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TITLE: The effects of potassium chloride to counteract the negative effects of urea side-banded on plant establishment using different placement configurations and soil types. (Prepared by Guy Lafond)

EXECUTIVE SUMMARY:

The use of urea fertilizer as a nitrogen source has increased dramatically during the last 20 years and its higher toxicity relative to ammonium nitrate requires careful management. The objective of this study was to determine if adding potassium chloride (0, 15 and 30 kg-K_2O/ha) to a urea band (0, 60 and 120 kg-N/ha) placed either in a 1"x1.5" (side and below) or 1"x3 (side and below) could potentially reduce the toxic effects of urea with an increase in plant populations. Research has shown that adding potassium chloride can reduce NH_3, NO_2 and the pH as a result of the delay in urea hydrolysis. This concept was tested in flax and spring wheat on a clay loam and a sandy loam soil.

Flax: Increasing the rate of nitrogen reduced plant populations. When the separation was varied, an interaction was observed such that the wider separation caused the reduction in plant numbers to be substantially lower as nitrogen rate was increased. In the absence of nitrogen, the narrower separation resulted in higher plant numbers probably as a result of less soil disturbance. Adding K to the urea band did not cause a further reduction in plant numbers due to the lack of a N*KCl interaction. There was a significant placement*KCl interaction for both soil types for plant numbers. Another year of data is required to ensure these interactions are agronomically important. There was a significant nitrogen*potassium interaction for grain yield. The presence of K resulted in maximizing grain yield at a lower rate of nitrogen.

Wheat: The wider separation resulted in slightly lower plant numbers due to more soil disturbance. However the yield was greater with the wider separation. This was observed on both soil types. Potassium caused a slight reduction in plant numbers on the sandy loam but not the clay loam soil. No effect of potassium chloride on yield was observed. There was a significant placement*KCl interaction for plant numbers. At the narrow separation, plant numbers increased with the addition of potassium chloride while at the wider separation, there was no difference. This is evidence that potassium chloride can alleviate the effects of urea in reducing plant numbers.

Overall, the study did not show any main effects due to potassium chloride except on plant numbers for spring wheat on the sandy loam site. A number of interactions were observed. For flax there was a nitrogen*KCl interaction for grain yield on the sandy loam site and a placement*KCl interaction for plant numbers for flax on both soil type. With spring wheat, only one interaction was observed. In this case it was the placement*KCl interaction for plant numbers on the clay loam soil. This supports the argument that potassium chloride can reduce the toxic effects of urea on plant numbers when placed together in a band.

LOCATION: Vale Farms Ltd (Conserva-Pak Seeding Systems)

COOPERATORS: Guy Lafond, Indian Head Research Farm
Jim Halford, Conserva-Pak Seeding Systems of Vale Farms Ltd
Judy McKell, Indian Head Agricultural Research Foundation

JUSTIFICATION: Work currently underway at Brandon, Morden, Indian Head, Melfort, Canora, Scott and Swift Current has clearly demonstrated the potential dangers of side-banding urea nitrogen at seeding time on plant establishment. Recent work in Eastern Canada has demonstrated the potential of using KCl with the urea fertilizer to counteract some of the negative effects of urea on plant densities and possibly other factors as well (ref. Agron J. 90:734-739).

OBJECTIVES: To examine closely the use of KCl as a way to counteract the negative effects of urea in a side-banded situation i.e, one-pass seeding and fertilizing system.

EXPERIMENTAL DESIGN: Factorial Randomized Split-Split Plot Design with four replicates (Total number of plots 288).

Factor 1 Urea fertilizer (Granular): 0, 60 and 120 kg-N / ha
Factor 2 Separation (horizontal x vertical): 1"x 1.5" , 1" x 3.0"
Factor 3 Crops: Flax and Spring Wheat
Factor 4 Soil Type: sandy loam and clay loam of an Oxbow Association
Factor 5 Potash 0, 15, and 30 kg/ha of K_2O (side-banded with urea)

Variables Measured:
-Plants per meter square (plants /m^2)
-Grain Yield (kg/ha)
-Grain Protein: Wheat only
-Soil Testing (texture, pH, conductivity, nutrients etc)

Agronomic Information: (See Table 1 for more information)

Table 1. Summary of Agronomic Information for 1999.

Variables	1999	
Seeding Date	May 28, 1999	
Harvest Date Wheat	October 6, 1999	
Harvest Date Flax	October 6, 1999	
Plant Counts (Spring)	June 18th, 1999	
Flax Variety	Norlin	
Wheat Variety	CDC Teal	
Seeding Rate (kg/ha) - Flax	63	
Seeding Rate (kg/ha) - Canola	134	
Soil Fertility - Flax	Sandy Loam	Clay Loam
Nitrogen (kg/ha) NO_3-N (0-24")	35	63
Phosphorus (kg/ha) PO_4-P (0-6")	66+	7
Potassium (kg/ha) K (0-6")	660+	540+
Sulfur (kg/ha) SO_4-S	45	56
Soil Fertility -Spring Wheat	Sandy Loam	Clay Loam
Nitrogen (kg/ha) N (0-24")	40	67
Phosphorus (kg/ha) P_2O_5 (0-6")	60	40
Potassium (kg/ha) K (0-6")	518+	600+
Sulfur (kg/ha) S (0-24")	48	57
Weed Control		
Fall Application (Product, Rate)	none	none
Pre-Seeding (Product,, Rate)	Round-up (880 g ai/ha)	
In-Crop (Product, Rate)	Wheat - Buctril-M @ 1.0 li /ha Flax - Poast @ 0.34 li/ac and Flax Max @ 0.6 li/ac	
Seeder Model and Row Spacing	Conserva-Pak 12"	

11 lbs Cl in top 24"

23 Cl in top 24"

RESULTS:

Table 2. Analysis of variance for each variable, crop and soil type.

Source	df	Sandy Loam			Clay Loam		
		Plants/ m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)	Plants/ m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)
Flax							
Nitrogen (N)	2	0.07	***	***	ns	-	-
Error (a)	9	-	-	-	-	-	-
K	2	ns	ns	ns	ns	-	-
N*K	4	ns	'*'	'*'	ns	-	-
Error (b)	18	-	-	-	-	-	-
Placement (P)	1	ns	ns	ns	ns	-	-
N*P	2	***	ns	ns	**	-	-
K*P	2	'*'	ns	ns	'*'	-	-
N*K*P	4	ns	ns	ns	ns	-	-
	cv	14.6	10.3	10.3	13.3	-	-
Spring Wheat							
Nitrogen (N)	2	ns	***	***	0.07	***	***
Error (a)	9	-	-	-	-	-	-
K	2	'*'	ns	ns	ns	0.09	0.09
N*K	4	ns	ns	ns	ns	ns	ns
Error (b)	18	-	-	-	-	-	-
Placement (P)	1	***	***	***	***	***	***
N*P	2	'*'	***	***	ns	ns	ns
K*P	2	ns	ns	ns	0.06	ns	ns

N*K*P	4	ns	ns	ns	ns	ns	ns
	cv	11.6	3.3	3.3	10.5	3.0	3.0

Table 3. Summary of results for all main effects in the study for flax at Vale Farms in 1999.

Variable		Sandy Loam			Clay Loam		
		Plants /m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)	Plants/ m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)
Nitrogen (N-kg/ha)	0	380a	502b	8.0b	390	-	-
	60	323ab	1646a	26.3a	365	-	-
	120	301b	1607a	25.7a	348	-	-
	s.e.	22	159	2.5	19	-	-
	LSD(05)	70	508	8.1	ns	-	-
Potassium (K_2O -kg/ha)	0	341	1210	19	362	-	-
	15	337	1269	20	364	-	-
	30	326	1277	20	378	-	-
	s.e.	12	35	0.6	8.9	-	-
	LSD(05)	ns	ns	ns	ns	-	-
Placement	1" x 1.5"	342	1275	20	373	-	-
	1" x 3.0"	328	1230	20	362	-	-
	s.e.	8.0	21	0.3	8.2	-	-
	LSD(05)	ns	ns	ns	ns	-	-

Table 4. Summary of results for the nitrogen by placement and potassium by placement interaction observed for plant numbers on both soil types in flax in 1999 and for the nitrogen by potassium interaction observed for grain yield on the sandy loam soil.

Variable		Sandy Loam			Clay Loam		
		1" x 1.5"	1" x 3.0"	Mean	1" x 1.5"	1" x 3.0"	Mean
Plants/m^2							
Nitrogen (N-kg/ha)	**0**	424	336	380	402	377	390
	60	312	335	323	387	342	365
	120	289	311	301	328	366	348
	Mean	342	328		373	362	
Plants/m^2							
Potassium (K_2O -kg/ha)	**0**	331	350	341	387	336	362
	15	363	311	337	360	368	364
	30	331	321	326	371	383	378
	Mean	342	328		373	383	

Grain Yield (kg/ha)					
		K_2O -kg/ha			Mean
		0	15	30	
Nitrogen (N-kg/ha)	**0**	554	451	503	**502**
	60	24 1479	26 1764	1695	**1646**
	120	1598	1591	1633	**1607**
	Mean	**1210**	**1269**	**1227**	

Table 5. Summary of results for all main effects in the study for spring wheat at Vale Farms in 1999.

Variable		Sandy Loam			Clay Loam		
		Plants /m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)	Plants/ m^2	Grain Yield (kg/ha)	Grain Yield (bus/acre)
Nitrogen (N-kg/ha)	**0**	297	1595a	24a	247b	3021b	45b
	60	291	332b	50b	270a	4082a	61a
	120	268	3673b	55b	262ab	4118a	62a
	s.e.	10	210	18	6	66	1
	LSD(05)	ns	896	13	20	211	3
Potassium (K_2O -kg/ha)	**0**	287ab	2796	42	253	3806	57
	15	294a	2929	44	266	3750	56
	30	274b	2854	43	259	3666	55
	s.e.	6	60	1.0	6	43	1
	LSD(05)	17	ns	ns	ns	ns	ns
Placement	**1" x 1.5"**	297a	2729a	41a	290a	3651a	55a
	1" x 3.0"	273b	2991b	45b	229b	3830b	57b
	s.e.	6	16	0.2	5	19	0.3
	LSD(05)	16	46	0.7	13	54	1.0

Table 6. Summary of results for the nitrogen by placement and potassium by placement interaction observed for plant numbers and grain yield on both soil types in whflax in 1999.

Variable		Sandy Loam			Clay Loam		
		1" x 1.5"	1" x 3.0"	Mean	1" x 1.5"	1" x 3.0"	Mean
		Plants/m^2			Plants/m^2		
Nitrogen (N-kg/ha)	**0**	314	279	**297**	275	234	**244**
	60	313	270	**291**	306	225	**266**
	120	264	272	**268**	289	230	**259**
	Mean	**297**	**273**		**290**	**229**	
					Plants/m^2		
Potassium (K_2O -kg/ha)	**0**				275	232	253
	15				306	224	266
	30				288	230	259
	Mean				290	229	