MANAGING SWEET SORGHUM FOR OPTIMUM ETHANOL YIELD IN MISSOURI

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ABSTRACT

Sweet sorghum has the potential in Missouri for production as a biofuel feedstock, but little is known of the crop’s yields and appropriate nitrogen management for optimizing ethanol yields. This thesis is a collection of three field studies examining the potential for sweet sorghum (Sorghum bicolor (L.) Moench) to be adopted as a biofuel feedstock for ethanol production in the state. The first study included testing the effects of five N fertilizer rates (0, 56, 112, 168, 224 kg-N ha\(^{-1}\)) on the production of two sweet sorghum cultivars (Dale and Top 76-6) over three years in central Missouri. Yields measured included dry matter, stem juice, Brix, fermentable sugar, theoretical juice ethanol, theoretical lignocellulosic ethanol, and total theoretical ethanol. N fertilizer treatment mostly increased yields, as total ethanol yield averaged 5828 L ha\(^{-1}\). The optimal range for N fertilizer rates was between 112 and 168 kg N ha\(^{-1}\). The second study included determining the above-ground plant N concentration, plant N content, N recovery efficiency, and physiological N-use efficiency of sorghum from the first study. The optimum range for highest nitrogen recovery and use efficiencies was identified as 0-112 kg N ha\(^{-1}\). The purpose of the third study was to better understand sweet sorghum’s affect on soil organic carbon. This involved comparing the effects of an alternative sweet sorghum–soybean (Glycine max L.) rotation to a maize (Zea mays L.)–soybean rotation at three study sites in Missouri and Arkansas on yields, soil organic carbon, and two labile soil carbon fractions: potassium permanganate oxidation and particulate, adsorbed, occluded carbon. Sweet sorghum ethanol yields were greater than maize yields across sites, but the soil carbon similarly decreased regardless of crop and location.