Yield and Ear Leaf Nitrogen Status in No-Tillage Second Crop Temperate and Tropical Corn

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Abstract

Fertilization and management of second crop corn *(Zea mays* L.) should differ from spring planted corn and need to be investigated in order to achieve optimum production. This study was conducted to observe the effects of sidedressed N and K on whole plant and grain yields of three second crop corn cultivars. The cultivars 'Pioneer 3320' (temperate hybrid), 'Pioneer X304C' (tropical hybrid), and 'FLOPUP' (Florida open pollinated, upright ear experimental) were planted at two locations in August 1987 near Gainesville,Florida on Arenic and Grossarenic Paleudults. At both locations four N rates (0,30,60, and 120 lb NA^{-1}) as subplot and two K-Mg (K_2SO_4:$MgSO_4$) rates (0 and 120 lb A^{-1}) as sub-sub-plot treatments were imposed in a split-split-plot field experiment with cultivars as main plot treatments in a randomized complete block design. Whole plant and grain yields at harvest were affected by cultivar and sidedressed Nand K-Mg rates at both locations. Cultivar and N and K-Mg rates affected ear leaf N concentration differently at each location. Maximum whole plant yields (13.9 and 14.5 ton A^{-1} at 35% moisture) were obtained from FLOPUP with 60 and 120 lb sidedressed N A^{-1} at location 1 and 2, respectively. Maximum grain yield (80 hu A')was obtained from FLOPUP with 120 lb sidedressed N A^{-1} and application of K-Mg.

Introduction

A second crop of corn *(Zea mays* L.) planted in late summer may provide Florida's dairy and beef cattle farmers with needed high quality forage. The late summer growing season is characterized by high rainfall, shortening daylength, reduced solar intensities, and decreasing mean daily temperatures. Reductions in yield caused by reduced daylength and solar intensity may be partially offset by the increased grain filling period resulting from lower mean temperatures. Photoperiod has been reported to have a greater effect than temperature on determination of plant leaf number and days to tassel initiation (Russell and Stuber, 1983). Brakke et al (1983) reported that to maximize corn yields, specific corn cultivars for specific environments and cropping systems need to be developed. Selection and breeding of corn cultivars which perform well in the late summer environment have been reported by Gallaher and others (Bustillo and Gallaher, 1988; Gallaher, 1986). The objective of this experiment was to study the yield response of three second crop corn cultivars grown under late summer conditions to sidedressed N and K-Mg (K_2S0_4:$MgSO_4$) fertilization.

Materials and Methods

This experiment was part of a larger field study investigating the growth and yield of temperate and tropical corn cultivars shown in late summer (Overman and Gallaher, 1989).Soils at both experimental sites were associations of Arenic and Grossarenic Paleudults (Soil survey Staff 1984). Three corn cultivars, 'Pioneer 3320' (temperate hybrid). 'Pioneer X304C' (tropical hybrid) and 'FLOPUP' (Florida open pollinated upright ear experimental line) were planted 8 August 1988 with a Brown-Harden no-tillage planter at a rate of 60,700 seed A^{-1} and thinned to 34,000 plants A^{-1} two weeks after emergence. Anhydrous ammonia at 89 lbs N A^{-1} was injected 10 inches below the row at planting. Ammonium nitrate (67 lbs N A^{-1}), muriate of potash (100 lb K A^{-1}), triple super phosphate (21 lb P A^{-1}) sulfate of potash magnesia (11 lb Mg A^{-1} 22 lb K A^{-1} 23 lb S A^{-1}) and Perk (25 lb containing the following percentages of soluble elements: 5% S, 5% Mg, 0.02% B, 0.50% Cu, 9% Fe, 2% Mn. 0.003%Mo, and 1% Zn) were surface broadcast immediately after planting. Irrigation water was applied by overhead sprinkler to insure at least 1 inch per four to seven days until early tassel, 1.5 inches per four days during early seed fill and 1 inch per four to seven days during late seed fill.

The herbicide Dual (Metolachlor: 2-chlora-N-(2-ethyl-6-methyIpheyl)-N-(2-methoxy-lmethylethyl) acetamide) was applied pre-emergence at 2 lb a.i. A'. Counter (Terbufos: S-(1-1-Dimethylethyl) thio)methyl)0,0-diethyl phosphorodithionate) was applied in bands over the row before emergence at a rate of 2 lb a.i. A^{-1} Gramoxone (Paraquat: 1,1'-Dimethyl-4,4:-bipyridium ion) at 0.37 Ib a.i. A^{-1} with a non-ionic surfactant (X77) was spot applied at knee-high stage. Two applications of Lannate (Methomyl S-Methyl-N-((methylcarbomoyl) oxy) thioacetimiddte) at 0.22 lb a.i. A^{-1} were sprayed into the whorl at 30 and 45 days after

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planting (DAP) to control fall armyworm *(Spodoptera frugiperda* L.)

Approximately 9 inches of rainfall occurred over a one week period in early September with over 3 inches occurring on 4 September 1988. Uniform chlorosis with some plants exhibiting both N and K deficiency symptoms was observed one week later in all three cultivars. It was strongly suspected that both N and K and possible S and Mg fertilizer applied earlier had leached from the root zone. Soil samples were taken at both locations to determine pH, organic C and Mehlich 1 extractable P, K, Ca, and Mg. Soil test means for location 1 were: pH of 6.4, 1.13% organic C, and P, K, Ca, and Mg amounts of 148, 103, 838 and 106 lb A^{-1}, respectively. On 12 September four N rates (0, 30, 60, and 120 lb N A^{-1}) and two K-Mg (K_2S0_4:$MgS0_4$) rates (0 and 120 lb A) were imposed as subplot and sub-subplot treatments, respectively, across all three cultivars at both locations. Ear leaf samples were collected at mid-silking (66 DAP) for N concentration determination by Micro-Kjeldahl technique (Gallaher et al, 1975; Gallaher et al, 1976). Whole plant and grain yields were determined at harvest and corrected to 15.5 and 35% moisture for grain and whole plant samples, respectively.

Results and Discussion

Grain and whole plant yields at both locations were significantly affected by the single effects of cultivar and N rate. The three way interaction of cultivar x N rate x K-Mg level was significant at location 2 and highly significant at location 1. Grain and whole plant yield means from locations 1 and 2 are presented in Tables 1 and 2, respectively. At both locations grain and whole plant yields of Pioneer 3320 did not show response to added N or K-Mg. At location l Pioneer X304C grain and whole plant yields responded to N rate when K-Mg was added. At location 2 grain and whole plant yields of Pioneer X304C showed less response to N rate and a slight response to K-Mg at the 30 lb N A^{-1} rate. Grain and whole plant yields of FLOPUP at location 1 showed a response to K-Mg application at 0, 30, and 60 lb N A^{-1} rates. At location 2 FLOPUP grain and whole plant yields exhibited a negative response to K-Mg addition at the 60 lb N A^{-1} rate and no response at other rates.

Ear leaf N concentration means for location 1 are presented in Table 3. Ear leaf N concentration was significantly affected by N rate at both locations and by K-Mg at location 2. At N rates of 0 and 30 lb A^{-1} FLOPUP was observed to have higher ear leaf N concentrations. At 60 and 120 lb N A^{-1} rates no differences among cultivars were noted. Within cultivars at location l little response to sidedressed N by Pioneer 3320 in ear leaf N concentration was noticed.

Ear leaf concentration means for location 2 are presented in Table 4. A positive increase in ear leaf N concentration occurred with K-Mg addition. Nitrogen application produced significantly higher ear leaf N concentrations than no application; however no differences among the three rates (30, 60, and 120 lb N A^{-1}) were noted.

According to Jones (1974) the sufficiency range for N in

Table 1. Grain and whole plant yields of corn cultivars as affected by sidedressed N rate and K-Mg for location 1.

	Cultivar					
	Pioneer 3320		Pioneer X304C		FLOPUP	
Nitrogen	K-Mg +	K-Mg	K-Mg +	K-Mg	K-Mg +	K-Mg
	Grain Yield					
lb A^{-1}			bu A^{-1}			
0	38	36	44	49	48	32
30	49	42	**64**	60	57	46
60	44	36	69	61	59	68
I20	35	41	55	53	41	55

LSD (0.05) 9 to compare K-Mg means for fixed N and cultivar.
LSD (0.05) 13 to compare N means for fixed cultivar and K-Mg.
LSD (0.05) 17 to compare cultivar means at fixed N and K-Mg.

	Whole Plant Yield:					
lb A^{-1}			ton A^{-1}			
0	7.1	7.7	8.0	8.9	10.1	7.0
30	9.4	8.3	11.4	10.8	12.0	9.5
60	8.1	7.1	12.0	11.0	11.9	13.9
I20	7.4	8.6	9.6	9.2	9.9	11.2

LSD (0.05) 1.9 to compare K level means for fixed N and cultivar
LSD (0.05) 2.5 to compare N means for fixed cultivar and K-Mg.
LSD (0.05) 3.4 to compare cultivar means to fixed N and K-Mg.

Grain yield of No. 2 grain expressed at 15.5% moisture.
Whole plant yield expressed at 35% moisture.
K-Mg K_2S0_4:$MgS0_4$) rate was 120 lb A_{-1}.

Table 2. Grain and whole plant yields of corn cultivars as affected by sidedressed N rate and K-Mg for location 2.

	Cultivar					
	Pioneer 3320		Pioneer X304C		FLOPUP	
Nitrogen	K-Mg +	K-Mg -	K-Mg +	K-Mg	K-Mg +	K-Mg
	Grain Yield					
lb A^{-1}			bu A^{-1}			
0	29	31	59	67	59	53
30	38	37	74	57	57	58
60	33	36	77	73	54	72
120	40	38	68	76	80	73

LSD (0.05) 14 to compare K-Mg means for fixed N and cultivar.
LSD (0.05) 17 to compare N means for fixed cultivar and K-Mg.
LSD (0.05) 34 to compare cultivar means at fixed N and K-Mg.

	Whole Plant Yield:					
lb A^{-1}			ton A^{-1}			
0	6.9	7.0	10.4	10.9	11.6	10.0
30	8.0	7.8	12.9	9.6	11.4	11.1
60	7.0	7.6	13.0	12.1	10.0	13.0
120	8.3	7.6	11.7	12.6	14.5	13.1

LSD(0.05) 2.6 to compare K level means for fixed N and cultivar.
LSD(0.05) 3.0 to compare N means for fixed cultivar and K-Mg.
LSD(0.05) 3.1 to compare cultivar means to fixed N and K-Mg.

Grain yield of No. 2 grain expressed at 15.5% moisture.
Whole plant yield expressed at 35% moisture.
K-Mg (K_2SO_4:$MgSO_4$) rate was 120 lb A^{-1}.

Table 3. Ear leaf N concentration means by N rate and cultivar for location 1.

Nitrogen	Cultivar		
	Pioneer 3320	Pioneer X304C	FLOPUP
lb A^{-1}		% N	
0	2.67	2.34	2.56
30	2.61	2.56	2.85
60	2.89	2.86	3.02
120	2.86	2.88	2.82

LSD(0.05) 0.12 to compare N rate means for a fixed cultivar.
LSD(0.05) 0.16 to compare cultivar means for a fixed N rate.

Table 4. Ear leaf N concentration means by N rate and K-Mg level for location 2.

Nitrogen	K-Mg		
	-	+	Mean
lb A^{-1}		% N	
0	2.58	2.64	2.61
30	2.81	2.85	2.83
60	2.82	2.92	2.87
120	2.86	3.05	2.96
Mean	2.17	2.87	2.82

LSD(0.05) 0.10 compare K-Mg rate means.
LSD(0.05) 0.21 to compare among N rate means

K-Mg (K_2SO_4:$MgSO_4$) rates of 0 and 120 lb A^{-1}.

the ear leaf of corn sampled at tasseling and before the silks turn brown would be 2.75 to 3.20%. Values for the three cultivars fell within this range from the application of 60 lb N A^{-1} for Pioneer 3320 and Pioneer X304C and 30 N A^{-1} for FLOPUP at location 1 and no K-Mg was needed (Table 3.). At location 2 all cultivars responded similarly and required 30 lb N A^{-1} and K-Mg to have leaf N values that fell within the sufficiency range.

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