

## Residual Cropping Effects on Corn Grain Yield

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### Introduction

Cropping systems are known to have residual effects on soil quality and the productivity of following crops. Many of these effects have not been quantified for a range of cropping systems. This study was conducted to evaluate the effect of growing several annual and perennial crops on subsequent corn production.

### Materials and Methods

Corn was grown on plots following 6 years during which one of 13 cropping systems was grown. The cropping systems were:

1. 'Arrow' alfalfa with subplots managed for either two or three cuts per year commencing the year following establishment.
2. 'Venture' reed canarygrass harvested twice per year, with subplots fertilized annually with 0, 70, 140, or 280 kg N ha<sup>-1</sup> beginning the year after establishment.
3. 'Cave-in-Rock' switchgrass harvested once per year, with subplots fertilized annually with 0, 70, 140, or 280 kg N ha<sup>-1</sup> beginning the year after establishment.
4. 'Sunny View' big bluestem harvested and fertilized as described for Cropping System 3.
5. 'M-81E' sweet sorghum harvested once per year, with subplots fertilized with 0, 70, 140, or 280 kg N ha<sup>-1</sup>.
6. 'FFR 201' forage sorghum (sorghum x sudangrass) planted, harvested, and fertilized as described for Cropping System 5.
7. 'Aroostock' winter rye planted near mid October and harvested at anthesis during the succeeding mid May, followed by M-81E sweet sorghum planted in late May or early June. Subplots were fertilized with 0, 70, 140, or 280 kg N ha<sup>-1</sup>. Half the N was applied in late March and the remainder before sorghum planting. The sweet sorghum was harvested in late September.
8. As described for Cropping System 7 but FFR 201 forage sorghum was planted instead of sweet sorghum.
9. 'Pioneer 3377' corn harvested for grain (with stover also removed). Subplots were fertilized with 0, 70, 140, or 280 kg N ha<sup>-1</sup>. This cropping system was in a 3-yr rotation with soybean (Cropping System 10) and winter rye/sweet sorghum (Cropping System 11). Corn followed rye/sorghum in the rotation.
10. 'Hack' soybean grown in a 3-yr rotation with corn and winter rye/sweet sorghum. Soybean followed corn in the rotation and was harvested for grain with the stover also being removed.
11. Winter rye/sweet sorghum or winter rye/forage sorghum grown in a 3-yr rotation with soybean and corn. Subplots either contained or did not contain winter rye in combination with two N fertilization rates, 70 or 140 kg ha<sup>-1</sup>. This cropping system followed soybean in the rotation.
12. M-81E sweet sorghum or FFR 201 forage sorghum intercropped into Arrow alfalfa beginning the year after alfalfa was established. Two subplots were planted to sweet sorghum and two to forage sorghum. Each sorghum was fertilized with 70 or 140 kg N ha<sup>-1</sup>.
13. As described for Cropping System 12 but sweet and forage sorghum were interplanted into Venture reed canarygrass instead of alfalfa.

Cropping Systems 9, 10, and 11 were in rotation as described. All other cropping systems were on the same plots each year. In the fall of 1993, perennial grasses and alfalfa were sprayed with a herbicide and the entire site was moldboard plowed. In late April 1994, Pioneer 3377 corn was planted. After the plants were established, 224 kg N ha<sup>-1</sup> from urea ammonium nitrate were applied to half of each plot.

## Results and Discussion

Except corn following switchgrass, 224 kg current N ha<sup>-1</sup> (N applied in 1994) resulted in near maximal grain yields regardless of the previous cropping system and previous N application rate. Highest corn yields occurred following alfalfa. There were marked carryover effects of previous N. Averaged for the eight cropping systems that received four rates of N yearly (Cropping Systems 2-9), corn grain averaged 7.6 t ha<sup>-1</sup> when the previous cropping systems received no N and no current N was applied. When no current N was applied, corn grain yields increased 12, 29, and 41% when the previous cropping systems received 70, 140, and 280 kg N ha<sup>-1</sup>, respectively. Application of 224 kg N ha<sup>-1</sup> to plots that had not received N for 6 years increased corn yields by 71%. The carryover effect of previous N was particularly strong for corn following the three perennial grasses (Cropping Systems 2-4). Corn yields increased 44, 77, and 97% over the unfertilized checks when the three previous perennial grasses were fertilized with 70, 140, and 280 kg N ha<sup>-1</sup> per year, respectively. This response is illustrated for reed canarygrass in Fig. 1. The four cropping systems that contained sorghum (5-8) had smaller carryover effects. Average corn yields were increased -2, 5, and 11% over the unfertilized checks when the previous crops were fertilized with 70, 140, and 280 kg N ha<sup>-1</sup>, respectively. This type of response is illustrated in Fig. 2 for corn following forage sorghum. We were unable to document any consistent effects of the cropping systems on soil aggregate stability or nitrate N in the soil profile before the corn was planted.

Alfalfa has strong positive carryover effects on subsequent corn production. Much of this can be accounted for by the fixed N, but there appeared to be an effect beyond the N effect. The perennial grasses had marked N carryover effects. N was probably tied up by the root system of these crops and was released to the corn as the root systems decomposed. N carryover effects from sorghum were much smaller.

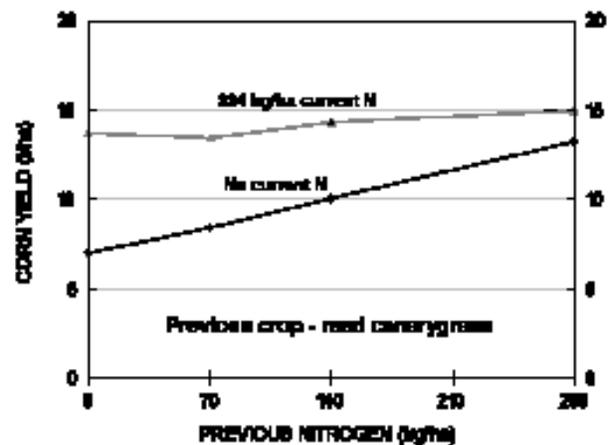


Figure 1. Corn grain yield following 6 years of reed canarygrass fertilized at four rates of nitrogen. The corn crop received 0 or 224 kg N ha<sup>-1</sup>.

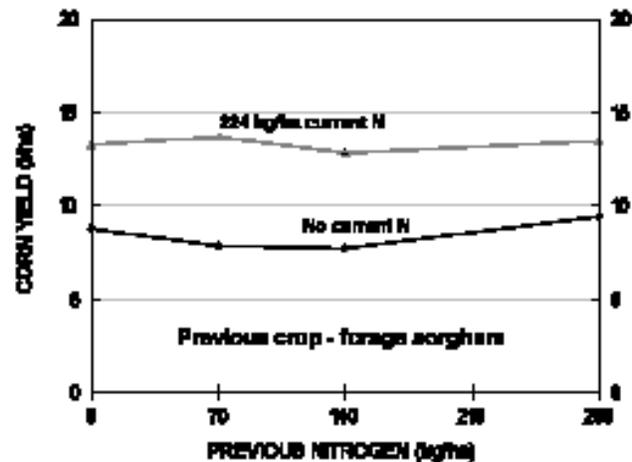


Figure 2. Corn grain yield following 6 years of forage sorghum fertilized at four rates of nitrogen. The corn crop received 0 or 224 kg N ha<sup>-1</sup>.