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Delayed control of a hairy vetch (*Vicia villosa* Roth) cover crop in irrigated corn production

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Abstract

Although a hairy vetch (*Vicia villosa* Roth) cover crop can supply nitrogen and suppress weeds, corn planting in central Illinois must be delayed past optimum planting dates to realize significant benefits from this cover crop. As an alternative to delayed planting, controlling a band of hairy vetch over corn rows followed by a sequential treatment between the rows may allow for increased vegetative growth and greater weed suppression. Vetch between the rows provided greater than 80% weed control if allowed to grow for at least four weeks. These treatments, however, reduced corn height by approximately 20%. If hairy vetch between the rows was controlled within 2 weeks of planting, it did not appear to adversely affect crop growth. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Cover crops have been used to reduce surface runoff and soil erosion, improve soil fertility, and suppress weeds (Robinson and Dunham, 1954; Hall et al., 1984; Blevins et al., 1990; Utomo et al., 1990). They have also been used on coarse-textured soils to control wind erosion (Bilbro, 1989).

Hairy vetch (*Vicia villosa* Roth) is often suggested as a preferred legume cover crop to supply nitrogen and suppress weeds in a corn production system (Ebelhar et al., 1984; Frye et al., 1985; Hanson et al., 1993; Stein, 1993). The effective use of a hairy vetch cover crop requires timely management and consideration of soil moisture status.

Several researchers found that hairy vetch effectively suppressed weed growth, but was overly competitive with corn if not controlled (Echtenkamp and Moomaw, 1989; Hoffman et al., 1993; Johnson et al., 1993). Further, a hairy vetch cover crop may deplete soil moisture ahead of corn planting (Ebelhar et al., 1984).

White and Worsham (1990) demonstrated that hairy vetch can be easily controlled with herbicides in no-till corn production, and suggested that a minimum of 75% control of hairy vetch was necessary to avoid yield losses. Similarly, Curran et al. (1994) effectively controlled a hairy vetch cover crop with herbicides or tillage prior to corn planting, but found mowing did not provide adequate control.

In central Illinois, most of the hairy vetch biomass production occurs in late spring. In order to realize significant benefits from this cover crop, corn planting must be delayed past optimum planting dates (Ebelhar et al., 1984; Bollero and Bullock, 1994).

As an alternative to delayed planting, controlling a band of hairy vetch over corn rows followed by a sequential treatment between the rows may allow for increased vegetative growth and greater weed suppression.

Teasdale and Daughtry (1993) found that live hairy vetch suppressed weeds longer and more effectively than desiccated hairy vetch. Further, under irrigated corn production, depletion of soil moisture should not be a major consideration.

The purpose of this study was to evaluate the sequential control of a hairy vetch cover crop in

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irrigated corn production. A band of vetch directly over the row was controlled at the time of corn planting, while the vetch between the row was controlled 1–4 weeks later.

2. Materials and methods

Studies were conducted on a Plainfield sand (Typic Udipsamment) at a field research site near Kilbourne, IL. The area is under a center pivot irrigation system. Hairy vetch (inoculated 'Common') was fall-seeded at a rate of 45 kg/ha in 1992–1994 using a grain drill.

On May 11, 1993, May 10, 1994, and May 11, 1995, corn was planted no-till into standing vetch. Corn 'Pioneer 3357' was planted at 74,000 plants/ha in 76-cm rows. Immediately after planting, 0.56 kg/ha of 2,4-D was applied to a 25-cm band of vetch directly over the row. Herbicides were applied with a CO_2 pressurized backpack sprayer using 80° even flat fan nozzles set on 76-cm spacing.

The vetch between the rows was controlled 1, 2, or 4 weeks after planting with a band application of 0.56 kg/ha of 2,4-D between the rows. Other treatments included (1) a band only application, where vetch between the rows was not controlled and (2) a broadcast application of 0.56 kg/ha of 2,4-D that killed all the vetch following corn planting.

The experimental design was a randomized complete block with three replications. Individual plots were 3 m by 9.1 m and included four rows of corn. No additional herbicides or fertilizers were applied to any of the plots.

Visual weed control ratings and corn height measurements were taken 6 weeks after planting. Grain yields were determined by harvesting 6 m from the middle two rows of each plot and adjusting to 15.5% moisture. Data were subjected to analysis of variance and means were separated using Fisher's Protected LSD test at the 5% level of significance.

Leaf nitrogen status was evaluated 4, 6, 9, and 11 weeks after planting using a SPAD 502, Minolta chlorophyll meter. Relative chlorophyll data presented are the means of 10 readings from randomly selected plants in the center two rows of each plot. Since leaf chlorophyll measurements were taken 4 times each growing season, these data were treated as repeated measurements and were analyzed using Proc Mixed as demonstrated by Littell et al. (1996).

3. Results and discussion

3.1. Weed suppression

Weed control improved as the time of killing vetch between the rows was delayed (Table 1). When the band only treatment was excluded from the data set and a week-value of zero was given to the broadcast treatment (i.e. all vetch killed at time zero) a significant linear increase in weed control with time was shown (Fig. 1).

Vetch between the rows effectively suppressed weeds if allowed to grow for 4 weeks or was left uncontrolled. These treatments provided greater than 80% control of large crabgrass (*Digitaria sanguinalis*) and longspine sandbur (*Cenchrus longispinus*).

Early control of hairy vetch, however, resulted in rapid decomposition of the vetch biomass. The remaining residue mat failed to provide adequate weed control. This was similar to results of Echtenkamp and Moomaw (1989) and Hoffman et al. (1993).

3.2. Crop response

Although weed control improved as vetch between the rows was allowed to grow for a longer time, interference with crop growth also increased (Table 1). The severity of interference was much greater for the *Band + 4 weeks* or the *Band only* treatments. Compared to a broadcast application, corn height was reduced by approximately 20% if vetch was allowed to grow for 4 weeks or was left uncontrolled. If hairy vetch between the rows was

Table 1
Weed control, corn height, and yield 1993–1995

Treatment	Weed control[a] (%)	Corn height[b] (cm)	Yield (kg/ha)
Broadcast	73	84	2416
Band + 1 weeks	75	81	3456
Band + 2 weeks	79	81	2815
Band + 4 weeks	87	64	2905
Band only	84	66	2389
LSD (0.05)	6	8	NS

[a] Visual weed control ratings taken 6 weeks after planting.
[b] Corn height measured 6 weeks after planting.

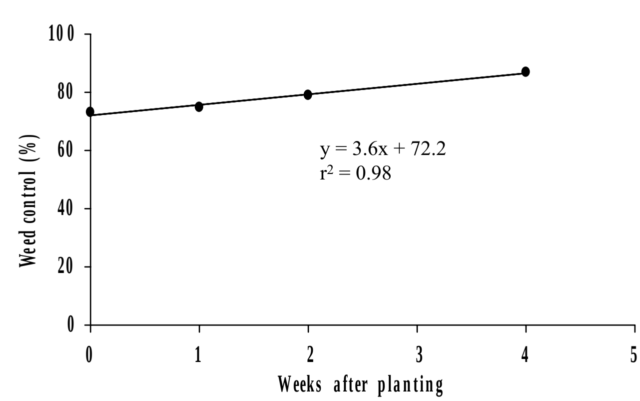

Fig. 1. Relationship between time of vetch removal and weed suppression 1993–1995.

Table 2
Estimates of corn leaf nitrogen status, 1993–1995. Leaf chlorophyll measurements taken 4, 6, 9, and 11 weeks after planting

Treatment	SPAD meter measurements after planting				
	4 weeks	6 weeks	9 weeks	11 weeks	LS means[a]
Broadcast	38	46	36	32	38b
Band + 1 weeks	37	49	41	36	41a
Band + 2 weeks	39	49	39	36	41a
Band + 4 weeks	35	45	42	38	40ab
Band only	37	39	38	36	38b
Mean	37	46	39	36	
Time of SPAD *reading*					
Linear[b]					
Quadratic[b]					

[a] Means in columns followed by the same letter are not significantly different ($P<0.05$) based on PROC Mixed analysis for repeated measurements.
[b] Denotes significance at the 0.01 level.

controlled within 2 weeks of planting, it did not appear to adversely affect crop growth. There was no evidence of crop injury following any of the 2,4-D applications.

Since no additional fertilizers or herbicides were applied to the plots, corn yields were considerably lower than normal (Table 1). There was no significant effect of treatment on final corn yields during all 3 years of the study. Although "year" was significant at the 0.01 level, there was no significant "year × treatment" interaction. As a result, data for the 3 years were combined.

3.3. Nitrogen contribution

Mixed analysis of the SPAD meter readings indicated that the time of vetch control (0, 1, 2, or 4 weeks after planting and band only) and the time of the SPAD reading (4, 6, 9, or 11 weeks after planting) significantly affected the SPAD reading (Table 2). No other main effects or interactions significantly affected the SPAD reading value.

SPAD meter readings of leaf chlorophyll were lower in the band only and broadcast treatments compared to treatments containing vetch that was controlled 1 or 2 weeks after planting.

In the band only plots, competition from uncontrolled vetch between the rows may be responsible for this difference. Alternatively, lack of nitrogen release from living vetch may help explain the lower corn leaf nitrogen readings.

In the broadcast treatment, all of the vetch was controlled at the time of planting. Since no additional fertilizer was applied, available nitrogen for corn growth was limited. Killing all of the vetch at planting may have resulted in less nitrogen being available later in the season.

In contrast, higher leaf chlorophyll measurements were recorded when hairy vetch between the rows was controlled 1 or 2 weeks after planting. As vetch residues decomposed, more nitrogen became available for plant uptake.

Delayed control of a hairy vetch cover crop may have some utility in irrigated corn production. Since nitrogen fertilizer is often added through irrigation systems, producers may be able to supply needed fertility without disturbing the cover crop residue.

It should be noted that plots with a hairy vetch cover crop had substantially higher populations of grasshoppers compared to adjacent corn plots grown without a cover crop. This was consistent in all 3 years of the experiment. Consequently, producers considering this type of cover crop system may need to scout fields more intensively for insects.

Finally interest in sustainable agriculture is increasing. The use of cover crops and reduced inputs will become more important as growers look at alternative production systems. Delayed control of a cover crop represents an option for irrigated maize producers.

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