NITROGEN MANAGEMENT OF CORN AS AFFECTED BY TIMING OF WEED CONTROL AND NITROGEN APPLICATION

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INTRODUCTION

No-tillage corn production in southern Illinois continues to be challenging with weed control problems and higher nitrogen (N) losses than conventional tillage systems. If weeds are not controlled on a timely basis, they could compete with corn for nutrients and water. Much of the work with weed control timing has dealt with single N rates of application. For this reason it has been difficult to determine the optimum economic N rate and to determine the effects on N use efficiency at this optimum rate. It is suggested that farmers control weeds in no-tillage systems before the weeds reach 4" of growth (Bryan Young, Southern Illinois University, personal communication), but often logistical problems and weather delays prevent this from occurring. Failure to control weeds on a timely basis sets up an unhealthy competition between weeds and corn for nitrogen and water.

No-tillage systems have a propensity for poor nitrogen utilization unless the N can be applied at sidedress. While this can prevent much of the N losses often seen with early and preplant N application, and reduce the N availability to weeds, it does create more competition among the weeds and early corn for what little N might be available prior to sidedressing. The objectives of this study were to 1) evaluate the effect of weed competition on corn grain yields and N use efficiency, 2) determine the effect of timing of N application on impacts of weed competition, and 3) evaluate the interactions of weed control and N timings.

MATERIALS AND METHODS

A field study was established in 2011 at the University of Illinois Dixon Springs Ag. Center in Johnson county and the Southern Illinois University Belleville Research Center in St. Clair county. Treatments consisted of a factorial with three dates of weed control (residual herbicide applications), two dates of N application and five N rates. The entire plot area was treated with a burndown herbicide (22 oz/acre Roundup PowerMax plus 1 pt/acre 2,4-D) application early preplant. This was followed by residual treatments of either 1) preplant [3 qt/acre Lexar plus 1 pt/acre atrazine shortly before or at planting], 2) when weeds were 4” average height [3.6 pt/acre Halex GT plus 2 pt/acre atrazine, POST applied], or 3) when weeds were 8” average height [same as 4” weeds mix].

N timings consisted of N applied either preplant or sidedress, with the sidedress application corresponding to on or near the date of herbicide application to 8” weeds. The N source at Belleville was ammonium nitrate surface broadcast preplant or surface banded between rows sidedress. The N source at Dixon Springs was UAN injected between rows. N rates consisted of 0, 60, 120, 180 and 240 lb/acre.

The experimental design was a split plot with the factorial arrangement of weed control date X N application date as whole plots and N rates as subplots, with four replications per location. See Table 1 below for important dates and other information about the trial. Grain yields and moisture was determined at physiological maturity.

Table 1. Dates and other trial information.

	Belleville	**Dixon Springs**
Herbicide application dates		
Early burndown	April 18	May 20
Preplant residual	June 6	June 1
4” weeds	June 24	June 23
8” weeds	July 1	June 30
N application dates		
Preplant	June 6	June 9
Sidedress	June 30	June 30
Other trial information		
Planting date	June 5	May 31
Hybrid	DeKalb DKC63-87	DeKalb DKC63-25
Corn whole plant sampling date	June 30	--
Weeds sampling date	June 30	--
Corn ear-leaf samples taken	--	July 29
Harvest date	October 31	October 31
Rainfall by month	Inches (deviation)	Inches (deviation)
April	7.91 (+ 4.27)	14.10 (+ 9.53)
May	3.72 (- 0.57)	8.54 (+ 2.96)
June	8.22 (+ 4.50)	8.25 (+ 4.17)
July	3.32 (- 0.12)	4.43 (+ 0.28)
August	1.79 (- 1.45)	3.10 (- 0.21)
September	2.97 (- 0.33)	6.63 (+ 3.09)

RESULTS AND DISCUSSION

Weeds were very few in number and spotty at Dixon Springs, whereas at Belleville, there was a much more uniform stand of weeds (Table 2). Fall panicum, ivyleaf morningglory, and common waterhemp were the predominate weeds at this location, with fall panicum having the largest stand density by far.

Corn stand densities were very good at Dixon Springs despite a wet May and June period. There were 8.54" of rainfall recorded in May and another 8.25" of rainfall in June, together resulting in 7.13" above normal. However, there was no rainfall the first 12 days of June, which likely helped with corn emergence and early growth. July, August, and September rainfall was 4.43" (0.28" above normal), 3.10" (0.21" below normal) and 6.63" (3.09" above normal), respectively.

Corn grain yields were also very good at Dixon Springs, with a strong N response as N rates increased (Tables 3 and 4). However, neither timing of weed control nor timing of N application had any effect on corn yields, stand densities or ear-leaf N composition. Increasing N rates increased yields and ear-leaf N levels.

At Belleville, corn yields were affected by timing of weed control, timing of N application and N rates. The highest yields were achieved when weeds were controlled at 4", compared to preplant and 8" weed control. There was a 17 bu/acre yield increase with sidedress N application compared to preplant, an indication that some of the preplant N was lost, or temporarily tied-up by the weeds. When N was applied preplant, the weeds left to grow to 8" took up significantly more N than when the weeds were killed at 4" (Figure 1). This may have contributed to the yield differences among these two treatments, but it is probably not the only factor contributing. It is uncertain what the effect of 8" weeds had on soil water usage over the preplant or 4" weeds, and whether this impacted yields.

Overall, the best treatment at Dixon Springs was when the weeds were killed at 8" and the N was sidedress, whereas the best overall treatment at Belleville was when the weeds were killed at 4" and the N was sidedressed (Figure 2). With all the rain at Dixon Springs during the growing season and the low population of weeds, it is doubtful that the weeds competed much for soil moisture or nitrogen. If anything the weed residue may have helped retain moisture during the dryer month of August, attributing to the higher yield. At Belleville it would appear that the 8" weeds did compete for both N and water, which is why the yields were lower with both the preplant N and the sidedress N, compared to the 4" weeds. There is a yield benefit with the 4" control timing over the preplant, perhaps due to beneficial effects of weed residue retaining soil moisture during the dryer parts of the growing season.

At Belleville, whole corn plants and weeds were measure for dry matter and N composition at the time of 8" weed control and sidedress N application (Table 5). At this time, there were no effects of weed control on corn dry matter or N content. Since sidedress N rates had not been applied yet, only the preplant N plots were sampled. With preplant N rates, the dry matter was maximized at the 120 lb/acre N rate and N content was maximized at the 180 N rate. At the same time, the 8" weeds had twice the dry matter with preplant N compared to the 8" weed control treatments which were to receive the sidedress N. These treatments were 5- to 6-times greater than the 4" weed control timing treatments. There was also a 3 fold increase in N content for the 8" weeds over the 4" weeds, again potentially accounting for the yield decrease with the 8" weed control timing over the 4" timing.

CONCLUSIONS

This was the first year of this study. Results should be interpreted with caution and the study will be repeated in future years.

Table 2. Weeds counts at Belleville, 2011.

Common Name	Code	Spray 4" Weeds		Spray 8" Weeds	
		Preplant N	Sidedress N	Preplant N	Sidedress N
		--------------- *Weed Counts (plants/sq yd)* ------------			
Giant foxtail	SETFA	9.0	6.3	1.0	0.6
Fall panicum	PANDI	44.3	52.3	59.1	59.6
Yellow nutsedge	CYPES	11.1	9.4	1.7	4.2
Giant ragweed	AMBTR	4.8	4.2	2.1	3.1
Common ragweed	AMBEL	2.3	2.5	3.1	2.7
Ivyleaf morningglory	IPOHE	6.7	10.9	6.7	8.4
Velvetleaf	ABUTH	2.3	3.1	0.2	1.9
Common waterhemp	AMATA	19.4	8.8	6.7	12.1
Common cocklebur	XANST	1.7	0.6	0.4	0.2
Pennsylvania smartweed	POLPY	8.8	1.0	0.8	0.6

Table 3. Effects of weed control timing, N timing and N rates on corn yield, stand densities and ear-leaf N, Belleville and Dixon Springs, 2011.

Herbicide Timing	N Timing	N Rate	Dixon Springs Yield	Dixon Springs Density	Dixon Springs Ear-leaf N	Belleville Yield	Belleville Density
		(lb/a)	*(bu/acre)*	*(plts/acre)*	*(%)*	*(bu/acre)*	*(plts/acre)*
Preplant	Preplant	0	77.4	32586	1.89	94.5	29500
		60	167.5	33173	2.40	100.9	30125
		120	201.2	32502	2.67	116.6	30125
		180	209.7	34262	2.90	126.3	29125
		240	213.8	31246	2.79	133.7	29375
Preplant	Sidedress	0	84.8	33843	1.95	94.8	29375
		60	162.8	32921	2.43	112.0	28625
		120	201.5	34513	2.67	126.9	29625
		180	211.3	33591	2.77	137.1	28875
		240	211.1	33089	2.72	160.3	30125
4”	Preplant	0	85.1	33508	1.80	91.5	28250
		60	142.4	33340	2.30	100.0	29875
		120	190.4	33089	2.64	123.8	29000
		180	213.1	33675	2.60	129.7	30000
		240	224.8	32921	2.80	137.4	30250
4”	Sidedress	0	96.3	32419	2.01	97.3	29625
		60	180.6	32335	2.51	127.7	29375
		120	202.4	33089	2.96	146.9	31125
		180	203.7	33424	2.88	150.9	29625
		240	204.4	33256	3.12	172.9	29500
8”	Preplant	0	85.4	33759	1.90	88.5	30125
		60	170.5	33173	2.66	95.3	29875
		120	196.4	34094	2.62	110.2	29125
		180	206.1	33424	2.77	119.0	29125
		240	222.2	33005	2.91	136.7	28750
8”	Sidedress	0	104.8	33927	2.03	84.6	29500
		60	188.6	32754	2.64	106.2	28875
		120	202.1	33424	2.71	136.6	29500
		180	208.6	33424	2.82	149.9	30125
		240	224.3	32921	2.64	148.0	28875

Table 4. Effects of weed control timing, N timing and N rates on corn yield, stand densities and ear-leaf N, Belleville and Dixon Springs, 2011.

Herbicide Timing	N Timing	N Rate	Dixon Springs Yield	Dixon Springs Density	Dixon Springs Ear-leaf N	Belleville Yield	Belleville Density
		(lb/a)	*(bu/acre)*	*(plts/acre)*	*(%)*	*(bu/acre)*	*(plts/acre)*
Preplant	Preplant		173.9	32754	2.53	114.4	29650
	Sidedress		174.3	33591	2.51	126.2	29325
4”	Preplant		171.2	33307	2.43	116.5	29475
	Sidedress		177.5	32905	2.69	139.1	29850
8”	Preplant		176.1	33491	2.57	110.0	29400
	Sidedress		185.7	33290	2.57	125.0	29375
Preplant			174.1	33173	2.52	120.3 b	29488
4”			174.3	33106	2.56	127.8 a	29663
8”			180.9	33390	2.57	117.5 b	29388
	Preplant		173.7	33184	2.51	113.6 b	29508
	Sidedress		179.1	33262	2.59	130.1 a	29517
		0	89.0	33340	1.93	91.9	29396
		60	168.7	32949	2.49	107.0	29458
		120	199.0	33452	2.71	126.8	29750
		180	208.7	33633	2.79	135.5	29479
		240	216.8	32740	2.83	148.2	29479
Statistics:							
CV			10.3	3.3	8.0	12.9	4.3
Herbicide (H)			NS	NS	NS	***	NS
N timing (NT)			NS	NS	NS	***	NS
H x NT			NS	**	*	NS	NS
N Rate (NR)			***	**	***	***	NS
N linear			***	NS	***	***	NS
N quadratic			***	NS	***	NS	NS
H x NR			NS	NS	*	NS	NS
NT x NR			NS	NS	NS	*	NS
H x NT x NR			NS	NS	NS	NS	NS
$LSD_{Herb.}$			NS	NS	NS	5.7	NS

*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = non-significant. Means within a column followed by the same letter are not significantly different at the 5% level.

Table 5. Effects of weed control timing, N timing and N rates on whole plant corn and weeds dry matter, N concentration and N content, Belleville, 2011.

Herbicide Timing	N Timing	N Rate	Whole Corn Plants Dry Matter	Whole Corn Plants N Conc.	Whole Corn Plants N Content	Weeds Dry Matter	Weeds N Conc.	Weeds N Content
		(lb/a)	*(lb/acre)*	*(%)*	*(lb/acre)*	*(lb/acre)*	*(%)*	*(lb/acre)*
Preplant	Preplant		25.25	2.99	5.11	--	--	--
	Sidedress		--	--	--	--	--	--
4”	Preplant		25.00	2.81	4.82	8.17	2.51	5.31
	Sidedress		--	--	--	4.86	1.31	1.26
8”	Preplant		25.80	2.93	5.21	54.08	1.54	17.83
	Sidedress		--	--	--	27.67	1.15	6.18
Preplant			25.25	2.99	5.11	--	--	--
4”			25.00	2.81	4.82	6.51 b	1.91 a	3.29 b
8”			25.80	2.93	5.21	40.88 a	1.34 b	12.00 a
	Preplant		25.35	2.91	5.04	31.13 a	2.02 a	11.57 a
	Sidedress		--	--	--	16.26 b	1.23 b	3.72 b
		0	18.42	1.97	2.38	13.96	1.36	3.80
		60	25.17	2.33	4.07	--	--	--
		120	29.17	2.95	5.69	22.50	1.87	9.08
		180	28.50	3.44	6.64	--	--	--
		240	25.50	3.85	6.43	34.63	1.65	10.05
Statistics:								
CV			29.2	12.8	40.0	76.0	41.2	66.9
Herbicide (H)			NS	NS	NS	***	*	***
N timing (NT)			n/a	n/a	n/a	**	*	**
H x NT			n/a	n/a	n/a	*	NS	NS
N Rate (NR)			***	***	***	**	NS	***
N linear			**	***	***	***	NS	***
N quadratic			***	NS	*	NS	NS	NS
H x NR			NS	NS	NS	*	NS	NS
NT x NR			n/a	n/a	n/a	NS	NS	**
H x NT x NR			n/a	n/a	n/a	*	**	NS
$LSD_{Herb.}$			NS	NS	NS	12.1	0.76	5.7

*, **, and *** refer to significance at the 10, 5 and 1% levels, respectively. NS = non-significant. Means within a column followed by the same letter are not significantly different at the 5% level. n/a = not applicable (not sampled).

Figure 1. Effects of weed control timing, N timing and N rate on N content of weeds, Belleville, 2011.

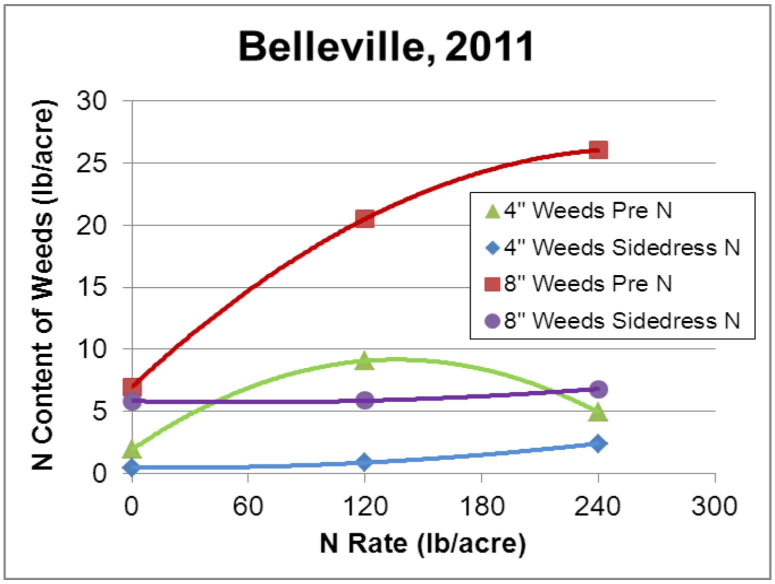

Figure 2. Effects of weed control timing and N timing on corn yields, Dixon Springs and Belleville, 2011.