Corn Hybrid Response to Nitrogen Fertilization in the Northern Corn Belt

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Recent research in the central Corn Belt showing that corn (*Zea mays* L.) hybrids differed markedly in yield response to N fertilization has stimulated interest in the N response characteristics of widely-grown hybrids in various production areas. However, little information is available on the importance of adjusting N application rates to improve yield or N fertilizer efficiency with specific hybrids. This study was conducted to determine if major differences in yield response to N fertilization exist among widely-grown hybrids in the northern Corn Belt, and to evaluate potential differences in N response characteristics among these hybrids. Experiments were conducted on a Plano silt loam (Typic Argiudoll) in southern Wisconsin using a split-plot treatment arrangement. Corn had been grown on the experimental sites since 1981. In 1985, subplot treatments were five 105- to 110-day relative maturity (RM) hybrids (Pioneer 3747 and 3732, Mo17 × A634, A632 × LH38, and LH74 × LH51). The same five hybrids plus two 95- to 100-day RM hybrids (Pioneer 3906 and 3737) were evaluated in 1986. Main plot treatments in both years were N rates of 0, 70, 140, and 210 lb N/acre broadcast applied as NH_4NO_3 before planting. In both years, grain yields varied with N rate and hybrid, but similar N rates were needed to maximize yields of the hybrids studied. Most hybrids produced maximum yields of 160 to 170 bu/acre with 140 lb N/acre in 1985, and 180 to 200 bu/acre with 210 lb N/acre in 1986. These responses are in good agreement with current Wisconsin N recommendations for corn production. The percentage of total N uptake accumulated at the midsilk stage of growth varied among hybrids and years. Results obtained suggest that the percent of total N accumulated at midsilk is not a consistent hybrid characteristic and is likely influenced by annual climatic variability. Nitrogen utilization efficiency (grain produced per pound of N uptake) was similar for the hybrids studied. We conclude that the N fertilizer requirements of the hybrids evaluated in this study are similar and that yields of these hybrids will likely be maximized with currently recommended N rates.

Additional Index Words: **Zea mays L., N uptake, N utilization efficiency.**

INTEREST in differences among corn hybrids in their grain yield response to N fertilization has been stimulated by recent research to evaluate N response characteristics of several hybrids (Tsai et al., 1984). This work has attracted the attention of agronomists and corn producers because it suggests that significant improvements in N fertilizer efficiency and corn yield are possible if fertilizer N is applied to individual hybrids at the rates needed to provide the N requirements of each hybrid. In their work, Tsai et al. (1984) identified three hybrids that differed markedly in their yield response to N fertilization. Yield of Pioneer 3732 was maximized by application of 60 lb/acre and produced substantially higher yields than Pioneer 3732. A third hybrid (B14 × Oh43) was intermediate in both response to N fertilization and grain yield. Tsai et al. (1984) concluded that these differences among hybrids in yield response to applied N were related to hybrid differences in: 1) ability to take up additional N after the midsilk stage, 2) rate and duration of grain fill, and 3) rate of zein protein synthesis in the kernel at various N rates. Subsequent research in Indiana (Mackay and Barber, 1986) showed that root growth of B73 × Mo17 was increased by N fertilization while applied N had no effect on root growth of Pioneer 3732. This work suggests that the greater root growth and continuation of root growth after midsilk observed with B73 × Mo17 could contribute to the N response differences observed between this hybrid and Pioneer 3732. In a study to evaluate the response of six corn hybrids to irrigation and N rate variables in Nebraska, Hatlitligil et al. (1984) also found that B73 × Mo17 produced higher grain yields and greater root mass than other hybrids. However, differences among hybrids in grain yield response to N fertilization were not detected in this work.

Research to date with a limited number of hybrids in the central Corn Belt has not provided information on the importance of adjusting N application rates to maximize yield and N fertilizer efficiency with specific hybrids in northern corn production areas. Additional research is needed to determine if major differences in response to N fertilization exist among widely-grown hybrids in the relative maturity range appropriate for the northern Corn Belt. The objectives of this research were: 1) to determine if major differences in yield response to N fertilization exist among several corn hybrids widely grown in southern Wisconsin, and 2) to evaluate potential differences among these hybrids in N uptake, timing of N uptake, and N utilization efficiency that could contribute to differences in yield response to N fertilization.

MATERIALS AND METHODS

Field experiments to evaluate potential differences in yield response to N fertilization among corn hybrids were conducted on a Plano silt loam (fine-silty, mixed, mesic Typic Argiudoll) at the University of Wisconsin Research Station at Arlington, WI, during 1985 and 1986. Experimental conditions and procedures are summarized in

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Table 1. The 1985 and 1986 experiments were conducted on separate but adjacent sites, where corn had been grown each year since 1981. Corn was grown without fertilizer N at each site during the year prior to use in these experiments to minimize the potential effects of residual profile NO_3-N on crop response to N treatments. Soil samples were taken to a depth of 3 ft each spring before application of N treatments to determine profile NO_3-N content. Before analysis, these soil samples were dried in a forced-draft dryer at 80°F and ground to pass a 0.08-in. screen. Nitrate-N in the soil samples was determined by automated analysis (Technicon Instrument Crop., 1977) of 2 *M* KCl extracts (Bremner and Keeney, 1966). Routine soil tests for pH, organic matter content, available P, and exchangeable K (Table 1) were performed as described by Liegel et al. (1980) on surface (0- to 8-inch) soil samples obtained before planting each year.

A randomized complete block design in a split-plot arrangement with four replicates was used in each experiment. Main plot treatments consisted of N fertilizer rates (0, 70, 140, 210 lb N/acre) broadcast applied as NH_4NO_3. The N treatments were incorporated into the soil by chisel plowing and disking before planting. Subplot treatments in 1985 consisted of five corn hybrids selected to represent a high percentage of the genetic backgrounds of 105- to 110-day RM hybrids (Minnesota relative maturity rating system, Peterson and Hicks, 1973) grown in Wisconsin. The hybrids used were Pioneer 3747 (P3747), Pioneer 3732 (P3732), Mo17 × A634, A632 × LH38, and LH74 × LH51. A narrow range in hybrid RM was used to minimize the potential effects of RM differences on response to N fertilization. In 1986, subplot treatments consisted of seven hybrids, including the five used in 1985 plus two 95- to 100-day RM hybrids [Pioneer 3906 (P3906) and Pioneer 3737 (P3737)].

Table 1. Experimental conditions and procedures.

Variable	Year 1985	Year 1986
Initial soil tests		
pH	6.2	5.8
Available P, lb/acre	246	172
Exchangeable K, lb/acre	372	293
Organic matter, T/acre	37	43
Profile nitrate-N, (0 to 3 ft), lb/acre	71	61
Planting date	30 Apr.	29 Apr.
Plant density, plants/acre		
Postemergence	25 000	27 000
Harvest	24 000	25 500
Plant harvest dates		
Midsilk	23-30 July	21-25 July
Maturity	19 Sept.	15 Sept.
Grain harvest date	7 Nov.	16 Oct.
Mean monthly temperature, °F†		
Apr. (47.0)	52.4	50.3
May (58.5)	62.5	59.0
June (67.6)	64.5	66.2
July (71.9)	71.2	71.7
Aug. (69.9)	66.5	64.1
Sept. (61.9)	61.9	61.6
Oct. (51.2)	49.8	50.5
Monthly precipitation, inches†		
Apr. (3.24)	2.36	2.73
May (3.21)	2.82	2.07
June (3.93)	3.50	4.18
July (3.93)	5.86	4.63
Aug. (3.84)	3.63	4.94
Sept. (3.44)	6.85	10.73
Oct. (2.37)	3.05	1.88

† Values in parentheses are 1951 through 1980 averages for temperature and precipitation.

Corn hybrids were planted in late April at a seeding rate of 37 000 seeds/acre, and the stand was hand-thinned to a density of 25 000 to 27 000 plants/acre after emergence. Starter fertilizer (150 lb/acre of 6–24–24) was applied in a 2-in. by 2-in. placement relative to the seed at planting. Conventional herbicide and soil insecticide applications were used to control weeds and insects. Individual plots were 10 ft wide (four 30-in. rows) and 30 ft long.

Ten plants were hand-harvested from each plot at midsilk (border rows) and at physiological maturity (center two rows) to determine hybrid and N rate effects on total N uptake at these stages of plant development. Midsilk plant harvests were made for each hybrid when silk emergence was detected on approximately 50% of the plants. Plant samples harvested at midsilk and physiological maturity were weighed, chopped, and subsampled for subsequent dry matter and total N determinations.

Before grain harvest, plant counts were made in each plot to determine the final harvest population. Grain yields were determined by machine harvest of 60 ft of row (center two rows) in each plot. Yields were adjusted to include grain removed in plant samples taken at physiological maturity. Subsamples of grain from each plot were retained for subsequent grain moisture and total N determinations. Grain yields are reported at 15.5% moisture.

Total N concentrations in plant tissue and grain were determined as described by Nelson and Sommers (1973). Before analysis, plant and grain samples were dried at 160°F and ground to pass a 0.04-in. screen. Nitrogen uptake at midsilk, physiological maturity, and in grain was calculated from plant tissue or grain N concentrations and the corresponding dry matter yields. The percentage of total N uptake at the midsilk stage of plant development was calculated from plant N uptake data obtained at midsilk and physiological maturity. Measurements of total N uptake at physiological maturity and grain yield data were used to evaluate treatment effects on nitrogen utilization efficiency (grain yield, lb/acre ÷ total N uptake, lb/acre).

Data were subjected to an analysis of variance, and N rate main effects and interactions were partitioned into linear and quadratic components (SAS Institute, Inc., 1982). Significant differences among hybrid treatment means and N × hybrid interactions were evaluated using a protected least significant difference (LSD) test.

RESULTS AND DISCUSSION

Analyses of variance for the 1985 and 1986 hybrid N response experiments are shown in Table 2. In both years, grain yield was significantly affected by N rate and hybrid, but the interactions between N rate and hybrid were not significant. The significant quadratic response to N rate in 1985 (Table 2) is reflected in the N treatment

Table 2. Analysis of variance of hybrid N response experiments, 1985 and 1986.

Source of variation	df	Grain yield	Total N uptake	Grain N uptake	% of total N uptake at midsilk	NUE†
		P > F				
			1985			
N rate (N)	3	0.01	0.01	0.01	0.22	0.01
N linear (lin)	1	0.01	0.01	0.01	0.09	0.04
N quadratic (quad)	1	0.01	0.05	0.01	0.14	0.21
Hybrid (H)	4	0.01	0.01	0.01	0.01	0.01
N × H	12	0.18	0.01	0.01	0.01	0.01
N lin × H	4	0.35	0.01	0.27	0.03	0.05
N quad × H	4	0.46	0.50	0.06	0.08	0.16
CV (%)		7.2	11.8	5.6	15.8	14.4
			1986			
N rate (N)	3	0.01	0.01	0.01	0.10	0.02
N linear (lin)	1	0.01	0.01	0.01	0.32	0.02
N quadratic (quad)	1	0.06	0.09	0.05	0.35	0.70
Hybrid (H)	6	0.01	0.03	0.01	0.02	0.11
N × H	18	0.38	0.02	0.27	0.08	0.02
N lin × H	6	0.84	0.14	0.71	0.08	0.77
N quad × H	6	0.10	0.12	0.05	0.27	0.02
CV (%)		8.2	15.9	9.3	23.8	18.6

† NUE = N utilization efficiency (grain yield, lb/acre ÷ total N uptake, lb/acre).

means shown for the 1985 experiment in Table 3. These means show that yields increased through the 140 lb N/acre rate, but no additional response occurred with the 210 lb N/acre rate. This result and the absence of a significant N × hybrid interaction indicates that, although yields varied among hybrids, similar N rates were needed to maximize yields of the hybrids evaluated. As shown in Table 3, four of the five hybrids studied in 1985 reached maximum or near-maximum yield at the 140 lb N/acre rate. Yield of LH74 × LH51 was maximized at the 70 lb N/acre rate in 1985, but this hybrid responded to higher N rates in 1986.

In general, hybrids responded to higher N rates in 1986 than in 1985, probably due to the higher yields produced in 1986 (Table 3). The significant linear response to applied N (Table 2) and the 1986 N treatment means in Table 3 show that yields increased through the highest N rate (210 lb N/acre). A quadratic response to N rate, significant at the 0.06 probability level, also occurred in 1986 (Table 2). This response is consistent with the smaller mean yield increases obtained as N rates were increased

Table 3. Effect of hybrid and N rate on grain yield, 1985 and 1986.

Year	Hybrid	N rate, lb/acre 0	70	140	210	Mean†
		Yield, bu/acre				
1985	P3747	133	151	170	166	155
	P3732	128	150	161	166	150
	Mo17 × A634	113	146	158	152	142
	A632 × LH38	120	147	159	142	142
	LH74 × LH51	120	166	158	167	153
	Mean	122	152	161	159	
1986	P3906	130	137	163	168	149
	P3737	144	185	190	198	179
	P3747	131	170	191	186	169
	P3732	151	162	180	200	173
	Mo17 × A634	135	155	165	176	158
	A632 × LH38	134	150	177	171	158
	LH74 × LH51	147	181	195	204	182
	Mean	139	163	180	186	

† Hybrid LSD (0.05), 1985 = 7.6 and 1986 = 9.7.

(Table 3). In 1986, two hybrids (P3747 and A632 × LH38) reached maximum yields with 140 lb N/acre. Yields with the remaining hybrids were increased by 5 to 20 bu/acre when the N rate was increased from 140 to 210 lb N/acre. These differences in hybrid response to N rates are small relative to those observed by Tsai et al. (1984), and the absence of a significant N × hybrid interaction (Table 2) indicates that they are not statistically significant. Our results (Tables 2 and 3), showing that similar N rates were needed to maximize yields of the hybrids evaluated, are in agreement with those of Hatlitligil et al. (1984), who also found similar yield responses to N fertilization among six hybrids in a Nebraska study.

To evaluate the possibility that RM differences between P3732 and B73 × Mo17 contributed to the hybrid N response differences detected by Tsai et al. (1984), two 95- to 100-day RM hybrids (P3906 and P3737) were included in the 1986 experiment. Although the RM difference between P3906 and 110-day RM hybrids such as LH74 × LH51 approached the RM difference between P3732 and B73 × Mo17, the N rates needed to maximize yield of the 95- to 100-day RM hybrids and the 110-day RM hybrids were similar in our work (Table 3). Differences in plant densities between our work and that of Tsai et al. (1984) may also have contributed to differences in hybrid N response characteristics observed in the two studies. Plant densities of 25 000 to 27 000 plants/acre were used in our work (Table 1), while approximately 22 000 plants/acre were used by Tsai et al. (1984). Differences in plant density within this range have been shown to influence corn yield response to N fertilization (Benson, 1981).

The hybrid yield responses to N fertilization illustrated in Table 3 are in good agreement with current N rate recommendations for corn production in Wisconsin (Kelling et al., 1981). In 1985, maximum yields of 160 to 170 bu/acre were obtained with the hybrids tested. On the soil used in this work, 150 lb N/acre is recommended for a 160 bu/acre yield goal. Maximum yields for most hybrids ranged from 180 to 200 bu/acre in 1986, and the

Table 4. Effect of hybrid and N rate on total N uptake at physiological maturity and N uptake in grain, 1985 and 1986.

Year	Hybrid	N rate, lb/acre									
		0	70	140	210	Mean†	0	70	140	210	Mean‡
		Total N uptake, lb/acre					Grain N uptake, lb/acre				
1985	P3747	159§	214	184	219	194	85¶	99	121	130	109
	P3732	126	191	178	218	178	72	98	102	111	96
	Mo17 x A634	145	182	184	212	181	78	101	123	117	105
	A632 x LH38	129	192	195	206	181	77	98	114	110	100
	LH74 x LH51	159	164	261	268	213	74	105	106	119	101
	Mean	144	189	200	225		77	100	113	117	
1986	P3906	140§	178	209	209	184	80	87	111	116	99
	P3737	150	176	222	211	190	78	107	122	124	108
	P3747	170	165	254	244	208	73	106	125	119	106
	P3732	162	165	233	217	194	84	91	109	116	100
	Mo17 x A634	133	193	225	194	186	74	92	103	115	96
	A632 x LH38	144	177	202	281	201	75	88	113	116	98
	LH74 x LH51	165	163	281	259	217	74	97	111	120	101
	Mean	152	174	232	231		77	95	113	118	

† Hybrid LSD (0.05), 1985 = 15.9 and 1986 = 22.1
‡ Hybrid LSD (0.05), 1985 = 4.1 and 1986 = 6.6.
§ N × hybrid LSD (0.05), 1985 = 33.9 and 1986 = 43.8.
¶ N × hybrid LSD (0.05), 1985 = 8.3 and 1986 = not significant.

current N recommendation for this yield range is 210 lb N/acre. Quadratic response functions for the effect of N rate on yield obtained in the 1985 and 1986 experiments were solved for the N rates recommended at the maximum yield levels obtained each year. The predicted yield values were 163 bu/acre with 150 lb N/acre in 1985 and 199 bu/acre with 210 lb N/acre in 1986. These results indicate that, under similar growing conditions, yields of the hybrids evaluated in this study are likely to be maximized at the N rates specified in current Wisconsin recommendations.

Total N uptake and N uptake in grain were significantly infuenced by hybrid and N rate in 1985 and 1986 (Table 2). Significant linear or quadratic responses to N rate occurred with both N uptake parameters in both years. The nature of these responses is illustrated by the N treatment means in Table 4. In 1985, total N uptake increased with increasing N rate through 210 lb N/acre, while in 1986, N uptake did not increase beyond the 140 lb N/acre rate. The high total N uptake and grain yield with no applied N (Tables 3 and 4) and the low initial profile NO_3-N levels (Table 1) suggest that substantial amounts of available N were supplied through mineralization of soil organic matter during the growing season. Grain N uptake increased through the highest N rate (210 lb N/acre) in both years. Total N uptake differences among hybrid means (Table 4) were due to higher N uptake values found with P3747 and LH74 x LH51 relative to other hybrids. In 1985, total N uptake with LH74 x LH51 was significantly higher than with the remaining four hybrids, and in 1986, N uptake with LH74 x LH51 was significantly greater than with four of the other hybrids evaluated. Total N uptake with P3747 was significantly higher than P3732 in 1985 and higher than P3906 in 1986. The higher total N uptake with LH74 x LH51 did not result in higher grain N uptake with this hybrid in either year. In 1985, the highest grain N uptake occurred with P3747 and Mo17 x A634, while the highest mean grain N uptake values in 1986 were obtained with P3737 and P3747.

Significant N × hybrid interactions for total N uptake in both years and for grain N uptake in 1985 (Table 2) indicate that the effect of N rate on N uptake varied among hybrids. The N × hybrid interactions (Table 4) for total N uptake appear to be due to higher N uptake at the 140 and 210 lb N/acre rates with some hybrids. This response pattern occurred with LH74 x LH51 in 1985, and with several hybrids in 1986. The significant N × hybrid interaction for grain N uptake in 1985 is likely due to differences in hybrid response at the two highest N rates. As shown in Table 4, grain N uptake with several hybrids (P3747, P3732, LH74 x LH51) increased at all levels of applied N, while other hybrids (Mo17 x A632 and A632 x LH38) maximized grain N uptake at the 140 lb N/acre rate.

The effects of hybrid and N rate on the percent of total N uptake accumulated at the midsilk growth stage is shown in Table 5. In both years, hybrids differed significantly in the percent of total plant N accumulated by the midsilk stage, but N rate effects were not significant (Table 2). A significant treatment interaction occurred in 1985 but not in 1986, indicating that 1985 hybrid effects on percent N uptake at midsilk varied with N rate.

Table 5. Effect of hybrid and N rate on percent of total N uptake accumulation at midsilk growth stage, 1985 and 1986.

Year	Hybrid	N rate, lb/acre				
		0	70	140	210	Mean†
		% of total N uptake				
1985	P3747	51‡	43	57	49	50
	P3732	75	58	75	65	68
	Mo17 x A634	82	84	85	75	82
	A632 x LH38	85	65	47	59	64
	LH74 x LH51	82	83	63	73	75
	Mean	75	67	65	64	
1986	P3906	74	87	76	62	75
	P3737	54	89	68	79	72
	P3747	64	100	80	81	81
	P3732	83	100	85	99	92
	Mo17 x A634	67	69	70	97	76
	A632 x LH38	96	74	86	67	81
	LH74 x LH51	64	73	61	74	68
	Mean	72	85	75	80	

† Hybrid LSD (0.05), 1985 = 7.6 and 1986 = 13.0.
‡ N × hybrid LSD (0.05), 1985 = 17.8 and 1986 = not significant.

Data obtained in 1985 and 1986 indicate that the percent of total N uptake accumulated at the midsilk stage varied substantially between years for most of the hybrids evaluated (Table 5). If means for the five hybrids studied in both years are ranked within years according to decreasing percent of total N accumulation at midsilk, no similarity in the relative order of the hybrids is apparent. Mackay and Barber (1986) also noted that the percent of total plant N accumulated by midsilk in B73 × Mo17 and P3732 ranged from 55 to 70% with no apparent differences between hybrids. In another growing season, at the same location, Tsai et al. (1984) found that P3732 contained 93% of its total N uptake at midsilk, while B73 × Mo17 had accumulated only 64% of its total N. Mackay and Barber (1986) attributed the differences in hybrid N accumulation between the two studies to severe moisture stress during the growing season in which their work was done. Differences in plant moisture stress between growing seasons may also have influenced hybrid N accumulation at midsilk in our work. In 1985, only 0.42 inch of rainfall occurred between 1 July and the midsilk growth stage (23 July). In contrast, near-optimum soil moisture was maintained by 2.92 inches of rainfall during the corresponding period (1 to 21 July) in 1986. Results from our work and that of Mackay and Barber (1986) suggest that percent of total N accumulation at midsilk may be a hybrid characteristic which is strongly influenced by annual variation in climatic conditions.

Nitrogen utilization efficiency (NUE) was significantly affected by hybrid and N rate in 1985 and only by N rate in 1986 (Table 2). Significant linear responses to N rate and significant N × hybrid interactions were observed in both years. In general, NUE decreased with increasing N rates (Table 6). Lower mean NUE values are particularly apparent at the 210 lb N/acre rate in 1985 and at the 140 and 210 lb N/acre rates in 1986. Decreases in NUE with increasing N rates are anticipated, since higher available N levels are usually needed to maximize N uptake than to maximize grain yield (Olson et al., 1976). Four of the five hybrids tested in 1985 did not differ significantly in NUE. Only LH74 × LH51 was significantly lower in NUE than the remaining hybrids. The NUE values obtained with the same five hybrids in 1986 were similar to the 1985 values, and all hybrids evaluated in 1986 did not differ significantly in NUE. Similar NUE values among the hybrids tested are consistent with the similar grain yield responses to N fertilization found with these hybrids (Table 3). Significant N × hybrid interactions in 1985 and 1986 (Table 6) appear to be due to variation in hybrid response to individual N treatments that resulted in frequent changes in the relative order of hybrid NUE values as N rates were increased. In 1985, NUE values for LH74 × LH51 decreased markedly at the 140 and 210 lb N/acre rates relative to the remaining hybrids. These reductions in NUE are consistent with the increased total N uptake and absence of grain yield response observed with LH74 × LH51 at these N rates in 1985 (Tables 3 and 4). However, individual hybrids or groups of hybrids that showed obvious differences in NUE response to N fertilization in 1986 could not be identified.

Table 6. Effect of hybrid and N rate on N utilization efficiency, 1985 and 1986.

Year	Hybrid	N rate, lb/acre 0	70	140	210	Mean†
		NUE§				
1985	P3747	48‡	39	54	45	46
	P3732	55	45	52	45	49
	Mo17 × A634	47	47	51	41	46
	A632 × LH38	53	42	44	40	45
	LH74 × LH51	42	52	33	30	39
	Mean	49	45	47	40	
1986	P3906	45‡	36	37	39	40
	P3737	45	52	42	45	46
	P3747	37	50	36	36	40
	P3732	48	47	37	44	44
	Mo17 × A634	54	39	35	44	43
	A632 × LH38	45	40	42	29	39
	LH74 × LH51	43	54	33	38	42
	Mean	45	45	37	39	

† Hybrid LSD (0.05), 1985 = 4.6 and 1986 = not significant.
‡ N × hybrid LSD (0.05), 1985 = 9.3 and 1986 = 11.4.
§ NUE = N utilization efficiency (grain yield, lb/acre ÷ total N upake, lb/acre).

SUMMARY

A 2-year study was conducted to evaluate N response characteristics of several corn hybrids widely grown in the northern Corn Belt. Grain yields varied among hybrids, but similar N rates were needed to maximize yields of the hybrids evaluated. Most hybrids reached maximum yield levels with 140 to 210 lb N/acre. Nitrogen rates needed to maximize yields of the hybrids studied were in good agreement with current University of Wisconsin N recommendations for corn. Results from this work indicate that corn yield or N fertilizer efficiency are not likely to be improved by adjusting N application rates for individual corn hybrids.

The percentage of total N uptake accumulated at the midsilk stage varied among hybrids and years. Results obtained suggest that plant N accumulation at midsilk may not be a consistent hybrid characteristic and is probably influenced by climatic variability. Nitrogen utilization efficiency (grain produced per pound of N uptake) was relatively constant among the hybrids tested. This result is consistent with the similar grain yield responses to N fertilization found with these hybrids.

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REFERENCES

Benson, G.O. 1981. Corn plant populations and N rates. Iowa State Univ. Ext. Pub. no. CE-1602a.

Bremner, J.M., and D.R. Keeney. 1966. Determination and isotoperatio analysis of different forms of nitrogen in soils: 3. Exchangeable ammonium, nitrate, and nitrite by extraction-distillation methods. Soil Sci. Soc. Am. Proc. 30:577–582.

Hatlitligil, M.B., R.A. Olson, and W.A. Compton. 1984. Yield, water use, and nutrient uptake of corn hybrids under varied irrigation and nitrogen regimes. Fert. Res. 5:321–333.

Kelling, K.A., P.E. Fixen, E.E. Schulte, E.A. Liegel, and C.R. Simson. 1981. Soil test recommendations for field, vegetable, and fruit crops. Univ. Wisconsin Ext. Pub. no. A2809.

Liegel, E.A., C.R. Simson, and E.E. Schulte. 1980. Wisconsin procedures for soil testing, plant analysis, and feed and forage analysis. Univ. Wisconsin Dep. Soil Sci. Soil Fert. Series no. 6 (revised).

Mackay, A.D., and S.A. Barber. 1986. Effect of nitrogen on root growth of two corn genotypes in the field. Agron. J. 78:699–703.

Nelson, D.W., and L.E. Sommers. 1973. Determination of total nitrogen in plant material. Agron. J. 65:109–112.

Olson, R.A., K.D. Frank, E.J. Diebert, A.F. Drier, D.H. Sander, and V.A. Johnson. 1976. Impact of residual mineral N in soil on grain protein yields of winter wheat and corn. Agron. J. 68:769–772.

Peterson, R.H., and D.R.Hicks. 1973. Minnesota relative maturity rating of corn hybrids. Univ. Minnesota, Agric. Exp. Serv. Agron. no. 27.

SAS Institute, Inc. 1982. SAS user's guide: Statistics. SAS Institute, Cary, NC.

Technicon Instrument Corp. 1977. Nitrate and nitrite in soil extracts. Industrial Method no. 487-77A. Technicon Instrument Corp., Tarrytown, NY.

Tsai, C.Y., D.M. Huber, D.V. Glover, and H.L. Warren. 1984. Relationship of N deposition to grain yield and N response of three maize hybrids. Crop Sci. 24:277–281.

ERRATUM

In "Corn Hybrid Response to Nitrogen Fertilization in the Northern Corn Belt" by L.G. Bundy and P.R. Carter, *J. Prod. Agric.* 1:99–104, the fourth sentence in the introductory paragraph on page 99 should read "Yield of Pioneer 3732 was maximized by application of 60 lb N/acre, while a second hybrid (B73 × Mo17) responded to more than 240 lb N/acre and produced substantially higher yields than Pioneer 3732." A correction was made for the reprints.

ERRATUM

In "Light Penetration through Tall Fescue in Relation to Canopy Biomass" by J.O. Trott, K.J. Moore, V.L. Lechtenberg, and K.D. Johnson, *J. Prod. Agric.* 1:137–140, there were errors in all three figures. Figure 1 should have had a label along the x axis reading "Canopy Biomass (lb/acre)." Also, the illustrations for Figs. 2 and 3 should have been reversed. Corrections have been made for the reprints.