EFFECT OF N APPLICATION TIMING AND PLANT GROWTH REGULATOR USE ON WHEAT[1]

E.C. Varsa, Beatrice Baikan and Awang Dayang[2]

Winter wheat is an important cash crop grown in the Midwestern states. However, progress in yield advancement has been slow compared to advances in other major wheat producing regions, notably Europe. This has lead to a competitive disadvantage of USA-produced wheat on the world market. In an effort to enhance wheat productivity and profitability a series of experiments were established in the fall of 1985 to assess the impact of more intensified management practices including the use of multiple N applications, fungicides, and a growth retardant (Cerone) on two high-yielding wheat varieties adapted to southern Illinois.

MATERIALS AND METHODS

During the 3-year period of 1986 to 1988 experiments were conducted at the Belleville and Carbondale Agronomy Research Centers of Southern Illinois University. The soils used were a Herrick silt loam, Aquic Argiudoll, at Belleville and Stoy and Alford silt loams, Aquic Hapludalf and Typic Hapludalf, respectively, at Carbondale. The previous crop was corn prior to the 1986 experiments and soybeans prior to 1987 and 1988 experiments. Phosphorus and potassium fertilizers as maintenance were applied before wheat seeding to soils that tested in excess of 50 lbs P ac^{-1} by the Bray P_1 test and 300 lbs K ac^{-1} or above in exchangeable K. Soil organic matter ranged between 1.5 and 1.8 percent at all locations.

Two high yielding wheat varieties were selected, Caldwell and Rhom Haas HW 3021--a hybrid wheat that is no longer commercially available. Nitrogen treatments consisted of granular urea applied at various times, before seeding and during crop development (Table 1). A "medium" and "high" N application rate was chosen to be approximately a grower recommended N rate and a rate of approximately 50% in excess of the recommended rate. This was 90 lbs N ac^{-1} for "medium" N fertility and 135 lbs N ac^{-1} for "high" N application. Timing consisted of either N application in the fall (F), including two treatments with N-Serve at 1/2 lb ac^{-1}, or splits of some N in the fall and some as either an early spring (ES) or late spring (LS) application. Early spring application coincided with wheat tillering, usually being applied in late February or early March. Late spring application was usually made after full flag leaf extension but before head emergence from the boot. This usually occurred in late April or early May.

---

[1]Presented at the Eighteenth North Central Extension-Industry Soil Fertility Workshop, November 9-10, 1988, St. Louis, MO

[2]Associate Professor and Graduate Assistants, Dep. of Plant and Soil Science, Southern Illinois University, Carbondale, IL 62901

Cerone, a plant growth regulator, was applied in an effort to reduce plant lodging especially that which may occur with the "high" N fertility treatments. Cerone treatment consisted of either no Cerone or Cerone applied at 0.3 lb a.i. ac^{-1}. Cerone was applied when the wheat heads had elongated into the boot but before their emergence from the boot. Fungicides, consisting of Bayleton at 1/4 lb ac^{-1} and Dithane M-45 at 2 lbs ac^{-1} were applied uniformly over all experiments at the stage of full flag leaf extension.

RESULTS AND DISCUSSION

Application of Cerone reduced average plant height by 2 to 6 inches compared to the control over all locations and years (Table 2). Generally, height reductions from Cerone were greater for Rhom-Haas HW 3021 (RH 3021) than for Caldwell but this might be expected because the RH 3021 was a taller growing variety. Detailed measurements (data not given) showed that uppermost internode extention was greatly reduced by Cerone with lower internodes being less affected.

Under certain conditions enhanced Septoria glume blotch was observed with Cerone use. At Carbondale, in 1986 and 1987, both wheat varieties were more infested with glume blotch as a result of Cerone treatment compared to the control (Table 3). This may have resulted because wheat was under a greater stress from the growth retardant thus allowing invasion of the disease to a greater degree in the plants. At Belleville little evidence of a disease differential was observed during those same years and in 1988 little disease pressure was observed at either location, primarily because of the unusually dry spring.

Wheat yields were variably affected by Cerone application (Table 4). Yields were decreased by Cerone 1 to 4 bu ac^{-1} in 1986, increased 0 to 2 bu ac^{-1} in 1987, and decreased 1 to 3 bu ac^{-1} in 1988. Generally, the decreases could be traced to enhanced Septoria infestation but not always. Other stress factors might have been involved which overshadowed the beneficial effects of reduced yield losses by Cerone from lodging.

Lodging was a serious problem at Belleville in 1986 and Carbondale in 1987 (Table 5). The other location in 1986 and 1987 had minimal lodging problems and in 1988 no lodging was observed anywhere, mainly because no severe storms occurred from heading through harvest. When lodging was serious, greatest incidence was observed at the highest rate of N application (135 lbs N ac^{-1}). Lodging, when severe, was greatly reduced by Cerone. With respect to N timing, lodging was greatest when all the N was applied in the fall, either without or with N-Serve, and lesser amounts were observed with split N applications. Usually the least lodging was observed with the three way split sequence.

Nitrogen timing and level of application (medium vs. high) had a significant effect on wheat yields at all locations and years (Table 6). Higher yields were obtained at Belleville than Carbondale in 1986 and 1987 but the opposite was observed in 1988. A dramatic response to N

over the control was noted in 1986 when the preceding crop was corn, whereas a lesser response to N was seen in 1987 and 1988 when the previous crop was soybeans. The "high" level of N was significant in increasing wheat yields at Belleville in 1986 and at both locations in 1988 but was of little or no consequence in increasing yields at Carbondale in 1986 and at both locations in 1987. Splitting the N application such that some was applied in the fall, early spring, and late spring resulted in some of the highest yields in 1986 and 1987 but was no different than applying all the N in the fall in 1988. Lack of significant N loss conditions during the 1988 growing season resulted in the complete fall treatments equalling the 3 way split. N-Serve inclusion in the all-in-the-fall N treatment was usually no different than its non-N-Serve comparison. The treatment of urea with N-Serve in the fall followed by a small amount of N in the late spring usually gave higher yields than the all in the fall N-Serve treatment. The traditional application of a small portion of N in the fall to wheat with the balance in the early spring usually resulted in yields that were equal to or only 1 to 3 bu ac^{-1} less than those from a 3-way split. Hence, there seems to be very little advantage to wheat producers for going to the expense of a later spring application compared to the customary fall and early spring N application sequence currently used.

SUMMARY AND CONCLUSIONS

Cerone effectively reduced wheat height but, under certain conditions, enhanced the susceptibility of the crop to Septoria glume blotch. Lodging was significantly reduced by Cerone especially under high N fertility and under conditions when the crop was exposed to storms.

Split N applications enhanced wheat yields compared to complete N treatment in the fall at seeding, even if N-Serve were used. The traditional grower N application practice of a small portion of N in the fall and the remainder in the early spring was usually equal to or only 1 to 3 bu ac^{-1} less than a three way N split of portions in the fall, early spring, and late spring at heading. This suggested that no strong economic advantage to wheat producers for multiple applications were evident over those practices currently recommended.

Table 1. Treatments applied to wheat experiments at the Belleville and Carbondale, IL locations, 1986-1988.

Varieties (as main plots):
- Caldwell
- Rhom Haas HW 3021

N Treatment and Timing (as subplots):

"Medium" (90 lbs N ac^{-1})			"High" (135 lbs N ac^{-1})		
Fall	Early Spring	Late Spring	Fall	Early Spring	Late Spring
90	0	0	135	0	0
90+1/2 N-Serve	0	0	135+1/2 N-Serve	0	0
25	65	0	45	90	0
65+1/2 N-Serve	0	25	110+1/2 N-Serve	0	25
25	40	25	45	65	25

Plant Growth Regulator, Cerone (as sub-subplots):

- 0 Cerone
- 0.3 lbs a.i. Cerone ac^{-1}

A mixture of Bayleton at 1/4 lb ac^{-1} and Dithane M-45 at 2 lbs ac^{-1} was applied as a blanket over all treatments at the stage of full flag leaf extension.

Table 2. Effect of Cerone on the height of 2 wheat varieties at Belleville and Carbondale, IL 1986-1988.

Variety	1986				1987				1988			
	B'ville		C'dale		B'ville		C'dale		B'ville		C'dale	
	-C	+C	-C	+C	-C	+C	-C	+C	-C	+C	-C	+C
	inches											
Caldwell	28	26	33	31	44	39	39	36	33	30	37	34
Rhom-Haas HW 3021	30	27	36	32	45	39	39	35	36	31	40	36

-C = no Cerone added +C = Cerone added at 0.3 lb a.i./acre.

Table 3. Effect of Cerone on the infestation of Septoria Glume Blotch at Carbondale, IL 1986 and 1987.

Variety	1986		1987	
	-C	+C	-C	+C
	% black heads			
Caldwell	29	35	23	25
Rhom-Haas HW 3021	16	27	16	20

-C = no Cerone added +C = Cerone added at 0.3 lb a.i./acre.

Table 4. Effect of Cerone on the yield of 2 wheat varieties at Belleville and Carbondale, IL 1986-1988.

Variety	1986				1987				1988			
	B'ville		C'dale		B'ville		C'dale		B'ville		C'dale	
	-C	+C	-C	+C	-C	+C	-C	+C	-C	+C	-C	+C
	bu ac											
Caldwell	69	65	47	46	80	81	50	52	74	73	88	86
Rhom-Haas HW 3021	67	64	58	55	85	85	61	61	74	71	85	84

-C = no Cerone added +C = Cerone added at 0.3 lb a.i./acre.

Table 5. Effect of Cerone and N fertilizer timing on lodging of wheat at selected sites.

N Treatment and Timing, lbs N ac^{-1}	Belleville[1] (1986)		Carbondale[2] (1987)	
	-C	+C	-C	+C
	--% lodged plants--		--rating score--	
0-N	3	1	1.0	1.0
90 (Fall)	41	1	1.6	1.1
90 + N-Serve (Fall)	32	9	1.7	1.0
90 (25-65-0)	6	1	1.2	1.0
90 (65 NS-0-25)	23	1	1.2	1.1
90 (25-40-25)	28	1	1.3	1.1
135 (Fall)	81	7	2.9	1.3
135 + N-Serve (Fall)	72	12	3.2	1.5
135 (45-90-0)	63	3	2.6	1.1
135 (110 NS-0-25)	55	9	2.4	1.6
135 (45-65-25)	68	5	2.0	1.1

[1]Data are a composite of 2 varieties and represents proportion of plants leaning in excess of 45 degrees.

[2]Data are from Caldwell variety only.
Rating: 1 = Almost all plants erect
2 = All plants leaning slightly or a few plants down
3 = All plants leaning moderately (45°), or 25 to 50 percent of plants down

Table 6. Effect of level of N fertilization and timing on wheat yields averaged over 2 varieties and Cerone treatments at Belleville and Carbondale, IL 1986-1988.

N Fertilizer Timing (F-ES-LS)	1986[1]				1987				1988			
	B'ville		C'dale		B'ville		C'dale		B'ville		C'dale	
	Med	High	Med	High	Med	High	Med	High	Med	High	Med	High
	--Bu/A--											
0-N	(27)		(27)		(64)		(49)		(48)		(61)	
X-0-0	60	72	50	56	83	83	59	53	69	82	86	93
X(NS)-0-0	64	73	47	56	85	84	59	54	74	80	85	92
X-X-0	68	80	50	55	83	83	56	54	72	80	89	94
X(NS)-0-X	64	75	52	60	86	88	57	58	71	81	81	91
X-X-X	68	79	55	60	86	86	57	58	71	80	84	91
LSD .05	3.9		3.0		3.2		4.0		3.4		3.0	

[1]"Med" (Medium) = 90 lbs N ac^{-1} as urea.

"High" = 135 lbs N ac^{-1} as urea.

PROCEEDINGS OF THE EIGHTEENTH

NORTH CENTRAL EXTENSION - INDUSTRY SOIL FERTILITY WORKSHOP

9-10, November 1988, Holiday Inn St. Louis Airport North

Bridgeton, Missouri

Volume 4

Program Chairman:

K. A. Kelling

Department of Soil Science
University of Wisconsin-Madison

CREDITS

The professionalism shown by Ms. Barbara Brown in typing portions of this document and in helping organize its preparation is acknowledged and appreciated.

Department of Soil Science
University of Wisconsin-Madison

and

Potash and Phosphate Institute
2805 Claflin Road
Suite 200
Manhattan, Kansas