RESCUE N APPLICATIONS FOR CORN: YIELD RESPONSE, LEAF BURN, AND YIELD LOSS

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Rescue N applications in a standing corn crop may be necessary when wet conditions prevent preplant N applications or loss of N was suspected due to wet conditions after application. In these situations, either tractor-mounted or high-clearance-mounted applicators can sidedress N fertilizer between corn rows, avoiding leaf burn. However, these applicators are not always available, or may be configured for other uses such as spraying herbicides; therefore, broadcast applications may be easier to accomplish. In addition, broadcasting N fertilizer by airplane is another option for rescue applications of N when soil conditions are too wet to carry traffic. Broadcast applications of N will cause leaf burn, but little if any research has been conducted to measure how much yield is lost due to this leaf burn for various application times and nitrogen forms. The amount of yield recovered may depend on the stage at which N is applied. Understanding yield loss associated with nitrogen burn at different stages of corn development would help corn producers to make informed decisions about whether to attempt rescue N applications and what type of application equipment to use. The objective of this study was to evaluate yield response of corn to rescue N applications, including broadcast applications that cause leaf burn and to evaluate dry and liquid nitrogen sources.

Field research was conducted at the University of Missouri Greenley Research Center near Novelty (40.035997 N, 92.243783 W), Bradford Research and Extension Center near Columbia (38.894165 N, 92.274145 W), Hundley-Whaley Research Center near Albany (40.251282 N, 94.326977 W), and Delta Center near Portageville (36.427945 N, 89.700234 W) in 2003. The soil was a Putnam silt loam (fine, montmorillonitic, mesic Mollic Albaqualf), Mexico silt loam (fine, montmorillonitic, mesic Vertic Albaqualfs), Grundy silt loam (fine, montmorillonitic, mesic Aquic Argiudolls), and Tiptonville silt loam (fine-silty, mixed, thermic Typic Argiudolls) at Novelty, Columbia, Albany, and Portageville, respectively. Researchers at each site utilized management practices commonly used by farmers in the area.

Research was arranged as a randomized complete block design with four replications at Novelty, Columbia, and Portageville and three replications at Albany. Ammonium nitrate (AN), urea ammonium nitrate (UAN), urea, or urea plus Agrotain at 1 qt/ton was applied broadcast or between the row at 150 lb N/acre preplant and to 1, 2, 3, and 4 ft tall corn except between-row, preplant urea and urea plus Agrotain at 1 gallon/ton; 1 ft corn treated with urea at Novelty, Columbia, and Albany; and 3 ft corn treated with urea and urea plus Agrotain at Novelty, Columbia, and Albany. Corn injury from 0 (no visual crop injury) to 100% (complete crop death) was evaluated 7 and 14 days after treatment based on the combined visual effects of N source on necrosis, chlorosis, and stunting.

Corn was harvested with a small-plot combine and final weight adjusted to 15% moisture. The cost-effectiveness of the rescue N applications was reported as a gross margin calculated as: [(grain yield * market price of $2.20/bu) – (cost of N fertilizer + additive + application)]. The application cost for a preplant broadcast application and sidedress application was estimated at $4.00/acre and $6.80/acre, respectively (Plain et al., 2001). An eight year average of the April cost of AN, UAN, and urea was $0.107/lb, $0.82/gal, and $0.115/lb, respectively (Anonymous 2003). Agrotain cost was $7.34/acre. Yield data were grouped according to low, medium and high yield environments in 2003 and subjected to analysis of variance and means separated at p = 0.05 using Fisher's Protected LSD.

Field research evaluated the impact of AN (ammonium nitrate), UAN (urea ammonium nitrate), urea, and urea plus Agrotain applied broadcast and between-row as a preplant and postemergence application to 1, 2, 3, and 4 ft corn. None of the between-row treatments injured corn except UAN at Portageville (Data not presented). Broadcast applied N injury was ranked UAN > AN > urea = urea + Agrotain. Yield response and returns related to rescue N applications were dependent on the grain yield environment. Rescue N treatments had gross margins similar to the untreated control in a low yield environment (Data not presented). In a medium yield environment, all rescue N treatments had grain yield similar to the highest yielding N source for any given timing except between-row urea to 2 ft corn, broadcast UAN to 2, 3, and 4 ft corn, and broadcast AN to 4 ft corn (Table 1). Broadcast AN and UAN to 1 ft corn, urea to 2, 3 , and 4 ft corn, and urea plus Agrotain to 2 and 4 ft corn had grain yields similar to the highest yielding N source for any given rescue N application timing in a high yield environment (Table 2). Recommendations for rescue N applications depend on anticipated grain yield, available nitrogen source, timing, injury, and application method. This research was repeated in 2004. The authors would like to thank the Missouri Fertilizer and Ag Lime Board for providing funding for this research. The Greenley Research Center would like to thank CPS at LaPlata for supplying ammonium nitrate, Morgan's Fertilizer at Edina for supplying 32% urea ammonium nitrate, and Agrotain International at Corydon, KY for supplying Agrotain for this trial.

Table 1. Corn grain yield and gross margin as affected by ammonium nitrate (AN), urea ammonium nitrate (UAN), urea, and urea plus Agrotain applied broadcast and between-row as preplant and sidedress to 1, 2, 3, and 4 ft corn in a medium yield environment at Novelty in 2003.

	Preplant	1 ft	2 ft	3 ft	4 ft	Preplant	1 ft	2 ft	3 ft	4 ft
Treatment	Yield (bu/a)					Gross margin ($/a)				
Untreated	58					127				
Broadcast										
AN	115	122	112	113	110	200	212	190	194	187
UAN	108	114	110	106	90	198	209	200	190	157
Urea	105	115	118	128	125	183	209	216	238	230
Urea + Agrotain	111	116	126	120	120	203	203	226	213	211
Between-row										
AN	110	112	118	126	125	189	191	203	222	219
UAN	105	114	118	124	125	192	208	217	230	233
Urea	—	—	110	—	120	—	—	197	—	221
Urea + Agrotain	—	118	121	—	120	—	215	216	—	212
LSD ($p \leq 0.05$)	15					33				

Table 2. Corn grain yield and gross margin as affected by ammonium nitrate (AN), urea ammonium nitrate (UAN), urea, and urea plus Agrotain applied broadcast and between-row as preplant and sidedress to 1, 2, 3, and 4 ft corn in a high yield environment at Portageville in 2003.

	Preplant	1 ft	2 ft	3 ft	4 ft	Preplant	1 ft	2 ft	3 ft	4 ft
Treatment	Yield (bu/a)					Gross margin ($/a)				
Untreated	102					225				
Broadcast										
AN	177	178	136	84	93	338	335	243	129	149
UAN	162	181	130	114	56	317	357	245	209	82
Urea	208	155	160	159	134	408	297	307	306	250
Urea + Agrotain	187	154	171	117	140	371	287	325	205	255
Between-row										
AN	170	202	141	143	152	321	390	255	258	279
UAN	181	176	141	121	128	359	346	269	225	239
Urea	—	143	155	146	128	—	270	297	277	238
Urea + Agrotain	—	178	175	141	117	—	348	334	258	205
LSD ($p \leq 0.05$)	33					73				