The Sustainability of Biomass Production in Mediterranean Climates - Nitrogen and Water Use in Low and High Input Irrigated Switchgrass (Panicum virgatum) Systems in California

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Introduction

Switchgrass has been cited as one of the more promising bioenergy crops in the US; however, information about switchgrass productivity for biofuel purposes in California is lacking. Nitrogen and irrigation demand are unknown. In ongoing research switchgrass has been managed as a 2-harvest system with 70% of the annual biomass produced in the first harvest. Single-harvest systems may produce less biomass but may also require less water and nitrogen. The objectives of this study were to evaluate biomass productivity, water use and nitrogen dynamics under low and high input systems. The low input consisted of a single-harvest in November with irrigation cut-off at flowering (July). The high input system consisted of a 2-harvest system (July and November) with irrigation throughout the growing season. Sub-treatments were 0, 100 and 200 kg N ha^{-1} yr^{-1}. Miniplots of 15N were used in the 100 kg N ha^{-1} yr^{-1} plots to determine fertilizer recovery efficiency, N use efficiency, and N fate.

Results and Conlusion

The low input system produced on average 29% less biomass than the high input system (17 Mg DM ha^{-1} yr^{-1} versus 23 Mg DM ha^{-1} yr^{-1} respectively), but required 35% less irrigation water, resulting in higher water use efficiency. The 100 and 200 kg N ha^{-1} yr^{-1} N treatments produced significantly more biomass than the 0 N plots, but were not different from each other in both harvest systems. Total N removal by harvest was 75 and 187 kg N ha^{-1} yr^{-1} in low and high input systems receiving 100 kg N ha^{-1} yr^{-1}. At the last harvest, the 15N miniplots showed that 92 and 80% of the fertilizer N was recovered, considering the plant and soil, in the low and high input system, respectively. Fertilizer N removed by harvest was 18% in the low input system and 42% in the high input system (sum of both harvests). At the last harvest 29% of the fertilizer N was stored in plant tissue (crown plus roots) and 46% was in the soil in the low input system, versus 12% in plant tissue and 25% in the soil in the high input system. The results suggest that single-harvest systems were able to use resources more efficiently, achieving greater biomass production per unit of water and nitrogen applied while maintaining high biomass productivities.

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Author publications

Pedroso, G.M., De Ben, C.; Hutmacher, R.B.; Orloff, S.; Putnam, D.; Six, J.; van Kessel, C.; Wright, S.; Linquist, B. (In Press). Establishment and Productivity of Irrigated Switchgrass across Ecozones in California. California Agriculture.