutrients for the targeted grass crop.