

## **Productivity and nutrient dynamics in bioenergy double-cropping systems.**

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### **ABSTRACT**

Double-crop systems have the potential to generate additional feedstocks for bioenergy and livestock utilization, and also to reduce NO<sub>3</sub>-N leaching relative to sole-crop systems. Field studies were conducted near Ames, IA, during 2005–2007 to evaluate productivity and crop and soil nutrient dynamics in three prototypical bioenergy double-crop systems, and in a conventionally managed sole-crop corn system. Double-cropping systems evaluated in the study included fall-seeded forage triticale (*X Triticosecale* Wittmack), succeeded by one of three summer-adapted crops: corn (*Zea mays* L.), sorghum-sudangrass [*Sorghum bicolor* (L.) Moench], or sunn hemp (*Crotalaria juncea* L.). Total dry matter production by triticale/corn and triticale/sorghum-sudangrass was 25% greater than sole-crop corn, which in turn produced 21% more dry matter than triticale/sunn hemp. Potential ethanol yield was greatest for triticale/corn, which was estimated to have the capacity to produce 1080 L ha<sup>-1</sup> more ethanol than sole-crop corn. Crop N uptake was greater in double-crop systems during April–June, greater in the sole-crop corn system during July–August, and greater again in double-crop systems during September–October. Relative to sole-crop corn, potentially leachable soil N was reduced in double-crop systems by 34 and 25%, respectively, in the spring (mid-April) and fall (late October). High nutrient density of biomass coupled with high productivity for triticale/corn and triticale/sorghum systems also resulted in the removal of 83, 41, and 177% more N, P, and K, respectively, compared with sole-crop corn. Sustained removal of large quantities of nutrient-dense biomass from double-cropping systems would necessitate increased fertilization or integration with nutrient recycling mechanisms.