Cover Crop Biomass and Subsequent Corn Yield for 13 Winter Rye, Wheat, and Triticale Cover Crop Cultivars

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Introduction:

Winter cover crops have the potential to reduce nitrate leaching and erosion in corn-soybean rotations in the Upper Midwest. The cover crop growing season between harvest and planting is cold and short, which limits cover crop growth. Additionally, previous studies have indicated that winter rye cover crops can reduce the yield of the following corn crop, if the cover crop is killed immediately before corn planting. Few studies have examined different cultivars of winter rye, wheat, and triticale to determine if there are differences in biomass production and effect on corn yield when these cultivars are used as winter cover crops.

Objectives:

- **Determine shoot biomass production of different cultivars**
- **Determine effect of cultivars on corn population and yield.**

Materials and Methods:

Eight winter rye, three winter wheat, and two winter triticale cultivars were planted in the fall following soybean harvest with a grain drill in rows 0.19 m apart in four years from 2005-2008. Plots were 3.8 x 38.1 m and there were three reps of each cultivar plus no cover crop control plots. Cover crop shoot biomass was measured in the following springs and corn population and yield in the same plots were measured the following falls (2006-2009). Corn yield had not been measured yet in 2009. Data was analyzed as a RCBD using PROC GLM for individual years and combined years. A 0.10 significance level was used for lsd tests, when main effects were significant.

Table 1

Cover Crop Shoot Dry Weight (Mg/ha)

Cultivar	Species	2006	2006 Rank	2007	2007 Rank	2008	2008 Rank	2009	2009 Rank	4-yr. Avg.	4-yr Rank	06-07 Rank
Aroostook	rye	4.01 a	2	1.40 cd	10	1.33 ab	4	1.77 a	1	2.13 a	2	3
Boreal	tritcale	1.97 d	13	1.08 de	11	0.43 c	12	0.30 gf	13	0.94 e	13	13
Dacold	rye	2.57 c	9	2.08 a	1	1.25 ab	7	1.42 abc	4	1.83 b	4	6
Elbon	rye	3.74 a	4	1.90 ab	2	1.60 a	1	1.39 abc	5	2.16 a	1	2
Handcock	rye	3.15 b	5			1.24 b	8	1.21 bcd	7	1.82 b	5	4
Maton	rye	4.10 a	1	1.59 bc	6	1.31 ab	5	1.45 abc	3	2.11 a	3	1
NE-422t	tritcale	1.99 d	12	1.42 cd	9	0.47 c	11	0.74 ef	12	1.15 e	12	12
Nekota	winter wheat	2.54 c	10	1.75 abc	4	0.47 c	10	1.20 bcde	8	1.49 cd	10	9
Oklon	rye	3.80 a	3	0.75 e	12	1.30 ab	6	0.92 ed	11	1.69 bcd	7	7
Pronghorn	winter wheat	3.01 bc	6	1.69 abc	5	0.49 c	9	1.10 bcde	9	1.57 bcd	9	5
Rymin	rye	2.71 bc	7	1.43 cd	8	1.33 ab	3	1.46 ab	2	1.73 bc	6	10
Wesley	winter wheat	2.62 bc	8	1.83 abc	3	0.37 c	13	1.00 cde	10	1.46 d	11	8
Wheeler	rye	2.49 cd	11	1.44 cd	7	1.46 ab	2	1.25 bcd	6	1.66 bcd	8	11
Year Avg.		2.98		1.53		1.00		1.17		1.67		
LSD (0.10)		0.53		0.44		0.35		0.46		0.27		

Table 2

Corn Final Population Following Cover Crop Cultivars (plants/ha)

Cultivar	2006	2006	2007	2007	2008	2008	2009	2009	4-yr.	4-yr	06-07
No Cover Crop	74818 a	1	74061 a	2	74634 a	6	73892 abc	9	74351 a	1	1
Aroostook	59000 de	14	70494 ef	11	66375 b	14	74060 abc	7	67482 d	14	14
Boreal	63592 de	11	73364 abc	4	71936 ab	10	73601 abc	11	70623 c	11	10
Dacold	68695 bcde	3	74474 a	1	74508 a	8	74328 abc	6	73001 ab	2	2
Elbon	70544 bcd	2	71872 bcde	7	71697 ab	12	72988 abc	12	71775 bc	4	3
Handcock	64613 bcde	7			74926 a	5	72338 bc	13	70625 c	10	6
Maton	66590 cde	5	71451 bcde	8	71817 ab	11	73945 abc	8	70951 bc	8	7
NE-422t	63783 bcde	10	69269 f	13	75763 a	2	74596 ab	4	70853 bc	9	11
Nekota	60594 e	13	70226 ef	12	75345 a	4	75553 a	1	70429 c	12	13
Oklon	64549 bcde	8	73211 abcd	5	71099 ab	13	75132 ab	2	70998 bc	7	8
Pronghorn	64357 bcde	9	72790 abcd	6	75584 a	3	73639 abc	10	71593 bc	6	9
Rymin	68333 abc	4	71281 def	10	74508 a	7	74421 abc	5	72136 bc	3	5
Wesley	61615 de	12	71336 cdef	9	76002 a	1	71649 c	14	70150 c	13	12
Wheeler	66016 ab	6	73556 ab	3	72654 ab	9	74596 ab	3	71705 bc	5	4
Year Avg.	65507		72107		73346		73910		71191		
LSD (0.10)	1899		868		2682		1160		891		

Table 3

Corn Yield Following Cover Crop Cultivars (Mg/ha)

Cultivar	2006	2006	2007	2007	2008	2008	3-yr	3-yr	06-07
No Cover Crop	12.21 a	1	11.95 a	2	12.10 abcd	4	12.09 a	1	1
Aroostook	11.07 de	11	11.25 def	10	11.65 bcde	11	11.33 e	14	13
Boreal	11.05 de	13	11.86 ab	5	12.19 abc	3	11.70 bcd	5	8
Dacold	11.36 bcde	9	11.12 ef	12	11.51 de	13	11.33 e	13	12
Elbon	11.56 bcd	4	11.66 abcd	7	11.92 abcde	6	11.71 bcd	4	4
Handcock	11.45 bcde	7			11.45 e	14	11.40 dc	12	7
Maton	11.18 cde	10	11.87 ab	4	11.60 cde	12	11.55 bcde	9	6
NE-422t	11.39 bcde	8	11.09 f	13	12.47 a	1	11.65 bcd	7	11
Nekota	10.97 e	14	11.18 ef	11	12.09 abcd	5	11.41 de	11	14
Oklon	11.51 bcde	6	11.96 a	1	11.90 abcde	7	11.79 abc	3	3
Pronghorn	11.51 bcde	5	11.28 cdef	9	11.66 bcde	10	11.48 dce	10	9
Rymin	11.67 abc	3	11.54 bcde	8	11.73 bcde	9	11.65 bcd	8	5
Wesley	11.06 de	12	11.70 abc	6	12.23 ab	2	11.67 bcd	6	10
Wheeler	11.89 ab	2	11.91 ab	3	11.76 bcde	8	11.85 ab	2	2
Year Avg.	11.36		11.52		11.86		11.58		
LSD (0.10)	1.24		0.86		0.65		0.76		

Fig. 1

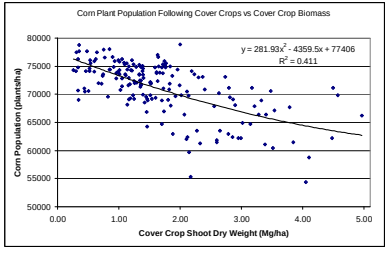

Fig. 2

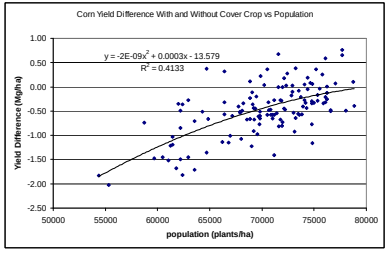

Table 4

Cultivar	Cover Crop Dry Weight 4-yr Rank	Cover Crop Dry Weight 06-07 Rank	Corn Population 4-yr Rank	Corn Population 06-07 Rank	Corn Yield Rank 3-yr Rank	Corn Yield Rank 06-07 Rank
No Cover Crop			1	1	1	1
Aroostook	2	3	14	14	14	13
Boreal	13	13	11	10	5	8
Dacold	4	6	2	2	13	12
Elbon	1	2	4	3	4	4
Handcock	5	4	10	6	12	7
Maton	3	1	8	7	9	6
NE-422t	12	12	9	11	7	11
Nekota	10	9	12	13	11	14
Oklon	7	7	7	8	3	3
Pronghorn	9	5	6	9	10	9
Rymin	6	10	3	5	8	5
Wesley	11	8	13	12	6	10
Wheeler	8	11	5	4	2	2

Results and Discussion:

Cover crop cultivar shoot biomasses for all 4 yrs are shown in Table 1. Cultivars differed significantly in all 4 yrs and the cult x year effect was significant. Although plant counts were not taken visual observations indicated that some cultivar differences, especially in 2008, were the result of poor winter survival. In general, the rye cultivars produced more biomass than the wheat or triticale cultivars. The rye cultivars Elbon and Aroostook produced the most biomass and the triticale cultivars NE-422t and Boreal produced the least biomsss averaged over 4 yrs.

Final corn populations following each of the cover crop cultivars in all 4 yrs are shown in Table 2. In 2006 and 2007 substantial reductions in corn population occurred following the cover crop cultivars and there were differences among cultivars. For example, even rye cultivars differed as Aroostook reduced population substantially and Dacold had less effect. In 2008 only Aroostook reduced corn population relative to the no-cover crop control and in 2009 none of the cultivar treatments differed from the control. Part of the effect of the cover crops seems to be related to the amount of shoot biomass that they produce (Fig. 1). That relationship may be stronger within a cultivar than across cultivars. For example, Dacold ranks relatively high for biomass production, but has a weak effect on population. Conversely, Nekota produces relatively low amounts of biomass, but has a strong effect on population.

Corn yields following each of the cover crop cultivars are shown in Table 3. Like populations differences among cultivars were only apparent in 2006 and 2007. In 2008 only one cultivar, Handcock differed from the control. Fig. 2 shows that part of the effect of cover crop cultivars on corn yield is their effect on corn population. Again this is not true for all cultivars as shown by the relative rankings in Table 4. For example, Dacold had relatively little effect on population but a big effect on yield.

Conclusions:

- **Winter rye, winter wheat, and winter triticale cultivars differed in shoot biomass production when used as winter cover crops.**
- **Cover crop cultivars differed in their effect on corn population in two of four years.**
- **Part of the negative effect of the cover crops on corn population seemed to be related to the amount of shoot biomass produced.**
- **Cover crop cultivars differed in how much they reduced corn yield in two of three years.**
- **Part of the reduction in corn yield caused by cover crops seems to be related to the reduction in corn population.**
- **Although it is too early to pick winners and losers, it is evident that genotypic differences exist.**