

Productivity and residual benefits of grain legumes to sorghum under semi arid conditions in south-western Zimbabwe

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Problem

Smallholder farmers in semi-arid Zimbabwe harvest low cereal yields due to poor soil fertility. Nitrogen is the major limiting nutrient. Fertilizer is expensive and organic sources such as manure are scarce. There is need to find alternative sources of nutrients. Legume-cereal rotations might be one of the options.

Objectives

- Assess the productivity of grain legumes under semi arid conditions.
- Assess the residual benefits of legumes to sorghum grown after the legumes.
- Simulate the results using the Agricultural Production Simulator (APSIM) model and assess whether the yield benefits to sorghum were due to nitrogen or water

Materials and Methods

Eight grain legume varieties were grown for 3 cropping seasons at Lucydale, Matopos (annual rainfall 590 mm). Sorghum was planted after the legumes for two seasons (2003/04 and 2004/05). The field results were further explored using the model APSIM (6 of the legumes)

Results

Legumes were harvested in all the three seasons of experimentation. The yields were higher than the current national averages. APSIM predicted the yields well (Figure 1a, b, and c).

Sorghum grain yields following legumes were higher than yields harvested from sorghum after sorghum plots (Figure 2a and b).

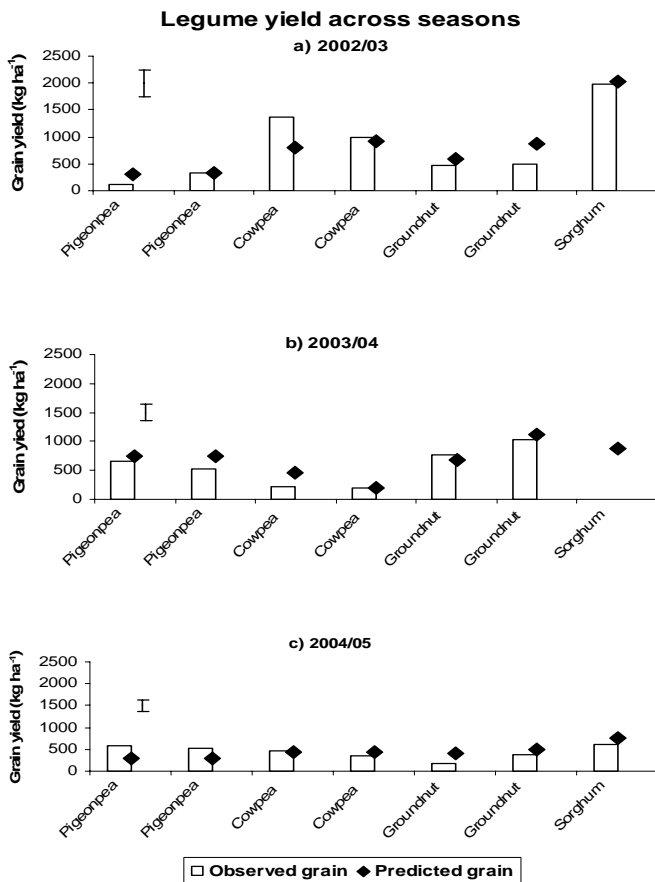


Figure 1. Legume and sorghum grain yields harvested at Lucydale, and APSIM predictions of the yields

Results

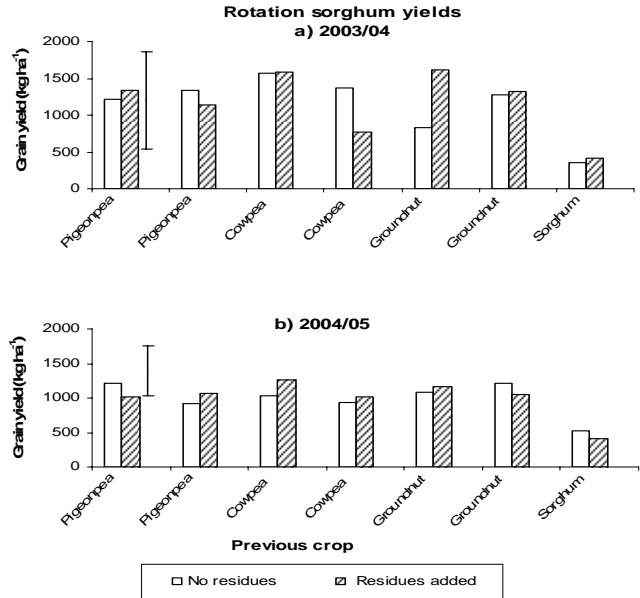


Figure 2. Rotation sorghum grain yields after legumes and sorghum at Lucydale, 2002/04 and 2004/05

The analysis of stress factors on crop growth using APSIM showed that sorghum yields were more limited by nitrogen supply than water availability. Sorghum grown after legumes exhibited less nitrogen stress compared to sorghum grown after sorghum (Figure 3a). The sorghum-sorghum-sorghum rotation was less affected by water stress compared to the legume-sorghum-sorghum rotation (Figure 3b).

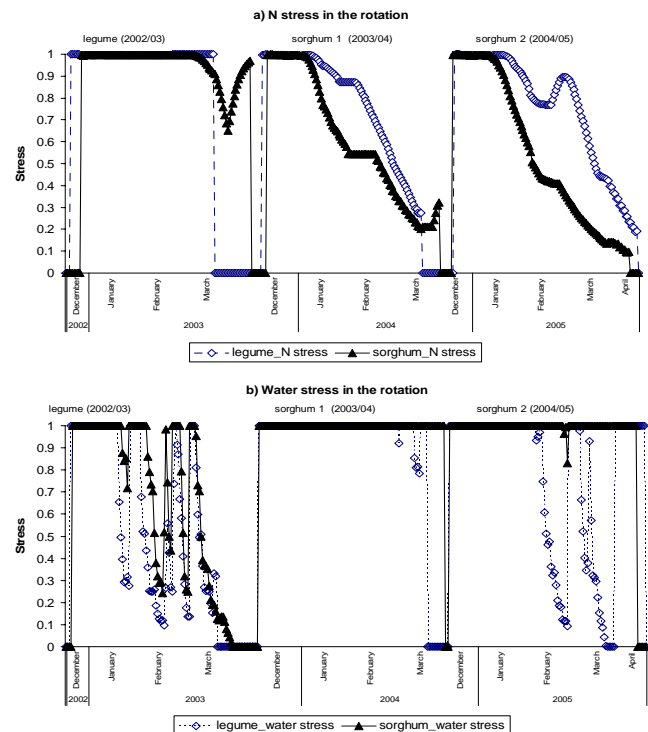


Figure 3. Nitrogen and water stress predictions in crops cross three seasons

Conclusions

Legumes had a beneficial effect on sorghum yield grown after the legumes. The APSIM model gave satisfactory predictions of legume yield across the three cropping seasons. Sorghum yield predictions by the model were also good. The APSIM model showed that the residual benefits of legumes to subsequent sorghum were mainly due nitrogen, more than water, under semi arid conditions.