

Performance of Sweet and Forage Sorghum Grown in Monoculture, Double Cropped with Winter Rye, or in Rotation with Soybean and Corn

D.R. Buxton, I.C. Anderson and A. Hallam

Introduction

Potential for soil erosion restricts sorghum grown for forage or biomass to soils with little slope. Furthermore, because most of the aboveground crop is removed, soils may be at risk for water and wind erosion, and leaching of soil nitrate from the time sorghum is harvested until the next crop is planted and established; more than 6 months in the North Central Region of the United States. Double cropping with winter annuals after sorghum harvest can provide soil protection during the winter and following spring, tie up excess soil N, increase water infiltration, and may increase total biomass yield per year. Early spring growth of winter annuals, however, depletes soil moisture and may limit subsequent crop production. Winter rye is a potentially complementary double crop to sorghum. It is the most winter-hardy of the small grains and can provide high-quality forage. Winter rye can be seeded in fall after sorghum and become established before late-fall and winter temperatures prevent growth and development. It initiates new growth in late winter and early spring so that considerable biomass is produced before soil temperatures are warm enough to plant sorghum. This study was conducted to determine yield potential and composition of sweet and forage sorghum grown alone and when these sorghums are double cropped with winter rye and to determine the effect of growing sorghum in successive monoculture in relation to sorghum grown in a 3-year rotation with corn and soybean.

Materials and Methods

The experiment was conducted for five consecutive years on a Harps soil in central Iowa near Ames with a slope of less than 1% and on mixed Clarinda, Clearfield, and Grundy soils in southern Iowa near Chariton with 2 to 7% slope. 'M-81E' sweet sorghum and 'FFR 201' forage sorghum (sorghum x sudangrass) were grown in

monoculture or double cropped with 'Aroostock' winter rye at four levels of N fertilization. Additionally, sweet sorghum, in a 3-year rotation with corn and soybean, was grown alone or double cropped with winter rye.

Results and Discussion

Sole forage and sweet sorghums were only moderately affected by N fertilization with average yields of 13.5, 16.1, 16.9, and 15.9 t ha⁻¹ when fertilized with 0, 70, 140, and 280 kg N ha⁻¹, respectively. Conversely, rye/sorghum was extremely responsive to N, with highest yields at 280 kg N ha⁻¹. Winter rye yields averaged 3.0, 4.1, 4.6, and 5.0 t ha⁻¹ and rye/sorghum yields were 72, 84, 95, and 110% of sole sorghum fertilized annually with 0, 70, 140, and 280 kg N ha⁻¹. Rye/sorghum yields were particularly sensitive to droughts. The low yield of rye/sweet sorghum relative to sole sweet sorghum during a drought year is illustrated in Fig. 1. Conversely, the high yield of rye/sweet sorghum during a wet year is shown in Fig. 2. Sweet sorghum grown in monoculture had yields similar to sweet sorghum grown in the 3-year rotation. Estimated annual soil erosion for sole sorghum determined by using the Universal Soil Loss Equation was 5 t ha⁻¹ in central Iowa and 35 t ha⁻¹ in southern Iowa. Planting rye before sorghum reduced the estimated loss to 3 t ha⁻¹ in central Iowa and 22 t ha⁻¹ in southern Iowa. Fiber concentration was higher in winter rye than in sorghum. Composition of sorghum was strongly influenced by environmental conditions of the study.

Conclusions

Winter rye can reduce potential soil erosion, but rye/sorghum yields are much more dependent on N fertilization and soil moisture than is sole sorghum. Though reduced, erosion was still too high to allow rye/sorghum production on the sloping soils of southern Iowa. Below normal

rainfall resulted in rye/winter yields that were consistently lower than those of sole sorghum. Including sweet sorghum in a 3-year rotation with corn and soybean had only limited impact

on sole sweet sorghum production compared with sorghum grown repeatedly on the same plots for 5 years.

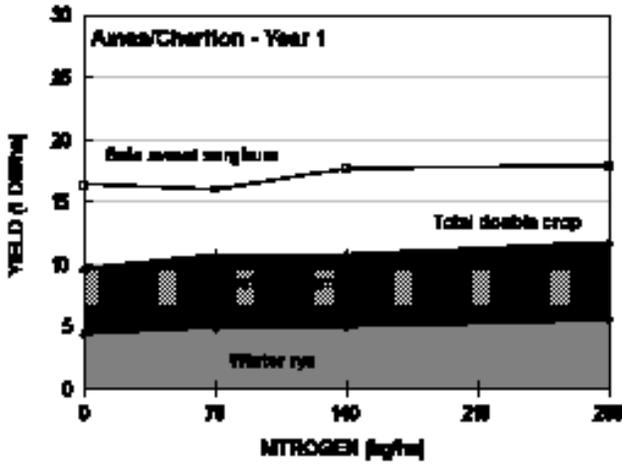


Figure 1. Yield of winter rye, winter rye plus double cropped sweet sorghum, and sole sweet sorghum at two locations in Iowa during a drought year.

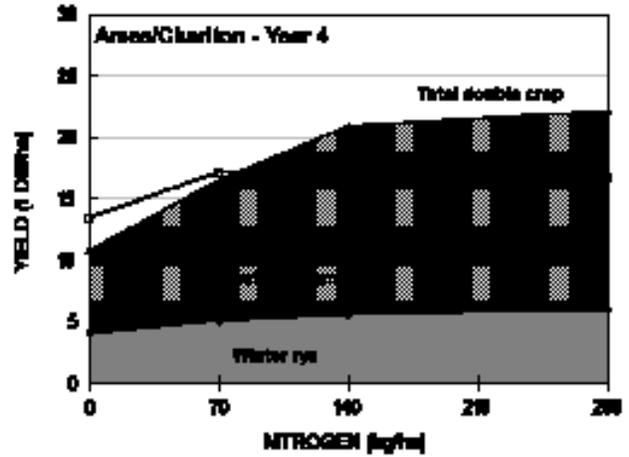


Figure 2. Yield of winter rye, winter rye plus double cropped sweet sorghum, and sole sweet sorghum at two locations in Iowa during a wet year.