1. Field Fertility Experiments Under Irrigated Conditions, 1991

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(Project funded by the Saskatchewan Water Corporation)

OBJECTIVES

The objectives of these field experiments were:

(1) to re-evaluate response to phosphorus under irrigation,

(2) to evaluate the revised nitrogen soil test benchmarks,

(3) to evaluate split applications of nitrogen, and

(4) to attain plot yields exceeding 100 bu/acre for CPS wheats.

EXPERIMENTAL METHODS

Phosphorus Experiments

The treatment schedule for the phosphorus experiment is outlined in Table 1.1. The experiment was conducted at two locations. The first location, described as Hauberg, was on NW24-27-7-W3 on an Elstow loam soil. The second experiment was at the

Table 1.1 Treatment schedule for phosphorus experiments.

Treatment No.	P_2O_5 (lb/acre)	Cultivar
1	0	Katepwa
2	10	
3	20	
4	30	
5	40	
6	60	
7	80	
8	0	Biggar
9	10	
10	20	
11	30	
12	40	
13	60	
14	80	

Source: Monoammonium phosphate 12-51-0

Saskatchewan Irrigation Development Centre (SIDC) main farm on SW15-29-8-W3 on a Bradwell very fine sandy loam soil. The Hauberg site was a dryland summerfallow field that had been farmed in a wheat-fallow rotation for the past many years. The SIDC site has been in irrigated agriculture since 1949. More details on the soils and soil analysis are provided further in the report.

The Hauberg site was planted with a Rogers drill equipped with the Conserva Pak seed and fertilizer furrow opener system. It was an 11-row drill with 8-inch spacing. One hundred pounds N/acre was applied as a deep band as ammonium nitrate (34-0-0) at a depth of 5-6 inches deep just prior to seeding. Seeding was completed on May 11 and Katepwa wheat was planted at 1.3 bu/acre and Biggar wheat at 2 bu/acre. The phosphorus application was as monoammonium phosphate (12-51-0) applied with the seed.

An additional 100 lbs N/acre was applied as broadcast ammonium nitrate at growth stage Zadoks 23 on June 13, 1991. Irrigation application was by a solid set sprinkler system with water drawn from the M1 canal. No irrigation was required in May or June and only moderate irrigation in July and August. The details of rainfall and irrigation applications are provided in Table 1.2 for all experiments.

The plot design was a split plot with phosphorus rate as the main plot and cultivar as the subplot; the plot size was 8 feet by 20 feet and the experiment was replicated eight times.

Plant samples were removed for analysis on June 10 (Zadoks 23 to 24) and on July 4 (Zadoks 47-59 for Katepwa and Zadoks 39-45 for Biggar). Three rows over a length of 0.845 m were sampled.

Final harvest was completed on August 20 and 21 by removing a 2-m length of seven rows by hand at the soil surface. The total weight was taken after drying, and then the sample was threshed and grain weight taken.

Table 1.2 Rainfall and irrigation data for field experiments (all data in mm). (Net soil water use estimated by hand probing)

S.I.D.C. site: seeded May 25, 1991; harvested August 27-28, 1991

Month	Rain		Irrigation	
May	3		0	
June	176		0	
July	55		30	
August	5		45	
Total	239	+	75	= 314
Estimated net soil water used				= 65
TOTAL WATER USE				379

Riley site: seeded May 11, 1991; harvested August 22, 1991

Month	Rain		Irrigation	
May	68		0	
June	101		6	
July	90		57	
August	1		65	
Total	260	+	128	= 398
Estimated net soil water used				= 30
TOTAL WATER USE				428

Hauberg site: seeded May 11, 1991; harvested August 20-21, 1991

Month	Rain		Irrigation	
May	(50)		0	
June	67		38	
July	100		181	
August	8		0	
Total	250	+	219	= 419
Estimated net soil water used				= 60
TOTAL WATER USE				479

All plant samples taken during the growing season and the final grain and straw samples were analyzed for all major and micronutrients by the Saskatchewan Soil Testing Laboratory.

At the SIDC site all procedures were the same as for the Hauberg site except that Katepwa wheat was seeded at 2 bu/acre and Biggar wheat at 3 bu/acre. Seeding was completed on May 25 and harvest on August 27 and 28. Plant samples were taken during the growing season on June 20 and July 8.

Nitrogen Experiments

The treatment schedule for the nitrogen experiments is provided in Table 1.3. The general field methods, seeding equipment and other operations were the same for the nitrogen experiments as the phosphorus experiments. The nitrogen experiments were conducted at two locations; SIDC main farm on SW15-29-8-W3 on a Bradwell very fine sandy loam soil and on the Riley Substation of SIDC at NW26-29-8-W3 on an Asquith fine sandy loam. The actual seeding operation for the nitrogen experiments was by cross-seeding at right angles. The drill was set to deliver 1.5 bu/acre of Biggar wheat or 1 bu/acre of Katepwa wheat and the plot was cross-seeded giving a total seeding rate of 3 bu/acre of Biggar and 2 bu/acre of Katepwa. An 8-34-20 fertilizer was applied with the seed with the drill set to deliver 100 lbs product/acre and thus with the cross seeding a total of 200 lbs product/acre was applied. Thus, the total side banded application at seeding was 16 lbs N/acre, 68 lbs P_2O_5/acre and 40 lbs K_2O/acre.

Table 1.3 Treatment schedule for nitrogen experiments.

Treatment No.	N rate** lbs/acre	lbs N/acre Placement and Timing PB*	BAS*	B*
1	0	0	0	0
2	0	0	0	0
3	25	25	0	0
4	25	0	25	0
5	50	50	0	0
6	50	25	25	0
7	75	75	0	0
8	75	50	25	0
9	100	100	0	0
10	100	75	25	0
11	150	150	0	0
12	150	75	25	50 Zadoks 13
13	200	200	0	0
14	200	75	25	50 Zadoks 13 + 50 Zadoks 23

*PB = Preplant Band; BAS = Band at Seeding; B = Broadcast

**N rate in addition to the 16 lbs N/acre applied as a sideband application at seeding (see text)

Seeding at the Riley site was on May 11 and at the SIDC site was on May 25. The long separation between seeding dates was because of frequent rains.

At the Riley site plant sampling was on June 11 and July 3, and the final harvest was on August 22. At the SIDC site plant sampling was on June 20 and July 9, and the final harvest was on August 27 and 28.

RESULTS AND DISCUSSION

Soil Analyses

Analyses of soil samples taken before and at seeding time for all experiments and for samples taken in mid-season (nitrogen experiments only) are presented in Table 1.4.

It should be noted that in the site selection process, detailed sampling was conducted and screening results were utilized in selecting an appropriate site. For example, for the phosphorus experiments eight individual replicates were laid out in the field and composite samples involving at least 10 cores were obtained for each of the eight replicates. For the phosphorus experiments the Hauberg site had only 5 ppm available phosphorus in the 0-6 inch depth. On the SIDC site the phosphorus test was slightly higher.

For the nitrogen experiments, the residual nitrogen at the time of seeding was equivalent to 128 lbs/acre two foot range for the SIDC site and 60 lbs/acre two foot range at the Riley site.

As part of the site selection and screening process, samples were taken on adjacent quarter sections of the SIDC farm just south of Outlook. The SW15 has been in irrigated agriculture since 1949. The irrigated agriculture involved continuous cropping with fertilizer rates several times that of comparable dryland agriculture and considerable use of forage crops in the rotation. On SE15, prior to 1987, the land was not irrigated.

Table 1.5 shows the comparison of the soil analysis of these two sites. The organic matter content on SW15 was about 50% higher than on SE15. The phosphorus contents

Table 1.4 Soil analyses for phosphorus and nitrogen experiments.

PHOSPHORUS EXPERIMENTS								
Site	**Depth (in.)**	**O.M. (%)**	**pH**	**EC (mS/cm)**	**N (ppm)**	**P (ppm)**	**K (ppm)**	**SO4-S (ppm)**
Hauberg	0-6	1.5	7.5	0.3	4	5	206	7
Sampled 7/5/91	6--12	1.0	7.8	0.4	13	3	75	6
	12--24		8.4	0.5	11	3	70	9
SIDC	0--6	2.3	8.1	0.6	17	7	101	18
Sampled10/4/91	6--12	2.1	8.2	0.4	12	5	63	19
SIDC	0-12		8.1	0.5	14	4	80	6
Sampled 20/5/91	12--24		8.1	0.6	11	4	75	14
NITROGEN EXPERIMENTS								
SIDC	0-12	2.2	8.1	0.4	14	6	75	14
Sampled10/4/91								
SIDC	0-12		7.9	0.6	17	5	94	11
Sampled 20/5/91	12--24		8.2	0.6	15	2	91	12
	24--36		8.5	0.7	10	3	131	23
SIDC	0--12				8	8	60	12
Sampled 18/7/91								
Riley	0-12	1.9	7.9	0.4	11	9	124	10
Sampled 10/4/91								
Riley	0-12		8.0	0.5	9	8	115	8
Sampled 6/5/91	12--24		8.3	0.5	6	4	61	19
	24--36		8.7	0.5	4	4	76	24
Riley	0--12				4	11	112	7
Sampled18/7/91								

Site	Legal location	Soil
Hauberg	NW24-27-7-W3	Elstow: loam
S.I.D.C.	SW15-29-8-W3	Bradwell: very fine sandy loam
Riley	NW26-29-8-W3	Asquith: fine sandy loam

Table 1.5 Comparison of soil analyses on SW15-29-8-W3 (SIDC Farm irrigated since 1949) and SE15-29-8-W3 (SIDC Farm irrigated since 1987).

Location	Depth (in.)	O.M.	pH	Cond. (mS/cm)	N	P	K	S
					ppm			
SW15	0-6	2.3	8.1	0.6	17	7	101	18
	6-12	2.1	8.2	0.4	12	5	63	19
SE15	0-6	1.6	7.9	0.4	13	7	218	12
	6-12	1.4	8.1	0.4	9	5	120	12

Samples taken April 10, 1991

were identical but the available potassium content of the land that had been irrigated for more than 40 years was only half of the potassium content of the land that had just recently been converted to irrigated agriculture. The much greater removal of potassium associated with the higher yields involved and with the more frequent use of forage crops in rotation is likely the explanation for the large difference in potassium for the two fields.

For the phosphorus experiments a special soil sampling program was conducted just after harvest. The samples were taken with a one-inch soil probe to a depth of 0-6 inches directly in the row and halfway between the rows. A composite of ten such cores was taken from both the row and interrow for each of two replicates of the experiment. Thus, the numbers presented in Table 1.5 represent the mean of two replicates and each replicate sample was a composite of ten soil cores.

The results (Table 1.6) show clearly the residual effect of the spring applied fertilizer phosphorus and the difference between the two soils. The residual available phosphorus on the sandier Bradwell soil was about double the values for the medium textured Elstow soil.

Table 1.6 Effect of sampling position on phosphorus soil tests (fall sampling 1991; Hauberg sampled Aug. 29 and S.I.D.C. sampled Sept. 3, 1991).

Seed placed P_2O_5 applied lbs/acre	Soil test P (ppm, 0-6")			
	Elstow: SiL (Hauberg farm)		Bradwell: vL (S.I.D.C. main farm)	
	Row	Inter row	Row	Inter row
0	4	4	7	5
40	7	5	13	6
80	14	6	30	8

Each sample is the mean of two replicates and each replicate sample was a composite of ten soil cores - 0-6" depth.

Yield Data

Phosphorus experiments: The total dry matter, grain yield and straw yield for the phosphorus experiments is presented in Table 1.7.

At the Hauberg site the yield increase of Katepwa wheat to phosphorus fertilizer was about 30% for both straw and grain. For Biggar wheat a yield increase of about 20% was noted in total dry matter, but almost all of this increase was in straw with no significant increase in grain yield. The Hauberg site has historically been farmed in a wheat-fallow dryland rotation with relatively small phosphorus fertilizer inputs and the soil is an Elstow silt loam.

At the SIDC site there was no significant yield increase to phosphorus for total dry matter, straw or grain yield. However, there was a trend suggesting a yield increase due to phosphorus fertilization in straw yield, but a decrease in grain yield due to phosphorus fertilization.

Table 1.7 Yield data for phosphorus experiments.

P_2O_5 (lb/acre)	Total DM kg/ha	Straw kg/ha	Grain yield kg/ha	Grain bu/acre	HI*
		Hauberg Site			
HY368 - Biggar					
0	10051	6091	3960	59	0.39
10	10716	6610	4106	62	0.38
20	11300	7049	4251	64	0.38
30	11383	7218	4166	62	0.37
40	11596	7274	4322	65	0.37
60	11963	7715	4247	64	0.36
80	11986	7865	4121	62	0.34
HRS - Katepwa					
0	9205	5809	3395	51	0.37
10	9677	6060	3616	54	0.37
20	10249	6490	3759	56	0.37
30	10733	6997	3736	56	0.35
40	10911	6979	3932	59	0.36
60	11666	7513	4153	62	0.36
80	11879	7588	4290	64	0.36
LSD(0.10) varieties	152	119	117		
P rate	308	228	133		
C.V.	8%	9%	7%		
		S.I.D.C. Site			
HY368 - Biggar					
0	11000	7234	3766	56	0.34
10	10827	7438	3389	51	0.31
20	10728	7332	3395	51	0.32
30	11521	7914	3607	54	0.31
40	10701	7487	3213	48	0.30
60	11220	8018	3202	48	0.29
80	11421	8153	3268	49	0.29
HRS - Katepwa					
0	11730	7743	3986	60	0.34
10	11403	7607	3796	57	0.33
20	11304	7558	3746	56	0.33
30	11676	7847	3829	57	0.33
40	11929	8010	3919	59	0.33
60	11547	7900	3647	55	0.32
80	11665	8008	3656	55	0.31
LSD(0.10) varieties	330	NS	225		
P rate	NS	NS	NS		
C.V.	3%	4%	7%		

* HI = Harvest Index

Nitrogen experiments: The yield data for total dry matter, straw yield and grain yield for the nitrogen experiments is presented in Table 1.8.

At the SIDC site there was no significant response to nitrogen in terms of total dry matter or grain yield The Biggar wheat suffered a severe disease problem in the form of root rot which manifested itself in a visible portion of premature "white heads".

At the Riley site there was significant response to nitrogen fertilizer in terms of total dry matter, straw yield and grain yield. The nitrogen response curve exhibited an unexplained dip at the 75 lbs N/acre rate. The peak of the yield curve is about 50 lbs N/acre. There were no significant differences between the treatment in which all nitrogen was applied as a preplant band and those with split applications.

Nutrient Uptake Data - Mid Season

Phosphorus experiments: The major and micronutrient values for plant samples taken at two stages in the growing season are provided in Tables 1.9 through 1.12.

At the first plant sampling at the early to mid tillering stage, the nitrogen content was about 5%, the phosphorus content about 0.4% and the potassium content about 4%. Phosphorus fertilization had no effect on the level of any of the nutrients in the plant except phosphorus. Phosphorus fertilization at the highest rate almost doubled the phosphorus concentration of the plant at the Hauberg site and increased it by about 50% at the SIDC site.

For the micronutrients, with the possible exception of boron, the nutrients were present at levels that would be considered sufficient by current guidelines.

By the time of the second sampling on July 4 and July 8, the nutrient concentrations had not markedly changed but the accumulation of dry matter was much greater.

Nitrogen experiments: Plant analysis for samples taken at two times through the growing season for the SIDC and Riley site, nitrogen experiments are presented in Tables 1.13 through 1.16. The concentrations of nutrients in the plant for the nitrogen experiments were approximately the same as for the phosphorus experiments and with the

Table 1.8 Yield data for nitrogen experiments.

Treatment	N rate lbs/acre	Place and timing PB	BAS	B	Total DM kg/ha	Straw kg/ha	Grain kg/ha	Grain bu/acre	HI
		--- lbs N/acre ---							
				Biggar Wheat - S.I.D.C.					
1	0	0	0	0	11386	6816	4570	69	0.40
2	0	0	0	0	10652	6418	4234	64	0.40
3	25	25	0	0	10730	6729	4001	60	0.37
4	25	0	25	0	10956	7050	3906	59	0.36
5	50	50	0	0	10704	6771	3933	59	0.37
6	50	25	25	0	11124	7180	3944	59	0.35
7	75	75	0	0	11843	7725	4118	62	0.35
8	75	50	25	0	11555	7456	4098	61	0.35
9	100	100	0	0	11980	7775	4205	63	0.35
10	100	75	25	0	11315	7599	3715	56	0.33
11	150	150	0	0	12371	8069	4302	65	0.35
12	150	75	25	50 Zakoks 13	12287	8214	4073	61	0.33
13	200	200	0	0	12028	7928	4100	62	0.34
14	200	75	25	50 Zadoks 13 + 50 Zadoks 23	11614	7859	3756	56	0.32
LSD(0.10)					NS	383	-		
C.V.					5%	8%	6%		
				Biggar Wheat - Riley					
1	0	0	0	0	8759	4724	4035	61	0.46
2	0	0	0	0	8920	4915	4005	60	0.45
3	25	25	0	0	10958	6290	4668	70	0.43
4	25	0	25	0	11229	6284	4945	74	0.44
5	50	50	0	0	11173	6358	4815	72	0.43
6	50	25	25	0	11110	6298	4811	72	0.43
7	75	75	0	0	10747	6745	4002	60	0.37
8	75	50	25	0	10402	6307	4095	61	0.39
9	100	100	0	0	12603	7145	5458	82	0.43
10	100	75	25	0	12501	7118	5383	81	0.43
11	150	150	0	0	12567	7512	5055	76	0.40
12	150	75	25	50 Zadoks 13	12574	7415	5159	77	0.41
13	200	200	0	0	12852	7430	5422	81	0.42
14	200	75	25	50 Zadoks 13 + 50 Zadoks 23	12863	7538	5325	80	0.41
LSD(0.10)					672	412	413		
C.V.					12%	14%	12%		

PB = Preplant Band; BAS = Band at Seeding; B = Broadcast; HI = Harvest Index

Table 1.9 Plant analysis and nutrient uptake for samples taken June 20 (Zadoks 13-22) at the SIDC site P experiment.

P2O5(lb/acre)												
Plant Analysis		**N**	**P**	**K**	**S**	**Ca**	**Mg**	**C u**	**Fe**	**Mn**	**Zn**	**B**
Katepwa		%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
0		5.1	0.32	4.1	0.40	0.73	0.33	9.2	433	79	37	17
10		5.3	0.34	4.3	0.40	0.69	0.34	9.4	278	80	50	12
20		5.5	0.36	4.7	0.43	0.71	0.34	9.4	225	82	36	18
30		5.4	0.40	4.1	0.43	0.73	0.33	9.3	313	89	45	23
40		5.3	0.38	4.3	0.41	0.68	0.37	9.0	251	86	41	12
60		5.4	0.39	4.2	0.42	0.68	0.33	9.5	269	84	40	21
80		5.6	0.44	4.2	0.41	0.66	0.32	9.0	240	83	31	10
Biggar												
0		5.6	0.30	4.0	0.43	0.78	0.34	9.1	269	79	36	34
10		5.6	0.32	4.2	0.44	0.75	0.36	10.6	255	76	36	19
20		5.7	0.35	4.1	0.45	0.79	0.36	9.4	313	86	37	12
30		5.7	0.36	3.7	0.44	0.77	0.35	8.7	211	81	40	15
40		5.6	0.35	3.9	0.45	0.72	0.38	9.5	372	81	41	10
60		5.7	0.39	3.9	0.43	0.74	0.37	9.1	258	82	33	15
80		5.7	0.42	4.0	0.45	0.76	0.35	9.2	215	82	44	16
	DM kg/ha		**UPTAKE**		**kg/ha**					**gm/ha**		
Katepwa												
0	209	11	1	9	1	2	1	2	90	16	8	4
10	246	13	1	11	1	2	1	2	68	20	12	3
20	279	15	1	13	1	2	1	3	63	23	10	5
30	297	16	1	12	1	2	1	3	93	26	13	7
40	284	15	1	12	1	2	1	3	71	24	12	3
60	269	15	1	11	1	2	1	3	72	23	11	6
80	304	17	1	13	1	2	1	3	73	25	9	3
Biggar												
0	311	17	1	13	1	2	1	3	84	25	11	11
10	290	16	1	12	1	2	1	3	74	22	10	6
20	309	18	1	13	1	2	1	3	97	27	11	4
30	391	22	1	14	2	3	1	3	82	32	16	6
40	382	21	1	15	2	3	1	4	142	31	16	4
60	336	19	1	13	1	2	1	3	87	28	11	5
80	389	22	2	15	2	3	1	4	84	32	17	6

Table 1.10 Plant analysis and nutrient uptake for samples taken June 10 (Zadoks 23-24) at the Hauberg site P experiment.

P2O5 (lb/acre)		N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn
Plant Analysis		%	%	%	%	%	%	ppm	ppm	ppm	ppm
Katepwa											
0		5.2	0.32	4.3	0.38	0.69	0.34	8.8	468	94	36
10		5.5	0.41	4.2	0.40	0.58	0.29	7.4	422	88	27
20		5.7	0.45	4.5	0.40	0.61	0.30	6.8	432	93	27
30		5.8	0.50	4.2	0.40	0.58	0.28	6.7	367	91	27
40		5.7	0.52	4.4	0.39	0.58	0.29	6.9	470	100	26
60		5.7	0.60	4.4	0.39	0.59	0.29	6.0	347	96	25
80		6.2	0.62	4.6	0.40	0.55	0.28	6.1	323	97	28
Biggar											
0		5.6	0.31	4.1	0.42	0.62	0.29	8.8	397	88	33
10		5.6	0.36	4.1	0.42	0.60	0.29	7.7	406	83	29
20		5.9	0.43	4.3	0.43	0.63	0.29	7.5	416	89	57
30		6.0	0.46	4.4	0.42	0.62	0.29	7.5	360	96	25
40		6.0	0.48	4.2	0.41	0.61	0.31	6.9	372	93	31
60		6.0	0.53	3.9	0.43	0.65	0.30	6.7	367	102	24
80		5.9	0.57	4.3	0.43	0.65	0.30	7.0	397	100	24
Uptake	**DM kg/ha**	**Uptake kg/ha**						**gm/ha**			
Katepwa											
0	766	12	1	10	1	2	1	2	106	21	8
10	637	12	1	9	1	1	1	2	93	19	6
20	966	18	1	14	1	2	1	2	139	30	9
30	614	13	1	9	1	1	1	1	81	20	6
40	658	13	1	10	1	1	1	2	107	23	6
60	810	16	2	12	1	2	1	2	97	27	7
80	712	16	2	12	1	1	1	2	82	25	7
Biggar											
0	701	14	1	10	1	1	1	2	96	21	8
10	915	18	1	13	1	2	1	2	128	27	9
20	994	20	1	15	1	2	1	3	143	31	20
30	1171	24	2	18	2	3	1	3	145	39	10
40	1178	23	2	16	2	2	1	3	141	35	12
60	1053	21	2	14	2	2	1	2	129	36	8
80	1166	23	2	17	2	3	1	3	154	39	9

Table 1.11 Plant analysis and nutrient uptake for samples taken July 8 (Katepwa - Zadoks 39-41, Biggar - Zadoks 37-39) at the SIDC site P experiment.

P2O5(lb/acre)												
Plant Analysis		**N**	**P**	**K**	**S**	**Ca**	**Mg**	**C u**	**Fe**	**Mn**	**Zn**	**B**
Katepwa		%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
0		4.1	0.32	3.2	0.32	0.52	0.27	8.4	155	49	34	10
20		3.5	0.30	3.4	0.29	0.49	0.25	7.3	156	53	29	10
40		4.1	0.35	3.7	0.31	0.54	0.30	8.0	189	54	84	9
80		3.9	0.35	3.5	0.30	0.56	0.28	6.9	182	56	32	12
Biggar												
0		4.8	0.31	3.6	0.36	0.73	0.29	8.4	143	54	32	11
20		4.7	0.32	3.4	0.37	0.74	0.30	8.9	159	57	35	11
40		4.8	0.37	3.7	0.37	0.76	0.34	9.2	146	58	32	13
80		5.2	0.38	3.7	0.38	0.85	0.34	8.2	194	64	29	10
	DM kg/ha	**UPTAKE**			**kg/ha**					**gm/ha**		
Katepwa												
0	2164	89	7	69	7	11	6	18	336	107	74	21
20	2543	89	8	85	7	13	6	19	397	136	74	24
40	2488	101	9	93	8	13	7	20	470	134	208	23
80	2691	106	9	94	8	15	8	19	489	152	87	32
Biggar												
0	2427	117	7	87	9	18	7	20	346	131	76	27
20	2351	111	8	80	9	17	7	21	373	135	81	26
40	2390	116	9	88	9	18	8	22	349	139	76	32
80	2657	137	10	97	10	23	9	22	514	169	78	26

Table 1.12 Plant analysis and nutrient uptake for samples taken July 4 (Zadoks: Katepwa 47-59, Biggar 39-45) P experiment at the Hauberg site.

P2O5(lb/acre)												
Plant Analysis		**N**	**P**	**K**	**S**	**Ca**	**Mg**	**Cu**	**Fe**	**Mn**	**Zn**	**B**
Katepwa		%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
0		3.4	0.27	2.6	0.27	0.33	0.19	8.2	129	62	38	12
20		3.7	0.33	2.6	0.30	0.36	0.23	7.7	125	60	34	11
40		3.2	0.29	2.9	0.27	0.38	0.23	6.9	133	70	33	9
80		3.4	0.40	2.9	0.29	0.39	0.23	6.2	106	66	22	11
Biggar												
0		3.9	0.30	2.6	0.36	0.51	0.27	9.0	139	65	38	11
20		4.0	0.31	2.9	0.40	0.59	0.31	8.0	173	71	34	10
40		4.1	0.30	2.3	0.36	0.60	0.33	7.7	160	77	24	12
80		3.8	0.41	2.8	0.39	0.63	0.33	7.7	129	76	27	12
	DM kg/ha	**UPTAKE**		**kg/ha**						**gm/ha**		
Katepwa												
0	2537	86	7	67	7	8	5	21	328	157	97	29
20	3063	112	10	79	9	11	7	23	383	183	104	33
40	3539	112	10	102	10	14	8	24	471	247	116	32
80	3742	126	15	109	11	15	9	23	397	249	82	41
Biggar												
0	2213	86	7	57	8	11	6	20	307	143	85	25
20	2949	119	9	87	12	17	9	24	510	209	99	31
40	2987	123	9	68	11	18	10	23	479	230	73	36
80	3021	114	12	84	12	19	10	23	390	229	81	35

Table 1.13 Plant analysis and nutrient uptake for samples taken June 20 (Zadoks 13-22) N experiment at the SIDC site.

Trt. No.	N rate	PB*	lbs N/acre Placement and Timing BAS	B		N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
Plant Analysis						%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
1	0	0	0	0		5.5	0.39	3.5	0.41	0.68	0.34	8.2	353	75	32	9
2	0	0	0	0		5.3	0.39	3.6	0.41	0.71	0.34	8.8	484	77	32	11
3	25	25	0	0		5.5	0.40	3.7	0.42	0.71	0.32	8.4	341	74	33	10
4	25	0	25	0		5.8	0.40	3.5	0.42	0.71	0.33	8.2	345	76	36	9
5	50	50	0	0		5.5	0.39	3.7	0.42	0.65	0.39	8.9	350	76	30	10
6	50	25	25	0		5.4	0.39	3.8	0.42	0.63	0.35	8.2	296	70	31	10
7	75	75	0	0		5.8	0.41	3.9	0.44	0.73	0.35	8.7	358	80	41	10
8	75	50	25	0		5.7	0.42	3.9	0.44	0.68	0.33	8.5	895	74	35	8
9	100	100	0	0		5.8	0.46	4.1	0.43	0.72	0.31	8.8	331	72	39	9
10	100	75	25	0		5.8	0.44	3.8	0.43	0.72	0.32	8.4	274	76	40	11
11	150	150	0	0		6.0	0.43	4.2	0.44	0.75	0.35	9.3	426	83	40	10
12	150	75	25	50 Z.13		5.9	0.45	4.3	0.43	0.74	0.31	9.2	375	79	61	10
13	200	200	0	0		6.0	0.44	4.2	0.44	0.76	0.33	9.3	375	77	43	10
14	200	75	25	50 Z.13 + 50 Z.23		5.9	0.43	3.9	0.43	0.72	0.34	8.8	473	81	36	11
					DM kg/ha	UPTAKE kg/ha						gm/ha				
1	0	0	0	0	314	17	1	11	1	2	1	3	111	24	10	3
2	0	0	0	0	301	16	1	11	1	2	1	3	145	23	10	3
3	25	25	0	0	329	18	1	12	1	2	1	3	112	24	11	3
4	25	0	25	0	364	21	1	13	2	3	1	3	126	28	13	3
5	50	50	0	0	366	20	1	13	2	2	1	3	128	28	11	4
6	50	25	25	0	337	18	1	13	1	2	1	3	100	24	10	3
7	75	75	0	0	396	23	2	15	2	3	1	3	142	32	16	4
8	75	50	25	0	371	21	2	14	2	3	1	3	332	27	13	3
9	100	100	0	0	362	21	2	15	2	3	1	3	120	26	14	3
10	100	75	25	0	398	23	2	15	2	3	1	3	109	30	16	4
11	150	150	0	0	358	21	2	15	2	3	1	3	153	30	14	4
12	150	75	25	50 Z.13	348	21	2	15	1	3	1	3	131	28	21	3
13	200	200	0	0	349	21	2	15	2	3	1	3	131	27	15	3
14	200	75	25	50 Z.13 + 50 Z.23	394	23	2	15	2	3	1	3	186	32	14	4

PB = Preplant Ban; BAS = Band at Seeding; B = Broadcast; HI = Harvest Index

Table 1.14 Plant analysis and nutrient uptake for samples taken July 9 (Zadoks 23-24) N experiment at the SIDC site.

Trt. No.	N rate	PB	lbs N/acre Placement and Timing BAS	B		N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
Plant Analysis						%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
1	0	0	0	0		3.9	0.33	2.9	0.29	0.58	0.30	6.5	71	42	23	10
2	0	0	0	0		3.6	0.31	2.4	0.25	0.53	0.26	6.0	82	38	21	10
3	25	25	0	0		3.5	0.34	3.2	0.29	0.61	0.29	6.0	113	45	22	10
4	25	0	25	0		3.7	0.34	3.2	0.29	0.60	0.29	6.2	97	41	23	12
5	50	50	0	0		3.6	0.31	2.9	0.28	0.57	0.28	6.7	141	41	24	11
6	50	25	25	0		3.9	0.33	3.0	0.30	0.61	0.33	7.3	114	42	24	11
7	75	75	0	0		3.8	0.33	3.0	0.30	0.64	0.32	6.3	81	41	23	14
8	75	50	25	0		3.9	0.35	3.0	0.31	0.64	0.32	6.7	139	45	24	13
9	100	100	0	0		3.9	0.35	3.0	0.33	0.76	0.31	7.3		57	28	13
10	100	75	25	0		4.1	0.35	3.0	0.33	0.72	0.32	7.1	123	48	27	12
11	150	150	0	0		4.4	0.35	3.0	0.33	0.69	0.33	7.1	128	46	26	10
12	150	75	25	50 Z.13		4.3	0.35	2.7	0.33	0.76	0.30	7.3	112	50	27	12
13	200	200	0	0		4.2	0.35	2.9	0.33	0.73	0.31	7.2	222	50	27	12
14	200	75	25	50 Z.13 + 50 Z.23		4.4	0.38	3.6	0.35	0.82	0.34	7.7	109	54	30	11
					DM kg/ha	UPTAKE kg/ha						gm/ha				
1	0	0	0	0	2767	108	9	80	8	16	8	18	197	116	64	27
2	0	0	0	0	2826	102	9	69	7	15	7	17	231	106	60	29
3	25	25	0	0	2809	99	9	88	8	17	8	17	316	126	62	27
4	25	0	25	0	2387	89	8	77	7	14	7	15	231	97	54	29
5	50	50	0	0	2495	91	8	72	7	14	7	17	352	103	59	28
6	50	25	25	0	2870	110	9	85	9	17	9	21	327	120	70	32
7	75	75	0	0	2898	111	10	87	9	18	9	18	235	119	66	39
8	75	50	25	0	2675	104	9	80	8	17	9	18	371	119	65	36
9	100	100	0	0	2555	99	9	77	8	19	8	19		146	72	32
10	100	75	25	0	2939	120	10	89	10	21	9	21	361	141	78	36
11	150	150	0	0	3085	137	11	93	10	21	10	22	394	143	82	31
12	150	75	25	50 Z.13	3229	140	11	88	10	24	10	24	360	162	89	39
13	200	200	0	0	3067	128	11	90	10	22	10	22	682	155	83	36
14	200	75	25	50 Z.13 + 50 Z.23	3125	138	12	112	11	26	10	24	340	169	94	34

Table 1.15 Plant analysis and nutrient uptake for samples taken June 11 (Zadoks 23-24) N experiment at the Riley site.

Treatment No.	lbs N/acre N rate	PB	Placement and Timing BAS	B		N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn
Plant Analysis						%	%	%	%	%	%	ppm	ppm	ppm	ppm
1	0	0	0	0		5.1	0.49	3.9	0.38	0.57	0.29	6.1	273	73	29
2	0	0	0	0		5.0	0.49	3.6	0.37	0.56	0.29	5.8	363	74	29
3	25	25	0	0		5.4	0.49	3.8	0.38	0.54	0.28	5.6	348	71	26
4	25	0	25	0		5.3	0.49	3.9	0.38	0.54	0.28	5.5	303	69	32
5	50	50	0	0		5.3	0.49	3.5	0.38	0.55	0.29	5.9	314	73	32
6	50	25	25	0		5.4	0.49	3.8	0.38	0.56	0.27	6.0	258	72	30
7	75	75	0	0		5.4	0.50	3.8	0.37	0.57	0.27	6.3	336	73	31
8	75	50	25	0		5.6	0.49	3.8	0.38	0.55	0.27	6.2	337	73	27
9	100	100	0	0		5.6	0.50	3.7	0.39	0.56	0.29	6.8	345	78	35
10	100	75	25	0		5.6	0.50	3.4	0.39	0.56	0.29	6.9	234	76	32
11	150	150	0	0		5.8	0.51	3.6	0.39	0.57	0.26	6.2	266	84	31
12	150	75	25	50 Z.13		5.9	0.51	3.8	0.40	0.55	0.26	6.3	287	79	29
13	200	200	0	0		6.1	0.53	3.6	0.40	0.62	0.29	6.8	303	85	32
14	200	75	25	50 Z.13 + 50 Z.23		5.9	0.52	3.9	0.40	0.58	0.28	6.4	246	77	33
UPTAKE					DM kg/ha	UPTAKE kg/ha						gm/ha			
1	0	0	0	0	326	17	2	13	1	2	1	2	89	24	9
2	0	0	0	0	437	22	2	16	2	2	1	3	159	32	13
3	25	25	0	0	388	21	2	15	1	2	1	2	135	28	10
4	25	0	25	0	390	21	2	15	1	2	1	2	119	27	12
5	50	50	0	0	442	24	2	15	2	2	1	3	139	32	14
6	50	25	25	0	400	22	2	15	2	2	1	2	103	29	12
7	75	75	0	0	420	23	2	16	2	2	1	3	141	31	13
8	75	50	25	0	430	24	2	16	2	2	1	3	145	31	12
9	100	100	0	0	490	27	2	18	2	3	1	3	169	38	17
10	100	75	25	0	341	19	2	12	1	2	1	2	80	26	11
11	150	150	0	0	452	26	2	16	2	3	1	3	120	38	14
12	150	75	25	50 Z.13	407	24	2	16	2	2	1	3	117	32	12
13	200	200	0	0	427	26	2	15	2	3	1	3	129	36	14
14	200	75	25	50 Z.13 + 50 Z.23	375	22	2	15	2	2	1	2	92	29	12

Table 1.16 Plant analysis and nutrient uptake for samples taken July 9 (Zadoks 37-39) N experiment at the Riley site.

Treatment No.	N rate	lbs N/acre PB	Placement and Timing BAS	B		N	P	K	S	Ca	Mg	Cu	Fe	Mn	Zn	B
Plant Analysis						%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm
1	0	0	0	0		3.2	0.44	4.0	0.27	0.44	0.29	5.8	110	55	24	5
2	0	0	0	0		3.0	0.44	3.9	0.27	0.46	0.31	5.8	126	57	21	6
3	25	25	0	0		3.4	0.44	3.8	0.31	0.53	0.32	6.0	96	56	32	5
4	25	0	25	0		3.2	0.44	3.9	0.29	0.50	0.30	5.6	84	55	24	6
5	50	50	0	0		3.3	0.44	3.9	0.32	0.59	0.33	6.1	119	56	25	6
6	50	25	25	0		3.2	0.44	3.9	0.29	0.52	0.31	5.9	106	56	25	6
7	75	75	0	0		3.7	0.43	3.9	0.32	0.70	0.32	5.8	95	59	23	6
8	75	50	25	0		3.7	0.45	3.8	0.33	0.63	0.30	6.3	113	55	27	8
9	100	100	0	0		3.8	0.42	3.7	0.33	0.66	0.35	6.4	118	59	30	7
10	100	75	25	0		4.0	0.46	3.9	0.36	0.73	0.38	6.5	124	62	30	7
11	150	150	0	0		4.2	0.46	3.8	0.37	0.82	0.35	6.1	131	69	33	5
12	150	75	25	50 Z.13		4.3	0.46	3.9	0.37	0.74	0.31	5.9	126	58	31	6
13	200	200	0	0		4.5	0.48	3.9	0.39	0.78	0.36	7.1	147	62	39	8
14	200	75	25	50 Z. 13 + 50 Z.23		4.3	0.46	4.3	0.35	0.78	0.31	6.3	125	61	38	7
UPTAKE					DM kg/ha	UPTAKE kg/ha						gm/ha				
1	0	0	0	0	2817	91	12	114	8	12	8	16	309	154	68	15
2	0	0	0	0	2862	87	13	111	8	13	9	16	361	164	59	18
3	25	25	0	0	3123	105	14	119	10	16	10	19	299	175	101	17
4	25	0	25	0	3138	99	14	122	9	16	9	17	263	174	75	19
5	50	50	0	0	3716	121	16	147	12	22	12	23	443	208	91	24
6	50	25	25	0	3579	115	16	139	11	19	11	21	380	201	91	21
7	75	75	0	0	4097	151	18	160	13	29	13	24	389	243	96	24
8	75	50	25	0	3458	127	15	130	11	22	10	22	390	189	94	26
9	100	100	0	0	3541	134	15	130	12	23	12	22	419	209	107	23
10	100	75	25	0	3717	149	17	143	13	27	14	24	462	231	110	26
11	150	150	0	0	4137	173	19	157	15	34	14	25	542	286	137	22
12	150	75	25	50 Z.13	3433	146	16	134	13	25	11	20	434	200	105	21
13	200	200	0	0	3827	171	18	148	15	30	14	27	563	236	149	29
14	200	75	25	50 Z. 13 + 50 Z.23	3936	171	18	169	14	31	12	25	493	238	149	29

possible exception of boron none of them were at a level that would suggest a critical level in terms of plant nutrition. At the Riley site the nitrogen concentration in the plant was increased by nitrogen fertilization and there was a trend towards increased nitrogen level at the SIDC site. The most significant observation from Tables 1.14 through 1.16 is the very large increase in uptake over a three week period from mid June to early July.

Nutrient Uptake Data - Final Harvest

Phosphorus experiments: The plant analysis and total uptake data for the phosphorus experiments are provided in Tables 1.17 and 1.18. At the SIDC site (Table 1.17) phosphorus fertilization had no effect on the uptake of any of the nutrients in the grain, but did result in an increase in phosphorus concentration and hence uptake in the straw. At the Hauberg site (Table 1.18) phosphorus fertilization had little effect on the nutrient concentration in the grain but uptake of nitrogen and phosphorus was increased by phosphorus fertilization because of the yield increase, particularly for Katepwa wheat.

The nitrogen concentration in the straw was increased by phosphorus fertilization at both sites and for both Katepwa and Biggar wheat.

Nitrogen experiments: The plant analysis for grain and straw for the nitrogen experiments are provided in Tables 1.19 and 1.20.

At the SIDC site nitrogen fertilization slightly increased the nitrogen content of the grain and of the straw. The straw nitrogen content was consistently higher for the split nitrogen treatments than for the treatment in which all of the nitrogen had been preplant banded at the SIDC site. This effect was not noted at the Riley site.

CONCLUSIONS

On a medium textured soil with a very low phosphorus test and with low previous phosphorus fertilizer additions, the response of Katepwa wheat was consistent with current predictions based on current soil test guidelines. This was particularly true for Katepwa

Table 1.17 Plant analysis of grain and straw for P experiment at SIDC site.

(a) Macronutrients

VARIETY		GRAIN							STRAW					
		N	P	K	S	Ca	Mg		N	P	K	S	Ca	Mg
P2O5 lb/ac	Protein	PLANT ANALYSIS							PLANT ANALYSIS					
Katepwa	%	%	%	%	%	%	%		%	%	%	%	%	%
0	16.9	2.96	0.33	0.36	0.18	0.04	0.13		0.48	0.02	2.03	0.11	0.22	0.10
20	16.9	2.96	0.37	0.39	0.18	0.04	0.15		0.50	0.03	2.66	0.13	0.23	0.08
40	17.0	2.99	0.35	0.35	0.19	0.04	0.14		0.52	0.04	2.49	0.14	0.29	0.11
80	17.0	2.98	0.35	0.35	0.17	0.03	0.13		0.83	0.04	2.49	0.14	0.29	0.10
Biggar														
0	15.3	2.69	0.30	0.53	0.17	0.06	0.14		0.71	0.04	2.38	0.19	0.40	0.14
20	18.1	3.17	0.31	0.55	0.17	0.06	0.15		1.25	0.05	2.37	0.18	0.38	0.15
40	16.0	2.80	0.31	0.53	0.17	0.07	0.15		1.24	0.05	2.48	0.19	0.40	0.16
80	15.7	2.76	0.32	0.53	0.18	0.06	0.15		1.19	0.06	2.36	0.20	0.42	0.16
Katepwa	YIELD KG/HA	UPTAKE KG/HA						YIELD KG/HA	UPTAKE KG/HA					
0	3986	118	13	14	7	2	5	7743	37	2	157	9	17	5
20	3746	111	14	15	7	1	6	7558	38	2	201	10	17	6
40	3919	117	14	14	7	2	5	8010	42	3	199	11	23	9
80	3656	109	13	13	6	1	5	8008	66	3	199	11	23	8
Biggar														
0	3766	101	11	20	6	2	5	7234	51	3	172	14	29	10
20	3395	108	11	19	6	2	5	7332	92	4	174	13	28	11
40	3213	90	10	17	5	2	5	7487	93	4	186	14	30	12
80	3268	90	10	17	6	2	5	8153	97	5	192	16	34	13
		TOTAL DM												
Katepwa		UPTAKE KG/HA												
0	11730	155	15	172	16	19	11							
20	11304	149	16	216	17	19	12							
40	11929	159	17	213	19	25	14							
80	11665	175	16	212	17	24	13							
Biggar														
0	11000	153	14	192	20	31	15							
20	10728	199	14	192	19	30	16							
40	10701	183	14	203	20	32	17							
80	11421	187	15	210	22	36	18							

Table 1.17 Continued

(b) Micronutrients

		GRAIN						STRAW				
P205(lb/ac)		Cu	Fe	Mn	Zn	B		Cu	Fe	Mn	Zn	B
		PLANT ANALYSIS						PLANT ANALYSIS				
Katepwa		ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm	ppm	ppm
0		5.2	50	38	37	0.7		2.0	21	13	4	<.1
20		4.4	43	42	33	0.7		2.0	22	14	4	<.1
40		3.7	59	37	36	<0.1		2.0	29	18	5	<.1
80		3.7	66	36	27	1.5		2.0	27	18	4	1
Biggar												
0		5.1	71	33	29	0.7		3.0	48	24	7	2
20		4.4	58	35	26	0.7		3.0	42	23	5	2
40		3.7	67	32	32	1.5		3.0	49	25	7	1
80		3.7	48	31	24	1.5		3.0	42	24	9	1
	YIELD						YIELD					
Katepwa	KG/HA	UPTAKE GM/HA					KG/HA	UPTAKE GM/HA				
0	3986	21	200	152	149	3	7743	15	162	100	31	—
20	3746	16	161	156	123	3	7558	15	165	105	30	—
40	3919	15	230	146	140	—	8010	16	229	143	39	—
80	3656	14	242	131	98	5	8008	16	216	144	32	8
Biggar												
0	3766	19	269	124	110	3	7234	22	347	174	51	14
20	3395	15	198	117	88	2	7332	22	306	167	37	15
40	3213	12	214	103	103	5	7487	22	365	186	52	7
80	3268	12	156	100	78	5	8153	24	342	195	73	8
		TOTAL DM										
Katepwa		UPTAKE GM/HA										
0	11730	36	362	252	180	—						
20	11304	32	326	261	153	—						
40	11929	31	460	288	179	—						
80	11665	30	458	275	130	13						
Biggar												
0	11000	41	616	297	160	17						
20	10728	37	503	285	124	17						
40	10701	34	579	290	156	12						
80	11421	37	497	295	151	13						

Table 1.18 Plant analysis of grain and straw for P experiment at the Hauberg site.

a) Macronutrients

		GRAIN							STRAW					
VARIETY		N	P	K	S	Ca	Mg		N	P	K	S	Ca	Mg
P2O5 lb/ac	Protein	PLANT ANALYSIS							PLANT ANALYSIS					
Katepwa	%	%	%	%	%	%	%		%	%	%	%	%	%
0	16.7	2.93	0.34	0.38	0.19	0.04	0.14		0.37	0.02	2.31	0.16	0.17	0.06
20	17.3	3.03	0.36	0.36	0.19	0.03	0.15		0.51	0.03	2.56	0.17	0.18	0.06
40	16.6	2.92	0.38	0.37	0.19	0.03	0.15		0.62	0.03	2.57	0.16	0.19	0.06
80	16.3	2.86	0.4	0.37	0.18	0.03	0.15		0.48	0.04	2.36	0.15	0.19	0.07
Biggar														
0	14.0	2.45	0.26	0.45	0.17	0.05	0.13		0.73	0.03	2.63	0.27	0.22	0.08
20	14.4	2.52	0.28	0.47	0.18	0.05	0.13		0.77	0.03	3.19	0.28	0.26	0.1
40	14.4	2.52	0.32	0.53	0.18	0.06	0.15		1.15	0.04	3.03	0.27	0.25	0.1
80	14.9	2.62	0.36	0.56	0.18	0.06	0.15		1.13	0.06	3.05	0.27	0.28	0.11
	YIELD							YIELD						
Katepwa	KG/HA	UPTAKE KG/HA						KG/HA	UPTAKE KG/HA					
0	3395	99	12	13	6	1	5	5809	21	1	134	9	10	3
20	3759	114	14	14	7	1	6	6490	33	2	166	11	12	4
40	3932	115	15	15	7	1	6	6979	43	2	179	11	13	4
80	4291	123	17	16	8	1	6	7588	36	3	179	11	14	5
Biggar														
0	3960	97	10	18	7	2	5	6091	44	2	160	16	13	5
20	4251	107	12	20	8	2	6	7049	54	2	225	20	18	7
40	4322	109	14	23	8	3	6	7274	84	3	220	20	18	7
80	4121	108	15	23	7	2	6	7865	89	5	240	21	22	9
		TOTAL DM												
Katepwa		UPTAKE KG/HA												
0	9205	121	13	147	16	11	8							
20	10249	147	15	180	18	13	10							
40	10911	158	17	194	19	14	10							
80	11879	159	20	195	19	16	12							
Biggar														
0	10051	141	12	178	23	15	10							
20	11300	161	14	245	27	20	13							
40	11596	193	17	243	27	21	14							
80	11986	197	20	263	29	24	15							

Table 1.18 Continued.

(b) Micronutrients

		GRAIN						STRAW				
P205(lb/ac)		Cu	Fe	Mn	Zn	B		Cu	Fe	Mn	Zn	B
		PLANT ANALYSIS						PLANT ANALYSIS				
Katepwa		ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm	ppm	ppm
0		4.5	39	44	36	0.7		2	56	22	8	1
20		3.7	35	47	37	0.7		2	58	23	6	1
40		3	34	47	30	0.7		2	59	24	5	<.1
80		2.9	43	19	26	1.5		2	34	24	5	<.1
Biggar												
0		3.6	38	30	28	1.5		2	12	19	6	1
20		3	44	32	25	1.5		2.9	23	21	6	1
40		3	45	35	24	0.8		2	35	22	4	3
80		3	38	36	19	<0.1		2.9	90	32	5	2
	YIELD						YIELD					
Katepwa	KG/HA	UPTAKE GM/HA					KG/HA	UPTAKE GM/HA				
0	3395	15	132	150	122	2	5809	12	327	126	46	6
20	3759	14	132	176	137	3	6490	13	375	146	38	6
40	3932	12	134	184	120	3	6979	14	412	167	35	—
80	4291	12	185	81	113	6	7588	15	257	181	38	—
Biggar												
0	3960	14	150	118	110	6	6091	12	72	115	37	6
20	4251	13	186	136	107	6	7049	20	159	145	42	7
40	4322	13	192	153	104	3	7274	15	255	160	29	22
80	4121	12	157	148	80	—	7865	23	709	255	39	16
		TOTAL DM										
Katepwa		UPTAKE GM/HA										
0	9205	27	459	276	167	8						
20	10249	27	507	322	176	9						
40	10911	26	546	351	154	—						
80	11879	28	442	262	151	—						
Biggar												
0	10051	26	222	233	146	12						
20	11300	33	344	280	149	13						
40	11596	28	447	313	133	25						
80	11986	35	866	402	118	—						

Table 1.19 Plant analysis of grain and straw for the N experiment at the SIDC site.

(a) Macronutrients

						GRAIN							STRAW					
	lbs N/acre					N	P	K	S	Ca	Mg		N	P	K	S	Ca	Mg
TRT		Placement			Protein													
No.	N rate	PB	BAS	B	%	%	%	%	%	%	%		%	%	%	%	%	%
1	0	0	0	0	12.5	2.19	0.30	0.45	0.15	0.04	0.13		0.5	0.04	2.1	0.13	0.27	0.14
2	0	0	0	0	12.5	2.19	0.31	0.47	0.15	0.05	0.14		0.63	0.04	2.21	0.14	0.32	0.14
3	25	25	0	0	12.4	2.35	0.29	0.47	0.16	0.05	0.13		0.41	0.04	2.16	0.15	0.33	0.14
4	25	0	25	0	13.1	2.30	0.30	0.50	0.15	0.05	0.14		0.41	0.04	2.18	0.14	0.31	0.14
5	50	50	0	0	13.8	2.42	0.29	0.49	0.15	0.05	0.14		0.59	0.04	2.23	0.14	0.28	0.15
6	50	25	25	0	13.2	2.32	0.30	0.50	0.15	0.05	0.14		0.8	0.05	2.10	0.14	0.35	0.17
7	75	75	0	0	14.0	2.45	0.30	0.50	0.16	0.05	0.14		0.98	0.07	2.25	0.16	0.38	0.18
8	75	50	25	0	13.3	2.33	0.30	0.50	0.16	0.05	0.14		1.15	0.07	2.10	0.17	0.44	0.21
9	100	100	0	0	13.9	2.44	0.31	0.49	0.16	0.06	0.15		0.54	0.06	2.25	0.16	0.41	0.17
10	100	75	25	0	13.3	2.33	0.30	0.51	0.16	0.06	0.14		1.04	0.05	2.29	0.16	0.38	0.17
11	150	150	0	0	14.1	2.47	0.30	0.51	0.16	0.06	0.15		0.88	0.05	2.26	0.17	0.45	0.17
12	150	75	25	50 Z13	14.1	2.47	0.30	0.49	0.16	0.06	0.14		1.04	0.06	2.51	0.16	0.37	0.15
13	200	200	0	0	13.9	2.43	0.30	0.50	0.16	0.06	0.14		0.62	0.05	2.22	0.17	0.42	0.17
14	200	75	25	50 Z13+ 50 Z23	14.4	2.54	0.29	0.49	0.16	0.06	0.14		1.27	0.06	2.20	0.17	0.43	0.17
					YIELD kg/ha	UPTAKE kg/ha						YIELD kg/ha	UPTAKE kg/ha					
1	0	0	0	0	4570	100	14	21	7	2	6	6816	34	3	143	9	18	10
2	0	0	0	0	4234	93	13	20	6	2	6	6418	40	3	142	9	21	9
3	25	25	0	0	4001	94	12	19	6	2	5	6729	28	3	145	10	22	9
4	25	0	25	0	3906	90	12	20	6	2	5	7050	29	3	154	10	22	10
5	50	50	0	0	3933	95	11	19	6	2	6	6771	40	3	151	9	19	10
6	50	25	25	0	3944	91	12	20	6	2	6	7180	57	4	151	10	25	12
7	75	75	0	0	4118	101	12	21	7	2	6	7725	76	5	174	12	29	14
8	75	50	25	0	4098	95	12	20	7	2	6	7456	86	5	157	13	33	16
9	100	100	0	0	4205	103	13	21	7	3	6	7775	42	5	175	12	32	13
10	100	75	25	0	3715	87	11	19	6	2	5	7599	79	4	174	12	29	13
11	150	150	0	0	4302	106	13	22	7	3	6	8069	71	4	182	14	36	14
12	150	75	25	50 Z13	4073	101	12	20	7	2	6	8214	85	5	206	13	30	12
13	200	200	0	0	4100	100	12	21	7	2	6	7928	49	4	176	13	33	13
14	200	75	25	50 Z13 + 50 Z23	3756	95	11	18	6	2	5	7859	100	5	173	13	34	13

						TOTAL DRY MATTER					
TRT					YIELD	UPTAKE KG/HA					
No.	N rate	PB	BAS	B	kg/ha	N	P	K	S	Ca	Mg
1	0	0	0	0	11386	134	16	164	16	20	15
2	0	0	0	0	10652	133	16	162	15	23	15
3	25	25	0	0	10730	122	14	164	16	24	15
4	25	0	25	0	10956	119	15	173	16	24	15
5	50	50	0	0	10704	135	14	170	15	21	16
6	50	25	25	0	11124	149	15	171	16	27	18
7	75	75	0	0	11843	177	18	194	19	31	20
8	75	50	25	0	11555	181	18	177	19	35	21
9	100	100	0	0	11980	145	18	196	19	34	20
10	100	75	25	0	11315	166	15	193	18	31	18
11	150	150	0	0	12371	177	17	204	21	39	20
12	150	75	25	50 Z13	12287	186	17	226	20	33	18
13	200	200	0	0	12028	149	16	197	20	36	19
14	200	75	25	50 Z13+ 50 Z23	11614	195	16	191	19	36	19

Table 1.19 Continued.

(b) Micronutrients

						GRAIN						STRAW				
	lbs N/acre					Cu	Fe	Mn	Zn	B		Cu	Fe	Mn	Zn	B
TRT		Placement				PLANT ANALYSIS						PLANT ANALYSIS				
No.	N rate	PB	BAS	B		ppm	ppm	ppm	ppm	ppm		ppm	ppm	ppm	ppm	ppm
1	0	0	0	0		3.7	30	29	20	0.7		1.5	78	16	3	3
2	0	0	0	0		3.7	37	31	22	<.1		1.5	86	18	6	2.9
3	25	25	0	0		3.0	29	28	19	<.1		1.5	47	16	4	4.4
4	25	0	25	0		5.2	30	31	20	0.7		1.5	41	16	3	1.5
5	50	50	0	0		3.8	44	30	21	1.5		1.5	94	16	7	2.9
6	50	25	25	0		3.7	101	33	22	0.7		2.9	125	19	4	2.9
7	75	75	0	0		3.0	65	30	19	0.7		2.6	61	50	36	2.6
8	75	50	25	0		3.0	78	31	21	0.7		3	88	24	6	3
9	100	100	0	0		2.9	53	32	21	0.7		1.5	65	22	7	2.9
10	100	75	25	0		3.7	120	31	23	0.7		1.5	59	19	10	1.5
11	150	150	0	0		3.7	87	32	21	0.7		2	44	21	6	3
12	150	75	25	50 Z13		2.9	42	30	21	0.7		2.9	92	21	42	1
13	200	200	0	0		3.7	104	32	22	1.5		2	54	20	8	2
14	200	75	25	50 Z13+ 50 Z23	YIELD	3.0	56	30	22	0.7	YIELD	3	45	21	18	2
					kg/ha	gm/ha					kg/ha	gm/ha				
1	0	0	0	0	4570	17	135	132	91	3	6816	10	528	112	20	20
2	0	0	0	0	4234	16	155	133	91	—	6418	10	551	112	37	19
3	25	25	0	0	4001	12	116	114	78	—	6729	10	316	108	30	30
4	25	0	25	0	3906	20	119	121	78	3	7050	11	289	114	20	11
5	50	50	0	0	3933	15	172	118	83	6	6771	10	637	110	49	20
6	50	25	25	0	3944	15	399	130	86	3	7180	21	900	136	32	21
7	75	75	0	0	4118	12	268	123	80	3	7725	20	467	386	274	20
8	75	50	25	0	4098	12	318	125	86	3	7456	22	654	177	44	22
9	100	100	0	0	4205	12	223	136	90	3	7775	12	504	172	58	23
10	100	75	25	0	3715	14	445	116	86	3	7599	11	445	144	78	11
11	150	150	0	0	4302	16	374	139	92	3	8069	16	353	169	48	24
12	150	75	25	50 Z13	4073	12	172	121	86	3	8214	24	756	169	346	8
13	200	200	0	0	4100	15	428	130	88	6	7928	16	431	157	63	16
14	200	75	25	50 Z13+ 50 Z23	3756	11	209	114	81	3	7859	24	354	165	141	16

						TOTAL DRY MATTER				
Trt.					YIELD	UPTAKE gm/ha				
No.	N rate	PB	BAS	B	kg/ha	Cu	Fe	Mn	Zn	B
1	0	0	0	0	11386	27	663	243	111	24
2	0	0	0	0	10652	25	706	245	129	—
3	25	25	0	0	10730	22	432	222	107	—
4	25	0	25	0	10956	31	408	235	99	13
5	50	50	0	0	10704	25	809	228	132	26
6	50	25	25	0	11124	35	1298	266	117	24
7	75	75	0	0	11843	32	735	509	354	23
8	75	50	25	0	11555	35	972	303	130	25
9	100	100	0	0	11980	24	727	308	148	25
10	100	75	25	0	11315	25	890	261	163	14
11	150	150	0	0	12371	32	728	308	140	27
12	150	75	25	50 Z13	12287	36	928	291	432	11
13	200	200	0	0	12028	31	859	287	151	22
14	200	75	25	50 Z13+ 50 Z23	11614	35	562	279	222	18

Table 1.20 Plant analysis of grain and straw for the N experiment at the Riley site.

(a) Macronutrients

						GRAIN							STRAW					
	lbs N/acre					N	P	K	S	Ca	Mg		N	P	K	S	Ca	Mg
TRT		Placement			Protein	PLANT ANALYSIS							PLANT ANALYSIS					
No.	N rate	PB	BAS	B	%	%	%	%	%	%	%		%	%	%	%	%	%
1	0	0	0	0	9.7	1.7	0.35	0.5	0.11	0.04	0.12		0.42	0.06	1.72	0.10	.23	0.08
2	0	0	0	0	8.6	1.5	0.34	0.5	0.11	0.04	0.12		0.41	0.05	1.76	0.10	.21	0.08
3	25	25	0	0	10.3	1.8	0.35	0.5	0.12	0.04	0.12		0.40	0.05	1.94	0.10	.26	0.08
4	25	0	25	0	10.3	1.8	0.33	0.5	0.12	0.04	0.12			0.05	1.93	0.10	.25	0.08
5	50	50	0	0	10.8	1.9	0.34	0.5	0.11	0.04	0.12		0.48	0.05	2.00	0.13	.27	0.09
6	50	25	25	0	10.3	1.8	0.34	0.5	0.12	0.05	0.11		0.33	0.05	2.05	0.12	.28	0.09
7	75	75	0	0	12.5	2.2	0.34	0.5	0.14	0.06	0.13		0.71	0.05	2.05	0.15	.36	0.10
8	75	50	25	0	10.8	1.9	0.33	0.5	0.13	0.05	0.12		0.22	0.06	2.20	0.15	.34	0.09
9	100	100	0	0	11.4	2.0	0.34	0.5	0.14	0.05	0.14		0.61	0.05	2.15	0.18	.34	0.12
10	100	75	25	0	12.0	2.1	0.34	0.5	0.14	0.05	0.14		0.61	0.04	2.19	0.17	.31	0.11
11	150	150	0	0	12.5	2.2	0.32	0.5	0.15	0.06	0.14		0.87	0.05	2.45	0.19	.37	0.12
12	150	75	25	50 Z13	12.5	2.2	0.32	0.5	0.15	0.06	0.14		0.78	0.06	2.48	0.20	.43	0.13
13	200	200	0	0	12.5	2.2	0.31	0.5	0.15	0.06	0.14		1.09	0.06	2.47	0.22	.47	0.15
14	200	75	25	50 Z13+ 50 Z23	13.1	2.3	0.32	0.5	0.15	0.06	0.14		1.16	0.07	2.55	0.22	.51	0.13
					YIELD kg/ha	UPTAKE kg/ha						YIELD kg/ha	UPTAKE kg/ha					
1	0	0	0	0	4035	70	14	19	4	2	5	4724	20	3	81	5	11	4
2	0	0	0	0	4005	62	14	19	4	2	5	4915	20	2	87	5	10	4
3	25	25	0	0	4668	86	16	23	6	2	6	6290	25	3	122	6	16	5
4	25	0	25	0	4945	88	16	23	6	2	6	6284		3	121	6	16	5
5	50	50	0	0	4815	89	16	23	5	2	6	6358	31	3	128	8	17	6
6	50	25	25	0	4811	87	16	23	6	2	5	6298	21	3	129	8	18	6
7	75	75	0	0	4002	88	14	20	6	2	5	6745	48	3	138	10	24	7
8	75	50	25	0	4095	78	14	20	5	2	5	6307	14	4	139	9	21	6
9	100	100	0	0	5458	110	19	27	8	3	8	7145	44	4	154	13	24	9
10	100	75	25	0	5383	113	18	27	8	3	8	7118	43	3	156	12	22	8
11	150	150	0	0	5055	111	16	25	8	3	7	7512	65	4	184	14	28	9
12	150	75	25	50 Z13	5159	111	17	25	8	3	7	7415	58	4	184	15	32	10
13	200	200	0	0	5422	120	17	26	8	3	8	7430	81	4	184	16	35	11
14	200	75	25	50 Z13 + 50 Z23	5325	121	17	27	8	3	7	7538	87	5	192	17	38	10

					TOTAL DRY MATTER					
TRT					YIELD	UPTAKE KG/HA					
No.	N rate	PB	BAS	B	kg/ha	N	P	K	S	Ca	Mg
1	0	0	0	0	8759	90	17	101	9	12	9
2	0	0	0	0	8920	82	16	106	9	12	9
3	25	25	0	0	10958	111	19	145	12	18	11
4	25	0	25	0		91	19	145	12	18	11
5	50	50	0	0	11173	120	20	152	14	19	11
6	50	25	25	0	11110	108	20	152	13	20	11
7	75	75	0	0	10747	136	17	159	16	27	12
8	75	50	25	0	10402	92	17	159	15	23	11
9	100	100	0	0	12603	154	22	181	21	27	16
10	100	75	25	0	12501	156	21	183	20	25	15
11	150	150	0	0	12567	177	20	209	22	31	16
12	150	75	25	50 Z13	12574	169	21	209	23	35	17
13	200	200	0	0	12852	201	21	210	24	38	19
14	200	75	25	50 Z13+ 50 Z23	12863	209	22	219	25	42	17

Table 1.20 Continued.

(b) Micronutrients

TRT No.	lbs N/acre N rate	Placement PB	BAS	B		GRAIN Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm		STRAW Cu ppm	Fe ppm	Mn ppm	Zn ppm	B ppm
						PLANT ANALYSIS						PLANT ANALYSIS				
1	0	0	0	0		2.9	32	28	18	0.7		1.5	55	13	3	3
2	0	0	0	0		2.2	27	30	17	<.1		1.5	53	13	3	2.9
3	25	25	0	0		2.2	25	29	17	<.1		1.5	67	18	10	4.4
4	25	0	25	0		2.2	25	28	18	0.7		1.5	71	13	4	1.5
5	50	50	0	0		2.3	23	27	17	<.1		1.5	49	15	3	3
6	50	25	25	0		2.2	25	28	16	<.1		1.5	63	13	12	3
7	75	75	0	0		2.2	31	32	18	<.1		2.9	196	25	9	4.3
8	75	50	25	0		2.2	26	31	17	<.1		1.5	133	18	24	3
9	100	100	0	0		2.2	37	32	20	2.2		1.5	64	15	7	3
10	100	75	25	0		2.2	41	32	19	0.7		1.4	82	14	13	1.4
11	150	150	0	0		2.2	34	32	19	0.7		1.5	73	16	5	3
12	150	75	25	50 Z13		2.2	37	31	18	0.7		1.5	52	16	25	1.5
13	200	200	0	0		2.3	54	29	19	<.1		1.5	59	18	25	1.5
14	200	75	25	50 Z13+ 50 Z23	YIELD kg/ha	2.2	44	30	18	0.7	YIELD kg/ha	2.9	126	23	10	2.9
						gm/ha						gm/ha				
1	0	0	0	0	4035	12	131	113	74	3	4724	7	260	63	14	14
2	0	0	0	0	4005	9	107	122	68	—	4915	7	259	65	14	14
3	25	25	0	0	4668	10	118	135	80	—	6290	9	424	111	65	28
4	25	0	25	0	4945	11	122	140	89	3	6284	9	445	84	28	9
5	50	50	0	0	4815	11	113	131	80	—	6358	10	313	95	19	19
6	50	25	25	0	4811	11	118	136	79	—	6298	9	394	84	75	19
7	75	75	0	0	4002	9	124	126	70	—	6745	20	1319	166	59	29
8	75	50	25	0	4095	9	106	127	70	—	6307	9	839	112	149	19
9	100	100	0	0	5458	12	200	176	110	12	7145	11	458	106	53	21
10	100	75	25	0	5383	12	218	174	103	4	7118	10	583	99	89	10
11	150	150	0	0	5055	11	172	161	94	4	7512	11	547	122	34	23
12	150	75	25	50 Z13	5159	11	191	160	92	4	7415	11	384	121	187	11
13	200	200	0	0	5422	12	294	159	102	—	7430	11	440	132	187	11
14	200	75	25	50 Z13+ 50 Z23	5325	12	232	159	96	4	7538	22	946	176	77	22

TRT No.	N rate	PB	BAS	B	YIELD kg/ha	TOTAL DRY MATTER UPTAKE gm/ha Cu	Fe	Mn	Zn	B
1	0	0	0	0	8759	19	391	176	88	17
2	0	0	0	0	8920	16	366	187	83	—
3	25	25	0	0	10958	20	542	246	145	—
4	25	0	25	0	11229	20	567	224	116	12.9
5	50	50	0	0	11173	21	426	226	99	—
6	50	25	25	0	11110	20	512	221	154	—
7	75	75	0	0	10747	28	1442	292	129	—
8	75	50	25	0	10402	18	945	239	218	—
9	100	100	0	0	12603	23	658	282	163	33.4
10	100	75	25	0	12501	22	801	273	192	13.7
11	150	150	0	0	12567	22	719	283	127	26.1
12	150	75	25	50 Z13	12574	22	575	281	279	14.7
13	200	200	0	0	12852	24	734	292	290	—
14	200	75	25	50 Z13+ 50 Z23	12863	34	1178	334	173	25.6

wheat. For the Biggar wheat the grown yield response was reduced because of root rot infestation and associated "white head" development. On a coarse textured soil with a medium phosphorus soil test level, and with a consistent and long time history of phosphorus fertilization, there was no effect of phosphorus fertilization on either Katepwa or Biggar wheat.

Split applications of nitrogen resulted in essentially the same results as applying all of the nitrogen as a preplant band. However, the two nitrogen experiments conducted were on soils with residual nitrogen levels in the 60-120 lbs/acre to two foot range and strong response to nitrogen would not be anticipated.

At the SIDC site with residual nitrogen levels at 128 lbs/acre to two feet, no response to nitrogen was obtained; but at the Riley site where the residual nitrogen was 60 lbs/acre to two feet, response to nitrogen was significant and within the range used in previous soil test benchmarks.

The nitrogen response data obtained in this year's investigation would fit the "average irrigation" guidelines now being utilized by the Saskatchewan Soil Testing Laboratory, which are similar to the guidelines used prior to 1991.

For CPS wheats a yield of 80 bu/acre was obtained and this is well below the 100 bu/acre target established. Failure to attain that yield goal was related mostly to disease infestation, particularly root rot infestation which resulted in unfilled "white heads".