PROGRESS REPORT FOR 2007 FIELD SEASON

Project Title: Can Arkansas Corn Growers Use A Chlorophyl Meter to Improve Nitrogen Use Efficiency?

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BACKGROUND INFORMATION

This project will evaluate the chlorophyl meter (CM) as a decision-aid tool for in-season application of nitrogen (N) fertilizer and predicting corn yields. The growers will benefit from development and availability of a new, rapid, and reliable tool that will enable them to apply N only when there is a likelihood of an increase in corn yield and profit margins. The Minolta chlorophyl meter (CM) is an easy-to-use, affordable, handheld spectrophotometer, that is capable of measuring an index of plant chlorophyl content, which is related to plant N content.

The 2007 cropping season was the first year of this three year project. Field studies were conducted to evaluate the effect of N application rate on leaf N concentration, leaf chlorophyl content, corn grain yield and grain N content. At the end of the project we will use the data to evaluate 1) the relationship between chlorophyl meter readings and corn grain yield, and nitrogen uptake, 2)the relationship between chlorophyl meter readings and optimum N rate, and 3) the most suitable corn growth stage(s) for using the chlorophyl meter as a diagnostic tool.

EXPERIMENTAL PROCEDURES

Field experiments were conducted at five locations in Arkansas on commercial corn producers' fields (CLZ72 and JAZ72) and University of Arkansas Agricultural Experiment Station Research Farms (DEZ72, LEZ72, LEZ77). Information on previous crop, corn cultivar, and agronomically important dates are listed in Table 1. Before application of any treatments, soil samples were collected from the 0- to 6-inch depth at each site and composited by replicate. Soil samples were processed and important soil properties were measured by standard methods of the University of Arkansas Soil Testing and Research Laboratory in Marianna Arkansas. When needed P, K, S, and Zn fertilizers were applied to each site following University of Arkansas Cooperative Extension Service soil-test recommendations for corn. All sites were irrigated and irrigation timing was managed by the cooperating growers or using the University of Arkansas Cooperative Extension Service Irrigation Scheduler program at AES sites. Plots were 25-ft long and 4-rows wide. The experimental design was a randomized complete block with six or seven total N rates and four replications of each treatment. Nitrogen fertilizer was applied in split applications at total-N rates of 0, 60, 120, 180, 240, and 300 lb N/acre at four sites and 0, 50, 100, 150, 200, 250, and 300 lb N/acre at one site. Prior to or at planting, 20 lb N/acre as ammonium sulfate was side-dressed at all sites to all plots except the 0 N control plots. The balance of each total-N rate was sidedressed as urea when plants were at the 5-to 7-leaf stage.

Chlorophyl meter (CM) data were collected with a Minolta SPAD 502 CM at two growth stages (V6 and V9-V14) from the newest fully expanded leaf that has a visible leaf collar. At least twenty readings were collected from each plot and the average value of those twenty readings were used to calculate the CM measurement for that individual plot. When plants were at early silk stage, ear leaf samples were collected from 10 plants/plot , dried overnight at 70°C, ground to pass a 1-mm sieve and analyzed for N by Kjeldahl procedure. At the AES sites, the two center rows of each plot were harvested with a plot combine. At commercial farm sites, one 15-ft long section from the two center rows of each plot was hand harvested. Grain samples were collected from all plots at harvest and processed for N analysis as described for ear leaves earlier.

Analysis of variance (ANOVA) was performed using the GLM procedure of SAS to evaluate the effect of N application rate on corn ear leaf, grain yield, and leaf CM. Sites were analyzed separately. Mean separations were performed by the Waller Duncan minimum significant difference (MSD) test at significance levels of 0.05 and 0.10.

2007 RESULTS

Soil texture in the 0-to 6-inch depth ranged from silt loam to silty clay loam (13-29% clay), soil pH ranged from 5.8 - 6.3 Table 2. and preplant soil NO_3-N ranged from 18 to 73 ppm (Table 2). Application of N significantly increased grain yield, leaf N concentration and leaf chlorophyl content (Table 3). Corn grain yield for the 0 N plots ranged from 31 to 179 bu/acre and 143-233 bu/acre for plots treated with 300 lb N/acre. Leaf N concentration for the 0 N plots was 1.62 to 2.87% and leaf N in plants from plots treated with 300 lb N/acre was 3.10 to 4.09%. Chlorophyl content of corn leaves in the 0 N plots was 30 to 51 SPAD units. In general yield and leaf N concentration increased as the N application increased and maximum yield was produced by application of 240 to 300 lb N/acre. We are currently working on the analysis of grain samples.

Table 1. Selected agronomic information for corn N-fertilization experiments conducted at Agricultural Experiment Stations and commercial fields in Arkansas during 2007.

Site ID	Previous crop	Cultivar	Planting date	N application dates		Harvest date
				1st	2nd	
CLZ72	soybean	Pioneer 33P67	4-April	10-May	31-May	28-Aug
DEZ72	corn	Belle 1545	1-May	17-May	8-June	30-Aug
JAZ72	corn	Pioneer 31G71RR2	4-April	8-May	24-May	15-Aug
LEZ72	corn	Pioneer 32B32	13-April	6-May	4-June	15-Aug
LEZ73	corn	Pioneer 33B54	9-April	9-April	4-June	30-Aug
LEZ77	corn	Belle H6280921	9-April	4-April	4-June	17-Sep

[a] Seedling emergence occurred 7-10 days after planting

Table 2. Selected soil chemical property means (0 -to 6-inch depth) of samples taken before planting in corn N- fertilization trials conducted at Agricultural Experiment Stations and commercial fields in Arkansas during 2007.

Site ID	Soil pH	Soil NO-N	Mehlich-3-extractable nutrients						Soil physical properties			
			P	K	Ca	Mg	Cu	Zn	Sand	Silt	Clay	Texture
			---------- (ppm) ----------						---------- (%) ----------			
CLZ72	5.8	53	67	168	1224	275	1.40	9.7	2	69	29	Silty clay loam
DEZ72	6.0	26	77	153	814	119	1.15	2.7	32	53	14	Silt loam
JAZ72	5.8	31	53	206	623	80	0.65	4.6	75	12	13	Sandy loam
LEZ72	6.2	29	43	128	1390	383	1.6	1.7	6	72	22	Silt loam
LEZ77	6.3	10	41	150	1771	361	1.6	3.2	5	64	31	Silty clay loam

[a] Soil pH was measured in a 1:2 (weight:volume) soil-water mixture.
[b] NO_3-N measured by ion-specific electrode.

Table 3. Effect of N-fertilizer rate on corn grain yield, leaf nitrogen and leaf chlorophyl meter in five trials conducted at Agricultural Experiment Stations and commercial farms in Arkansas during 2007.

Total-N rate	CLZ72			DEZ72			JAZ72		
	Yield	Leaf N	CM (14-leaf)	Yield	Leaf N	CM (9-leaf)	Yield	Leaf N	CM (6-leaf)
lb/acre	bu/acre	-- % --	SPAD	bu/acre	-- % ---	SPAD	bu/acre	--- % ---	SPAD
0	179	2.87	35.0	115	2.93	51.4	131	2.71	38.0
60	221	3.14	41.1	152	3.90	58.5	203	3.33	43.6
120	222	3.29	43.1	149	3.98	58.4	189	3.25	43.5
180	227	3.19	43.1	156	4.12	59.0	222	3.61	43.0
240	239	3.32	44.3	171	4.32	58.9	214	3.74	43.4
300	233	3.10	42.7	178	4.11	60.1	220	3.65	44.4
MSD 0.05 [a]	28	0.35	1.9	5.85	0.47	3.5	23	0.27	5.0
MSD 0.10 [b]	23	0.29	1.6	4.97	0.39	3.0	20	0.23	4.0
p value	0.0044	0.0703	<.0001	<.0001	0.0003	0.0012	<.0001	<.0001	0.1041

[a, b] Minimum significant difference at P=0.05 and P=0.10 as determined by Waller-Duncan

Table 3. (continued) Effect of N-fertilizer rate on corn grain yield, leaf nitrogen and leaf chlorophyl meter in five trials conducted at Agricultural Experiment Stations and commercial farms in Arkansas during 2007.

N rate	LEZ72			N rate	LEZ77		
	Yield	Leaf N	CM (12-leaf)		Yield	Leaf N	CM (9-leaf)
lb/acre	bu/acre	-- % --	SPAD	lb/acre	bu/acre	-- % --	SPAD
0	59	2.30	35.0	0	31	1.62	29.8
60	109	3.49	41.1	50	89	2.38	36.6
120	129	3.79	43.1	100	102	3.10	40.2
180	148	3.88	43.1	150	117	3.53	41.6
240	154	3.81	44.3	200	135	3.76	43.5
300	168	3.74	42.7	250	131	3.83	44.6
				300	143	4.09	45.5
MSD 0.05 [a]	18	0.30	2.5	MSD 0.05 [a]	23	0.34	2.8
MSD 0.10 [b]	16	0.25	2.1	MSD 0.10 [b]	19	0.29	2.4
p value	<.0001	<.0001	<.0001	*p* value	<.0001	<.0001	<.0001

[a, b] Minimum significant difference at P=0.05 and P=0.10 as determined by Waller-Duncan

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