Cover Crops for Herbicide Replacement in No-tillage Corn (*Zea mays*)[1]

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Abstract. Weed control by rye, crimson clover, subterranean clover, and hairy vetch cover crops was evaluated in no-tillage corn during 1992 and 1993 at two North Carolina locations. Weed biomass reduction was similar with rye, crimson clover, and subterranean clover treatments, ranging between 19 and 95% less biomass than a conventional tillage treatment without cover. Weed biomass reduction using hairy vetch or no cover in a notillage system was similar averaging between 0 and 49%, but less than other covers approximately 45 and 90 d after planting. Weed biomass was eliminated or nearly eliminated in all cover systems with PRE plus POST herbicide treatments. Weed species present varied greatly between years and locations, but were predominantly common lambsquarters, smooth pigweed, redroot pigweed, and broadleaf signalgrass. Corn grain yield was greatest using PRE herbicides or PRE plus POST herbicides, averaging between 16 to 100% greater than the nontreated control across all cover treatments depending on the year and location. **Nomenclature:** Broadleaf signalgrass, *Brachiaria platyphylla* (Griseb.) Nash. #[3] BRAPP; common lambsquarters, *Chenopodium album* L. # CHEAL; redroot pigweed, *Amaranthus retroflexus* L. # AMARE; smooth pigweed, *Amaranthus hybridus* L. # AMACH; corn, *Zea mays* L. 'Dekalb 689'; crimson clover, *Trifolium incarnatum* L. 'Dixie Reseeding'; hairy vetch, *Vicia villosa* Roth; rye, *Secale cereale* L. 'Wren's Abruzzi'; subterranean clover, *Trifolium subterraneum* L. 'Mount Barker.'

Additional index words: Allelopathy, conservation tillage.

INTRODUCTION

No-tillage corn production has gained popularity as a method of reducing soil erosion, labor, and fuel costs (Gebhardt et al. 1985). However, inadequate weed control in no-tillage systems has been a major barrier to further adoption (Gebhardt et al. 1985).

Undesired pesticide mobility has resulted in recent rate adjustments and other label changes for several herbicides. Reducing herbicide inputs by using allelopathic cover crops could be a benefit in no-tillage systems and compatible with the goals of sustainable agriculture.

Cover crops have long been used to reduce soil erosion, improve soil structure, fix nitrogen, and alter physical and chemical soil characteristics (Worsham et al. 1995). Moreover, allelopathic traits have been noted in several cover crops. Recently, researchers have evaluated the possibility of using cover crops to control weeds (Lehman 1993; Worsham 1989).

Rye is commonly cited in the literature as a weed-controlling cover crop (Barnes and Putnam 1986; Barnes et al. 1986; Doll and Bauer 1991; Eadie et al. 1992; Johnson et al. 1993; Liebl et al. 1992; Worsham and Blum 1992). Crimson clover, subterranean clover, and hairy vetch are legumes also noted for weed control (Enache and Ilnicki 1990; Hoffman et al. 1993; Johnson et al. 1993; Lehman 1993; Teasdale 1993a; Teasdale 1993b; Teasdale et al. 1991; Teasdale and Daughtry 1993; Worsham and Blum 1992). Weed control with these species has been variable. However, weed control with rye, subterranean clover, and crimson clover has been comparable whereas control with hairy vetch has been less (Worsham 1989; Worsham and Blum 1992).

The objectives of this study were to evaluate six cover crop/tillage systems for potential use in corn production and to determine if weed suppression from cover crops could replace or reduce the need for herbicides.

MATERIALS AND METHODS

Experiments were conducted in 1992 and 1993 at the Central Crops Research Station at Clayton, NC and the Upper Coastal Plain Research Station at Rocky Mount,

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[3]Letters following this symbol are a WSSA-approved computer code from Composite List of Weeds, Revised 1989. Available from WSSA, 1508 West University Ave., Champaign, IL 61821-3133.

NC. Separate but adjacent sites were used each year at each location. Soils were a Johns sandy loam (fine loam/sandy or sandy skeletal siliceous Thermic Aquic Hapledaults) with pH 5.5 and 0.6% organic matter and a Norfolk loamy sand (fine loamy siliceous Thermic Typic Kandiudaults) with pH 6.2 and 0.4% organic matter at Clayton and Rocky Mount, respectively. The experiment consisted of six cover crop/tillage systems and four herbicide programs arranged factorially in a split-plot design with four replications. Cover crop/tillage systems were whole plots and herbicide programs were subplots. Subplot size was 1.8 by 7.6 m in 1992 and 1.8 by 15.3 m in 1993.

Cover crop/tillage systems included no-till planting into killed rye, crimson clover, subterranean clover, hairy vetch, and no cover crop plots and planting into conventionally-tilled plots with no cover crop which were disked twice and bedded with in-row subsoiling within 2 wk of corn planting. Four weed management programs were established in each cover crop/tillage system at corn planting including: 1.4 kg ai/ha of atrazine [6-chloro-*N*-ethyl-*N*′-(1-methylethyl)-1,3,5-triazine-2,4-diamine] plus 2.2 kg/ha of metolachlor [2-chloro-*N*-(2-ethyl-6-methylphenyl)-*N*-(2-methoxy-1-methylethyl)acetamide] applied PRE; 1.7 kg/ha of ametryn [*N*-ethyl-*N*′-(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine] plus 0.25% (v/v) nonionic surfactant applied POST; 1.4 kg/ha of atrazine plus 2.2 kg/ha of metolachlor applied PRE followed by 1.7 kg/ha of ametryn plus surfactant applied POST; and a nontreated check which received no herbicide following cover crop desiccation. PRE herbicides were applied in 187 L/ha water at 207 kPa immediately after planting. The POST herbicide was applied 60 and 50 d after planting (DAP)[4] in 1992 and 1993, respectively, in 187 L/ha water at 207 kPa and was directed to the lower 15 cm of 60- to 90-cm tall corn.

Cover crops were established in October 1991 and 1992. Experimental sites were moldboard-plowed, disked, and bedded with in-row subsoiling prior to planting cover crops. Cover crops were sown by hand and the plots were cultipacked to cover the seeds. Seeding rates for rye, crimson clover, hairy vetch, and subterranean clover were 125, 30, 45, and 30 kg/ha, respectively. Rye plots in 1993 received a late-winter application of 55 kg/ha of nitrogen applied as ammonium nitrate.

The isopropylamine salt of glyphosate [*N*-(phosphonomethyl)glycine] at 2.2 kg ae/ha was applied in 187 L/ha water at 207 kPa to all plots 2 wk before corn planting. Crimson clover, hairy vetch, and subterranean clover treatments also received a subsequent application of 0.56 kg ae/ha of the dimethylamine salt of 2,4-D [(2,4-dichlorophenoxy)acetic acid] prior to corn planting to enhance control. Rye, crimson clover, and hairy vetch biomass was measured immediately before glyphosate application in 1992 and 1993. Subterranean clover biomass was determined only in 1992 as stand and growth were too erratic for accurate measurement in 1993. The aerial portion of cover crop biomass was clipped from four randomly selected 0.25-m^2 sections of the plots, dried at 60 C for 48 h, and weighed.

A surface application of 27-27-162 kg/ha N-P_2O_5-K_2O was made to all plots after appropriate spring tillage and prior to planting both years at Clayton. Additional N was applied at 152 and 114 kg/ha as 34-0-0 in 1992 and 1993, respectively, immediately after planting. A surface application of 28-56-56 and 22.5-45-45 kg/ha N-P_2O_5-K_2O was made at Rocky Mount in 1992 and 1993, respectively, after spring tillage and prior to planting. Additional N was applied at 150 kg/ha as 28% urea ammonium nitrate immediately after planting each year. Corn was planted in early to mid-April, in 91-cm rows at approximately 62,000 seeds/ha. The planter[5] used for both no-till and conventionally-tilled plots was equipped with a 2.5-cm fluted coulter in 1992. A "bubble" coulter was used in 1993.

Soil moisture was determined in each cover crop/tillage system on the day of corn planting. Four 1.9-cm diam by 15-cm deep soil cores were collected, weighed, dried at 100 C for 24 h, and reweighed. Percentage soil moisture was then calculated.

Corn height was measured 45 DAP in 1992 as an indication of crop vigor. Crop stand was evaluated visually 45 DAP in 1993 using a scale of 0 (no live plants) to 100% (no reduction in stand). Conventionally-tilled plots receiving PRE herbicides were assigned a 100% rating because they consistently had the best corn plant population and vigor. Other plots were evaluated relative to this treatment. Composite grass and broadleaf weed control was estimated visually 45 DAP in 1992 using a scale of 0 (no control) to 100 (complete control). The nontreated check in the conventionally-tilled system was arbitrarily assigned a rating of 0, and all treatments were evaluated relative to this treatment. Predominant species at both locations included common lambsquarters, smooth pigweed, redroot pigweed, and broadleaf signalgrass. The Clayton location also

[4]Abbreviations: DAP, days after planting.

[5]John Deere MaxEmerge 2, Deere and Co., Moline, IL.

had fall panicum (*Panicum dichotomiflorum* Michx. # PANDI) and large crabgrass (*Digiteria sanguinalis* (L.) Scop. # DIGSA).

Weed suppression at Clayton in 1993 could not be estimated accurately because of variation in weed species composition among the cover crops. Hence, total weed biomass in two randomly selected 0.25-m^2 sections of each plot was determined 45 DAP at both locations. Winter annual weeds including Virginia pepperweed (*Lepidium virginicum* L. # LEPVI) and Italian ryegrass (*Lolium multiflorum* Lam. # LOLMU) severely infested rye and no cover/no-till treatments at Clayton. Summer annual weeds including common lambsquarters, common ragweed (*Ambrosia artemisiifolia* L. # AMBEL), large crabgrass, and fall panicum were predominant in other cover crop/tillage systems. Predominant species at Rocky Mount included common lambsquarters, common ragweed, broadleaf signalgrass, and large crabgrass. Late-season weed biomass was determined 85 and 90 DAP in 1992 and 1993, respectively. Corn ears were harvested by hand in 1992 and mechanically in 1993. Grain yield was adjusted to 15.5% moisture.

Data were subjected to analysis of variance with partitioning appropriate for the factorial treatment arrangement. Means for main effects and interactions were separated as appropriate using Fisher's Protected LSD Test at $P \leq 0.05$. Arcsine transformations were computed for weed suppression ratings and corn stand ratings before analysis of variance. Non-transformed data are presented with statistical interpretation based upon transformed data. Data from the two locations and years were not combined because of significant differences between them.

RESULTS AND DISCUSSION

Rye and crimson clover consistently produced the greatest biomass of the four cover crops. Rye, crimson clover, subterranean clover, and hairy vetch biomass at time of kill was 514, 369, 353, and 238 g/m^2, respectively, averaged over locations in 1992. Subterranean clover biomass could not be determined accurately at either site in 1993 because poor fall establishment resulted in an erratic stand. Averaged over locations, rye, crimson clover, and hairy vetch produced 454, 350, and 219 g/m^2 of biomass, respectively, in 1993 (data not shown).

Glyphosate completely killed rye, but not legume cover crops. Surviving legumes severely reduced early corn growth at Clayton in 1993.

Although corn was tallest in crimson clover and hairy vetch plots and shortest in conventionally-tilled plots (data not shown), the shorter, stouter plants in conventionally-tilled plots were much more vigorous than the taller, spindlier plants in crimson clover plots. Shading from the surviving crimson clover and hairy vetch mulch promoted taller, thinner, and less vigorous corn growth.

Early season visual rating of corn in 1993 was a better indicator of vigor than corn height. Greater corn vigor was noted in conventionally-tilled plots than all other treatments (data not shown). Among no-tillage systems, corn vigor was greatest in rye and least in crimson clover with vigor in the no cover/no-till system intermediate between that of rye and leguminous cover crops. Poor vigor, especially in crimson clover, likely was due to competition from cover crops not completely killed by the desiccation treatment.

A cover crop/herbicide program interaction was noted for early season control of grass and broadleaf weeds in 1992 (Table 1). Weeds were controlled at least 90% in those plots receiving PRE herbicides regardless of the cover system.

Early season control of grass and broadleaf weeds without PRE herbicides was 17 to 30 and 19 to 27%, respectively, in the no cover/no-till system. Weed reduction in no cover/no-till was due to the lack of spring soil disturbance and subsequent weed seed germination which also occurred in all no-tillage cover treatments. Early season weed control ranged from 17 to 30% for stale seedbed systems relative to spring tillage systems.

Control of grass weeds without PRE herbicides was greatest in the rye cover system. Control was slightly less with crimson clover and subterranean clover. Rye, crimson clover, and subterranean clover increased grass weed control 46 to 61% above the no cover/no-till system. Control was similar with no cover/no-till and hairy vetch at Clayton. Grass weed control with hairy vetch-was similar to subterranean clover and crimson clover at Rocky Mount.

Hairy vetch cover crop control of broadleaf weeds was inconsistent between locations with control not different than the no cover/no-till system at Clayton but greater than that treatment at Rocky Mount. Hairy vetch biomass at burndown was similar at both locations (data not shown). The environment, weeds, and hairy vetch biomass apparently interacted differently at the two locations which caused the inconsistency. Control inconsistencies between years and locations has been reported previously with hairy vetch and other cover crops (Worsham et al. 1995). Broad-

Table 1. Early season weed control as affected by cover crop/tillage systems and PRE herbicides in 1992.[a]

	Clayton				Rocky Mount			
	Broadleaf weeds		Grasses		Broadleaf weeds		Grasses	
Cover crop/tillage system	PRE[b]	NTC[b]	PRE	NTC	PRE	NTC	PRE	NTC
	%							
Rye/no-till	100 a	86 b	99 a	76 c	93 ab	87 b	95 a	91 a
Crimson clover/no-till	100 a	66 c	93 b	63 d	96 a	64 c	94 a	64 b
Subterranean clover/no-till	99 a	89 b	94 b	70 cd	98 a	75 c	99 a	74 b
Hairy vetch/no-till	99 a	19 d	90 b	19 e	97 a	64 c	98 a	64 b
No cover/no-till	99 a	19 d	95 b	17 e	97 a	27 d	97 a	30 c
No cover/conventional	99 a	0 e	96 b	0 f	93 ab	0 e	98 a	0 d

[a]Means within a location and type of weed followed by the same letter are not different at $P \leq 0.05$ according to Fisher's Protected LSD test of arcsine transformed data. Data recorded 45 d after planting.

[b]PRE = 1.4 kg/ha atrazine plus 2.2 kg/ha metolachlor applied PRE. NTC = nontreated check.

leaf weed control was comparable with rye, crimson clover, and subterranean clover when compared over both locations.

PRE herbicides increased grass and broadleaf weed control in all cover crop/tillage systems. In the rye/no-till system, grass and broadleaf weeds were controlled 91 and 87%, respectively, without herbicides at Rocky Mount. Control of broadleaf weeds was only about 10% less in the rye/no-till system without PRE herbicides than in any cover crop/tillage system receiving PRE herbicides. Mulch from the desiccated rye cover crop at least partially replaced weed control from herbicides early in the growing season, the time when weed-free conditions are most critical for crop growth (Hall et al. 1992).

Weeds were not separated into grass and broadleaf species when the late-season biomass determinations were made in 1992. At Clayton, weed biomass in the plots not receiving herbicides was nearly two times greater in the conventional system compared with any no-till system (Table 2). Biomass was similar in the rye, crimson clover, and hairy vetch/no-till systems and the no cover/no-till system. Only subterranean clover had less weed biomass than the no cover/no-till system. Season-long weed control by cover crops with no additional weed management inputs has been inconsistent in reported research (Worsham et al. 1995). However, subterranean clover has been reported to control weeds longer than other cover crops, especially when used as a living mulch (Enache and Ilnicki 1990). The subterranean clover cover crop was partially able to survive the burndown treatment and grow under the corn crop.

Late-season weed biomass at Clayton was reduced at least 96% relative to the nontreated control when POST or PRE plus POST herbicide programs were used regardless of the cover crop/tillage system (Table 2). Weed biomass was similar with POST and PRE plus POST herbicide programs in all cover crop/tillage systems. Weed biomass was similar with PRE and POST herbicide systems in all

Table 2. Late-season weed biomass as affected by cover crop/tillage systems and herbicide programs in 1992.[a]

	Clayton				Rocky Mount			
Cover crop/tillage system	PRE[b]	POST[b]	PRE + POST	NTC[b]	PRE	POST	PRE + POST	NTC
	g/m²							
Rye/no-till	3 g	1 g	0 g	242 bcd	12 d	11 d	1 d	101 c
Crimson clover/no-till	53 efg	2 g	1 g	205 cd	6 d	2 d	1 d	161 ab
Subterranean clover/no-till	73 ef	0 g	0 g	179 d	16 d	9 d	0 d	113 bc
Hairy vetch/no-till	90 e	12 fg	1 g	288 b	7 d	5 d	0 d	122 bc
No cover/no-till	11 fg	2 g	0 g	263 bc	1 d	16 d	2 d	215 a
No cover/conventional	52 efg	22 efg	1 g	511 a	7 d	25 d	0 d	195 a

[a]Means within a location followed by the same letter are not different at $P \leq 0.05$ according to Fisher's Protected LSD test. Data recorded 85 d after planting.

[b]PRE = 1.4 kg/ha atrazine plus 2.2 kg ha metolachlor applied PRE; POST = 1.7 kg/ha ametryn applied POST-directed; NTC = nontreated check.

cover crop/tillage systems except subterranean clover and hairy vetch/no-till, where greater biomass was noted with the PRE herbicide program.

Late-season weed biomass at Rocky Mount in 1992 was similar in nontreated checks in the no cover/conventional, no cover/no-till, and crimson clover systems in contrast to results at Clayton (Table 2). Compared with the no cover/no-till system, the rye and subterranean clover mulch reduced weed biomass 53 and 47%, respectively, in nontreated checks. Weed biomass in hairy vetch plots was similar to that in crimson clover. Excellent weed control was obtained with all herbicide programs in all cover crop/tillage systems at Rocky Mount.

Early season weed biomass at Clayton in 1993 was greater in the nontreated checks for the rye/no-till and no cover/no-till systems than in the no cover/conventional tillage system (Table 3). This was due primarily to a dense infestation of winter annual weeds which were not controlled by burndown herbicides in the rye/no-till and no cover/no-till systems. Virginia pepperweed was the predominant species in the rye/no-till system without PRE herbicides. The PRE herbicides reduced biomass of weeds in the rye/no-till system 92% relative to the nontreated check. Italian ryegrass was the predominant species in the no cover/no-till system. The PRE herbicides did not reduce weed biomass in this cover crop/tillage system relative to the nontreated check. Weed biomass also was similar with and without PRE herbicides in the crimson clover/no-till, subterranean clover/no-till, and hairy vetch/no-till systems.

All no-till systems at Rocky Mount in 1993 had less early season weed biomass in nontreated checks than the no cover/conventional tillage system (Table 3). Biomass was similar in the rye/no-till system and the no cover/no-till systems but systems with a crimson clover or subterranean clover cover crop had less weed biomass than the no cover/no-till system. Unlike previous reports (Worsham and Blum 1992), weed biomass in the rye/no-till system was greater than in the crimson clover/no-till and subterranean clover/no-till systems at both locations.

Early season weed biomass in the nontreated check for the hairy vetch/no-till system relative to other systems varied in 1993 (Table 3). The hairy vetch controlled weeds better at Clayton than at Rocky Mount. Inadequate kill by the desiccation treatment at Clayton allowed hairy vetch to compete with weeds after corn planting. Weed control may be greater by a living hairy vetch mulch than by a desiccated mulch (Teasdale and Daughtry 1993).

Weed biomass in late 1993 was comparable to that in 1992 except for the POST treatment in 1993. Excellent weed control occurred in all cover crop/tillage systems in the PRE plus POST herbicide treatment (Table 4). Differences between biomass were variable in PRE and POST

Table 3. Early season weed biomass as affected by cover crop/tillage systems and PRE herbicides in 1993.[a]

	Clayton		Rocky Mount	
Cover crop/tillage system	PRE[b]	NTC[b]	PRE	NTC
	g/m^2			
Rye/no-till	15 cde	196 a	0 e	49 c
Crimson clover/no-till	12 cde	6 de	2 de	10 de
Subterranean clover/no-till	41 cde	54 cd	3 de	19 d
Hairy vetch/no-till	41 cde	56 c	6 de	79 b
No cover/no-till	147 ab	184 a	2 de	55 c
No cover/conventional	1 e	115 b	20 d	101 a

[a]Means within a location followed by the same letter are not different at $P \leq 0.05$ according to Fisher's Protected LSD test. Data recorded 45 d after planting.

[b]PRE = 1.4 kg/ha atrazine plus 2.2 kg/ha metolachlor applied PRE. NTC = nontreated check.

Table 4. Late-season weed biomass as affected by cover crop/tillage systems and herbicide programs in 1993.[a]

	Clayton				Rocky Mount			
Cover crop/tillage system	PRE[b]	POST[b]	PRE + POST	NTC[b]	PRE	POST	PRE + POST	NTC
	g/m^2							
Rye/no-till	5 h	52 fgh	0 h	75 efg	18 f	54 ef	1 f	256 c
Crimson clover/no-till	84 ef	13 h	2 h	148 bcd	112 de	75 def	3 f	301 bc
Subterranean clover/no-till	27 gh	82 efg	15 h	131 cde	41 ef	144 d	7 f	253 c
Hairy vetch/no-till	113 de	29 fgh	5 h	203 b	148 d	289 bc	13 f	456 a
No cover/no-till	40 fgh	169 bc	40 fgh	196 b	13 f	231 c	3 f	313 bc
No cover/conventional	10 h	5 h	0 h	309 a	16 f	107 de	3 f	371 b

[a]Means within a location followed by the same letter are not different at $P \leq 0.05$ according to Fisher's Protected LSD test. Data recorded 90 d after planting.

[b]PRE = 1.4 kg/ha atrazine plus 2.2 kg/ha metolachlor applied PRE; POST = 1.7 kg/ha ametryn applied POST-directed; NTC = nontreated check.

only treatments. Favorable conditions for POST herbicide efficacy in 1992 resulted in excellent late season weed control. Low soil moisture at the time of POST application in 1993 likely caused less control. Biomass was not significantly lower in POST versus nontreated check treatments in rye and subterranean clover plots at Clayton and in the no cover/no-tillage at both locations in 1993 (Table 4). Weed biomass was greatest in nontreated weed management treatments within all cover crop treatments in both years and locations. Adequate, season-long weed control is typically not expected with any cover treatment without additional weed management input (Worsham et al. 1995).

A cover crop/tillage system by herbicide system interaction for corn yield was not observed. Lack of an interaction indicates that cover crops did not substitute for herbicides. Pooled over cover crop/tillage systems, all herbicide programs resulted in greater corn yield than in the nontreated check (Table 5). Greatest yield consistently was obtained in systems including PRE or PRE and POST herbicides. Corn yield in systems containing only POST herbicides were less than yield in systems with PRE and POST or only PRE herbicides at three of four and two of four locations, respectively. Competition from weeds not controlled by the POST treatment was probably more important than, or at least as important as, early season weed competition prior to the POST treatment. Yield was similar with systems containing PRE and PRE plus POST herbicides, indicating adequate control of weeds and cover crops by the PRE herbicides.

A significant main effect of cover crop/tillage systems on yield was noted only at Rocky Mount in 1993. Corn yield was greatest where cover crops were used (Table 6).

Table 5. Corn grain yield as affected by weed management programs.[a]

Weed management program	1992 Clayton	1992 Rocky Mount	1993 Clayton	1993 Rocky Mount
	kg/ha			
PRE[b]	8940 a	8160 a	7320 a	3990 ab
POST[b]	7600 b	7720 a	4550 b	3600 b
PRE + POST	8860 a	8160 a	7120 a	4390 a
NTC[b]	6920 c	7030 b	3500 c	2320 c

[a]Means within a column followed by the same letter are not different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data pooled over cover crop/tillage systems.

[b]PRE = 1.4 kg/ha atrazine plus 2.2 kg/ha metolachlor applied PRE; POST = 1.7 kg/ha ametryn applied POST-directed; NTC = nontreated check.

Table 6. Corn grain yield as affected by cover crop/tillage systems at Rocky Mount in 1993.[a]

Cover crop/tillage system	Yield
	kg/ha
Rye/no-till	4720 a
Crimson clover/no-till	3960 ab
Subterranean clover/no-till	3720 abc
Hairy vetch/no-till	2540 c
No cover/no-till	2920 bc
No cover/conventional	3570 abc

[a]Means followed by the same letter are not different according to Fisher's Protected LSD Test at $P \leq 0.05$. Data pooled over herbicide programs.

Corn yield was lowest in the hairy vetch cover crop treatment with significantly lower yield than in the rye and crimson clover cover crop treatments, but not less than subterranean clover, no cover/no-till and no cover/conventionally-tilled treatments (Table 6). Lower early season stand ratings in rye, crimson clover, and subterranean clover did not coincide with lower corn yield. Although results were inconsistent, use of cover crops showed no negative effect on corn yield.

Several benefits can be obtained from cover crops in cropping systems. Our study documents early season weed control by cover crops used in a no-tillage system with adequate soil moisture. Rye, crimson clover, and subterranean clover tended to control weeds better than hairy vetch, which was in agreement with previous research (Enache and Ilnicki 1990; Worsham 1989; Worsham and Blum 1992). However, in this and other studies, weed control by cover crops was inconsistent or inadequate. Regardless of cover crop/tillage systems, PRE herbicides were needed for adequate season-long weed control and greatest corn yield. Although some early season weed control by the cover crops was noted, there was no evidence that use of cover crops can replace herbicides. However, more recent evidence indicates that a cover crop can be manipulated to achieve greater weed control in the subsequent crop. For example, increasing the seeding rate of rye from 125 to 180 kg/ha increased weed control significantly (Nagabhushana et al. 1995).

Weed control using cover crops should not be the primary concern when selecting or managing cover crops for corn production. Cost and ease of establishment, cover crop residue management, and nitrogen fixation also should be important considerations for selecting a cover crop. However, cover crops can provide the benefit of providing additional weed control if managed properly.

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