Growth and Nitrogen Contribution of Cover Crops in Long-term Cropping Systems

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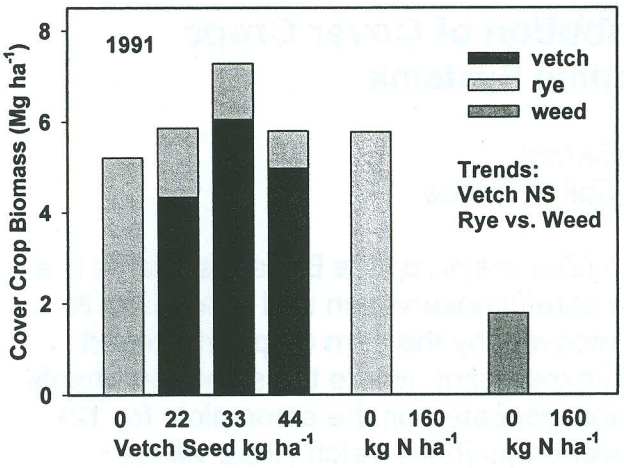
Nitrogen management in cover crop-sweet corn (*Zea mays rugosa* Bonaf.) systems is a complex and dynamic process and requires the careful observation and analysis of N inputs for an assessment of the subsequent N recovery by the corn crop. This report summarizes key trends observed in a long-term experiment, where the same treatments of winter cover crops and sweet corn rotation were repeated on the same plots for 12+ years. The treatments consist of fall-planted cover crops [hairy vetch (*Vicia villosa* Roth), rye (*Secale cereale* L.), oat (*Avena sativa* L.)] and ammonium nitrate (NH_4NO_3) fertilizer in sweet corn production (Table 1). Ammonium nitrate fertilizer was applied as a sidedress application to the corn when the corn was 30 cm high. A low, medium, or a high seeding rate of hairy vetch was planted with rye and later separately with oat, to help determine the most economical vetch seeding rate. Treatments of hairy vetch + oat were planted to ascertain whether this combination was a superior replacement for a hairy vetch + rye companion planting. Rye is winter hardy, however, oat dies at the time of the first severe or killing frost.

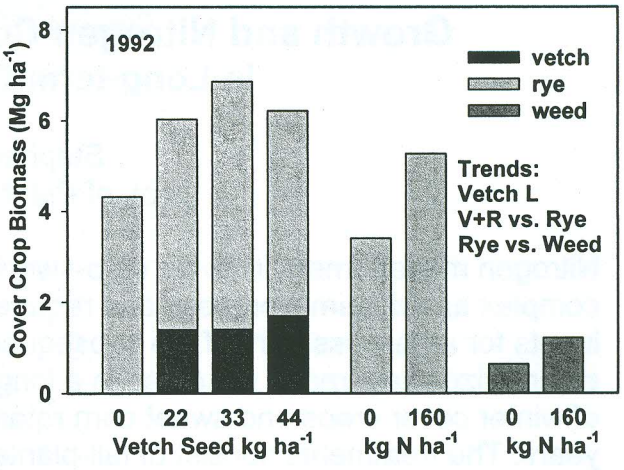
Table 1. Cover crop treatments and N applied to the sweet corn crop.

Treatment	Seeding Rate			N applied†
	Vetch	Oat	Rye	
	kg ha^{-1}			
1	20	40	0	0
2	30	40	0	0
3	40	40	0	0
4	20	0	56	0
5	30	0	56	0
6	40	0	56	0
7	0	0	0	0
8	0	0	90	0
9	0	0	0	140
10	0	0	90	140

† as NH_4NO_3 sidedress to the corn

Significant trends in growth of cover crop species occurred over the time period of this long-term study. In spring 1991, the first cover crop growth year, growth of vetch planted with rye was several orders greater than the rye growing with the vetch (Figure 1). In the fall of 1990 the cover crops were planted following several years of corn. In 1992 the vetch growth was suppressed by the greater vigor and growth of the rye presumably





Figures 1 and 2. Cover crop biomass for the first and second years of the long-term cropping system study.

responding to residual N contributed from the previous vetch growth. A similar result was found in 1993. For the years 1994 to 1996 rye with vetch was replaced with oat. The oat made some growth in the fall but winter killed and thus did not compete with the vetch growth in the spring (Figure 3). As a result the growth of vetch in these years increased to the level seen in the first year.

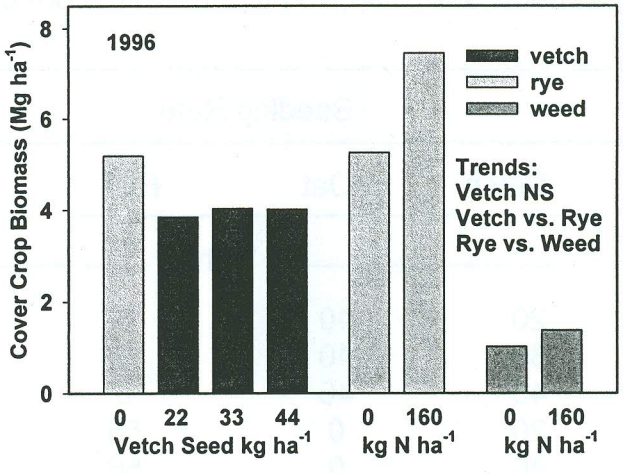
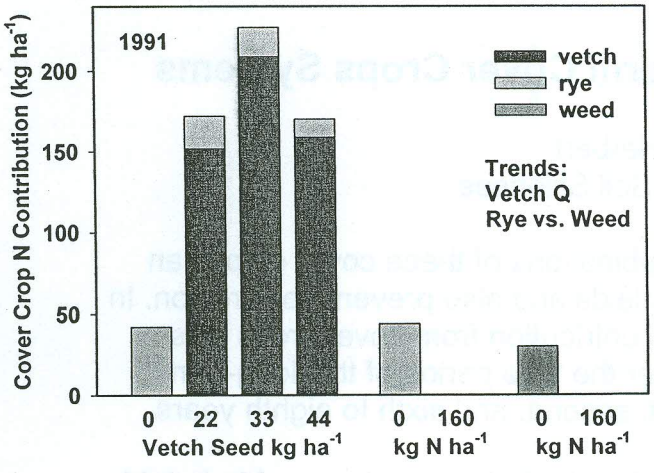


Figure 3. Cover crop biomass for the sixth year of the long-term cropping system study.

The presence of rye in planted with hairy vetch, in causing vetch biomass to be suppressed, reduced N contribution upon incorporation, compared to plots where vetch was planted with oat (Figures 4 to 7). In the first year (Figure 4) vetch contributed more than 150 kg/ha (135 lb/ac) of N from above ground biomass. Additional N would be available from dropped leaves and root biomass. In the second year the N contribution from vetch was much reduced because of the suppression in vetch growth by the rye (Figure 5). The recover of N contribution occurred when vetch was planted with oat (Figures 6 and 7).

The amount of N contributed by the hairy vetch residue did not increase substantially with increasing seeding rate of vetch in any year. Rye biomass was significantly higher in plots where there was a carryover of N from high vetch growth the previous season or



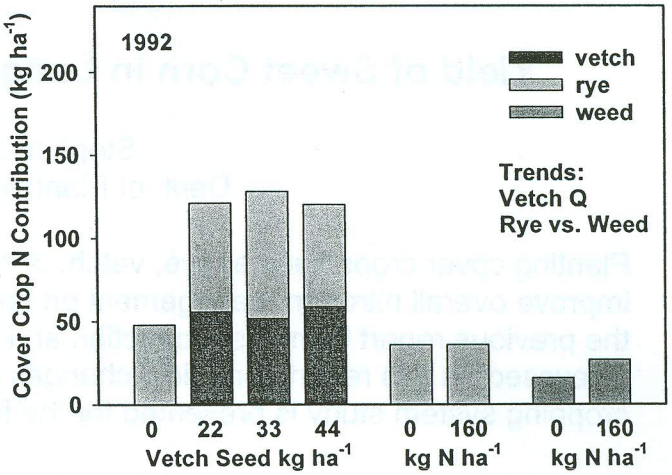
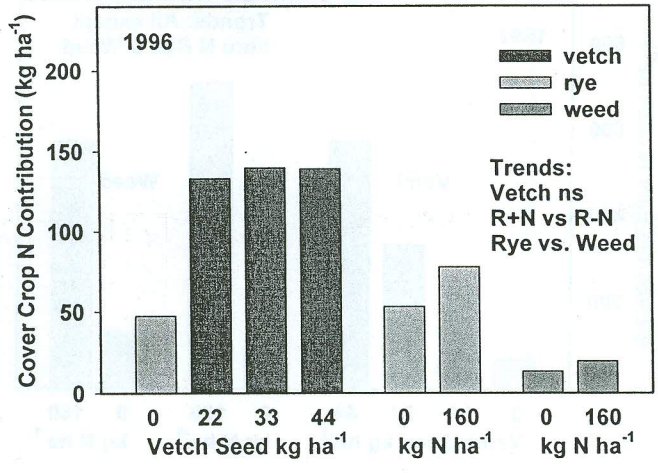


Figure 4 and 5. Nitrogen contributed by cover crops in the first and second years of the long-term cropping system study.



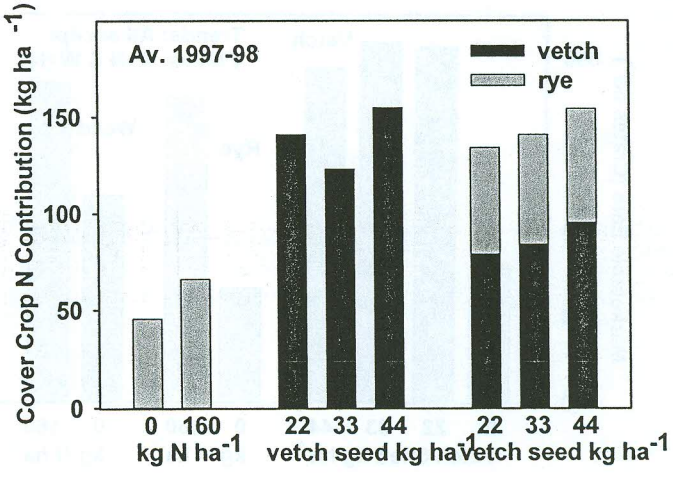


Figure 6 and 7. Nitrogen contributed by cover crops in the sixth and seventh and eighth years of the long-term cropping system study.

from sidedress N to the corn in the previous summer. In later years, when rye and oat were grown with vetch (Figure 7) the amount of N contribution from vetch with rye was significantly lower than N contribution from vetch with oat.

Based on this long-term cropping system study, oat rather than rye is the preferred companion cover crop for hairy vetch and there was no benefit to increasing seeding rate of hairy vetch above 20 lb/ac. The recommended rate had been 40 lb/ac. The pre-sidedress soil nitrate test (PSNT) in 1997 and 1998 and cover crop grow responses in subsequent years revealed that only the hairy vetch-oat combination met or exceeded 25 pmm NO_3 -N in soil. This is the recommended sufficiency level for field and sweet corn. This again supports the conclusion that oat is the preferred companion cover crop with hairy vetch.

(Several graduate students in Dept. of Plant and Soil Sciences have contribute to these long-term cover crop studies and there contributions are acknowledged.)