DEVELOPMENT OF A RISK MANAGEMENT GUIDE FOR WHEAT PRODUCTION

3RD ANNUAL REPORT

APRIL 1, 1989 TO MARCH 31, 1991

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Maurice Kraut
Project Coordinator
Canada Grains Council
760-360 Main Street
Winnipeg, Man. R3C 3Z3
Phone: 1-204-942-2254
Fax: 1-204-943-8233

David Rourke
Project Leader
Ag-Quest, Inc.
Independent Agricultural Research Services
Box 144, Minto, Man. ROK 1MO
Phone: 1-204-776-2087
FAX: 1-204-776-2250

CONTENTS

A RISK MANAGEMENT GUIDE FOR CANADIAN WHEAT PRODUCERS

PROJECT OBJECTIVE

The objective of this project is to develop a risk management guide which will enable wheat producers in Canada to evaluate the risk and probability of success associated with the use of inputs or other management practices throughout the growing season. The purpose of the guide will be to assist farmers in evaluating the potential net return associated with major production management decisions. Specifically, the Applicant will:

1. Develop a set of risk management charts and associated documentation (hereafter referred to as "the guide") that can be used by wheat producers to evaluate the risk and probability of success associated with major production management decisions throughout the growing season.

2. Conduct an extensive review of the pertinent literature in order to design the necessary components of each part of the guide and to highlight areas requiring further research.

3. Conduct a field study to develop methods for establishing yield targets for major Canadian wheat varieties under Canadian conditions and for updating these yield targets as the season progresses.

4. Determine the probabilities associated with achieving a positive net return from the use of inputs or other management practices given the latest yield target for the crop, expected market prices for the crop and input costs.

5. Field test and refine the risk management guide with the assistance of commercial farm operators.

6. Produce a prototype professional quality guide and employ the services of a professional agronomist to promote the use and benefits of the guide throughout the farm, private and public extension communities across Canada.

The proposed guide will provide for initial practical yield targets based on environmental and economic factors and provide farmers with the necessary information to update yield predictions at critical decision making stages of crop growth. The guide will provide benchmarks and threshold levels for farmers to assess the risk or likelihood of achieving net returns from each cropping input. The net effect of the guide will be to increase the probability of the farmer achieving the maximum economic yield.

The long term target for the guide will be to have all farmers in Canada who are concerned about lowering the per unit cost of production using the guide in the management of their farms.

MODULE PREPARATION

During the 1990/91 season, work has been conducted on development for the background of the guide modules. The preliminary information will serve both as the basis for a production guide for wheat production as well as the major source of information on which to base the decision making guide (Risk Management Guide).

Seven sections have been prepared. They include: weed control; crop establishment; crop nutrition and a general introduction section describing types of wheat, their uses and adoption. The weed control module has focused on describing crop yield losses due to weeds. While the major information is focused on grassy weeds, competition with broadleaf weeds is also discussed. The module serves as the basis on which to build the decision making guide to assist farmers in ensuring herbicide applications are economical.

The crop establishment module describes the various factors affecting establishment of wheat. Factors discussed include seeding rate, seeding date, seeding depth, row spacing, seed quality, seedbed preparation and seeding equipment.

The crop nutrition module provides information on the nutritional aspects of wheat production as well as the implications of using soil tests and fertilizer (both organic and inorganic) to feed the crop.

The introductory section of wheat describes the importance of wheat worldwide and domestically. The module also includes information on the types of wheat grown in Canada, their uses, adoption and economics.

The disease control module describes the various diseases affecting wheat, their appearance, life cycles and control measures.

The lodging control module provides information on the causes and effects of lodging as well as the use of plant growth regulators to control lodging.

The insect control module describes the various insects affecting wheat, their appearances, habits, life histories, damages and control.

Module preparation will continue in 1991 and 1992 with emphasis on harvest systems.

COMMON TERMS USED TO DENOTE TRIAL CONDITIONS

TRIALS: 071 IH, NH, DH, IP, NP, DP, D-IH, D-IP

IH - Hard Red Spring Wheat under high moisture conditions

IP - Canada Prairie Spring Wheat under high moisture conditions

NH - Hard Red Spring Wheat under normal moisture conditions

NP - Canada Prairie Spring Wheat under normal moisture conditions

DH - Hard Red Spring Wheat under dry conditions

DP - Canada Prairie Spring Wheat under dry conditions

D-IP - Hard Red Spring Wheat under dry soil/high rainfall conditions

D-IH - Canada Prairie Spring Wheat under dry soil/high rainfall conditions

TARGET YIELD CALCULATION

A target yield can be determined based on the following information:

Target Yield = PAW X WUE

PAW = plant available water
    = soil H20 at seeding + expected rainfall - 5 inches
      (Note- 5 inches of water is necessary for vegetative growth)

WUE = water use efficiency
    = HRSW 4 bu/acre/inch of water
    = CPS 5.2 bu/acre/inch of water

eg. Soil water at seeding = 6 inches
    Expected rainfall = 8 inches
    Type of wheat = HRS (Katepwa)
    Total water = 14 inches
    PAW = 14 - 5 = 9 inches

Target Yield = 9 inches x 4 bu/acre/inch = 36 bu/acre

The same formula can be used to determine the post harvest water use efficiency using actual rainfall rather than expected rainfall.

The nitrogen requirement to achieve the target yield is based on the following formula:

Nitrogen Required/Bushel of Yield	HRSW	2.0 lbs/bu
	CPS	1.4 lbs/bu

eg. HRSW
Target Yield x 2.0 lbs/bu = Total N needed
    40   x 2.0 lbs/bu = 80 lbs/acre

Total N needed - Soil N = Fertilizer N required
     80   -   40   = 40 lbs/acre

1989 WORK SUMMARY

The 1990 work on the risk management guide was focused on 2 series of field trials as well as development of preliminary information on three of the seven modules of the guide.

The field trials included 9 Target Nitrogen trials at Minto, 1 Target Nitrogen trial at each of the following locations: Fairfax, Brandon, Rivers and Goodlands, 2 nitrogen timing trials and 3 trials on reliability of early tissue testing.

SECTION A TARGET NITROGEN TRIALS

SECTION CONTENTS

LIST OF FIGURES

LIST OF TABLES

A12 C071 D-IP EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, DRY SOIL/HIGH RAINFALL MINTO, 1990

A13 PLANT, TILLER AND SPIKELET COUNTS ON ALL C071 TRIALS MINTO, 1990

A14 SUMMARY OF THE EFFECT OF TOPDRESSED N ON KATEPWA AT VARIOUS N LEVELS UNDER MEDIUM & HIGH MOISTURE CONDITIONS MINTO, 1990, 2 STATION YEARS

A15 SUMMARY OF THE EFFECT OF TOPDRESSED N ON HY320 AT VARIOUS N LEVELS UNDER MEDIUM & HIGH MOISTURE CONDITIONS MINTO, 1990, 2 STATION YEARS

A16 THREE YEAR SUMMARY OF THE EFFECT OF TOPDRESSED N ON KATEPWA AT VARIOUS N LEVELS UNDER MEDIUM & HIGH MOISTURE CONDITIONS MINTO, 1988-1990, 6 STATION YEARS

A17 THREE YEAR SUMMARY OF THE EFFECT OF TOPDRESSED N ON HY320 AT VARIOUS N LEVELS UNDER MEDIUM & HIGH MOISTURE CONDITIONS MINTO, 1988-1990, 6 STATION YEARS

A18 COMPARISON OF YIELD ON SPLIT N VS SINGLE N TREATMENTS

SECTION A

C071 IH, NH, DH, D-IH, IP, NP, DP, D-IP

OBJECTIVE: To determine the effect of topdressed nitrogen on Katepwa and HY320 grown at various N levels, under low, medium and high moisture conditions.

METHODS AND MATERIALS

Wheat was seeded near Minto, Manitoba on May 12, 1990 (C071 DP, D-IP, NP, IP) and May 19, 1990 (C071 DH, D-IH, NH, IH) at a rate of 300 seeds/m2 (96 kg/ha for Katepwa and 111 kg/ha for HY320). The soil was a Ryerson clay loam (27% sand, 48% silt, 25% clay with clay subsoil). Organic matter was 4.7% and pH was 7.5. The seed was treated with Vitavax Dual and seeded in 15 cm rows at a depth of 5 cm (C071 DH,DP,NH,NP) and 4 cm (C971 IH,IP). Rainfall and temperature data is available from Appendix A. 1990 had a wet spring, normal June, hot and dry July and August.

Nine kg/ha of N and 40 kg/ha of P205 were placed with the seed. Initial applications of N were banded between every second seed row as 46-0-0 at the appropriate rates (Tables A1 - A4). The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5m. Hoegrass was applied on June 10 at .7 kg ai/ha to control green foxtail and wild oats. Broadleaf weeds were controlled with Estaprop at .41 kg ai/ha on June 12. Tilt was applied at a rate of .125 kg/ha on July 9 to control tanspot and leaf rust. Sevin was applied at a rate of 1.5 l/ha to control grasshoppers. Additional N was applied on June 19 at G.S. 31 using 34-0-0 as the N source. The rates of N are shown in Tables A1 - A4 following this section. Plant counts were taken on May 28 (C071 DP, D-IP) and June 14 (C071 NP, IP) and on June 11 (C071DH, D-IH, NH, IH). Tiller counts were taken on June 20 (C071 DP, D-IP, NP, IP) and June 25 (C071 DH, D-IH, NH, IH). Spikelet counts were taken on July 3, 4 and 5 by counting the spikelets on every tiller from 5 consecutive plants in two rows. Heads/m2 were recorded July 18 (C071 DP, D-IP,IH), July 19 (C071 DH,DP, NP, IP) and July 24 (C071 NH,NP, D-IH). Plant, tiller and head counts were taken by sampling the same 6 1/2 m rows. Maturity ratings were performed on August 16 (C071 DH, D-IH, NH, IH), August 17, (C071 DP, D-IP, NP, IP). The depth of moist soil was measured using a Brown soil moisture probe. Plots were trimmed to a 5 m length and a 1.25 m strip was harvested from the centre of each plot using a Hege plot combine. Yields were adjusted to 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test. The above trials were all harvested on September 3.

TABLE A1. C071 IH, IP TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS00/GS31	FERTILIZER N APPLIED (KG/HA) N AT SEEDING	N AT GS 31
1	50/0	--	--
2	50/50	--	38.5
3	75/0	2.5	--
4	75/50	2.5	38.5
5	100/0	21.7	--
6	100/50	21.7	38.5
7	125/0	41	--
8	125/50	41	38.5
9	150/0	60.3	--
10	150/50	60.3	38.5
11	CHECK/0	--	--
12	CHECK/50	--	38.5

TARGET YIELD CALCULATION
TARGET YIELD = WATER USE EFFICIENCY(WUE) X PLANT AVAILABLE WATER(PAW)
WUE = 4 and 5.2 bu/acre/inch for Hard Red Spring and Canada Prairie Spring respectively
PAW = Total water (inches) - 5 inches of water necessary for vegetative growth
TOTAL WATER = Soil water at seeding (inches) + [Expected Precipitation(inches-May 1 - July 31)]
KATEPWA TARGET YIELD = 4 bu/acre/inch x [(5.6 inches + 8.0 inches)-5]
= 34.4 bu/acre
HY320 TARGET YIELD = 5.2 bu/acre/inch x [(5.6 inches + 8.0 inches)-5]
= 44.72 bu/acre

KATEPWA N requirements based on Target Yield
TARGET N = Target Yield x N requirement/bushel
= 34.4 bu/acre x 2 lb N/bushel*
= 68.8 lb N/acre or 68.8 lb N/acre x 1.12
= 77.06 kg N/ha
SOIL N = 55.31 kg/ha
TARGET N APPLIED = Total N required - Soil N

*Katepwa total N requirements are assumed to be 2 lbs/bushel of yield.
*HY320 is assumed to have the same N requirements as Katepwa, however it will yield 30% more with approximately 30% less protein.

TABLE A2. C071 NH, NP TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS00/GS31	FERTILIZER N APPLIED (KG/HA) N AT SEEDING	N AT GS 31
1	50/0	--	--
2	50/50	--	38.5
3	75/0	2.5	--
4	75/50	2.5	38.5
5	100/0	21.7	--
6	100/50	21.7	38.5
7	125/0	41	--
8	125/50	41	38.5
9	150/0	60.3	--
10	150/50	60.3	38.5
11	CHECK/0	--	--
12	CHECK/50	--	38.5

TARGET YIELD CALCULATION
TARGET YIELD = WATER USE EFFICIENCY(WUE) X PLANT AVAILABLE WATER(PAW)
WUE = 4 and 5.2 bu/acre/inch for Hard Red Spring and Canada Prairie Spring respectively
PAW = Total water (inches) - 5 inches of water necessary for vegetative growth
TOTAL WATER = Soil water at seeding (inches) + [Expected Precipitation(inches-May 1 - July 31)]
KATEPWA TARGET YIELD = 4 bu/acre/inch x [(5.6 inches + 8.0 inches)-5]
= 34.4 bu/acre
HY320 TARGET YIELD = 5.2 bu/acre/inch x [(5.6 inches + 8.0 inches)-5]
= 44.72 bu/acre

KATEPWA N requirements based on Target Yield
TARGET N = Target Yield x N requirement/bushel
= 34.4 bu/acre x 2 lb N/bushel*
= 68.8 lb N/acre or 68.8 lb N/acre x 1.12
= 77.06 kg N/ha
SOIL N = 55.31 kg/ha
TARGET N APPLIED = Total N required - Soil N

*Katepwa total N requirements are assumed to be 2 lbs/bushel of yield.
*HY320 is assumed to have the same N requirements as Katepwa, however it will yield 30% more with approximately 30% less protein.

TABLE A3. C071 DH, DP TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS00/GS31	FERTILIZER N APPLIED (KG/HA) N AT SEEDING	N AT GS 31
1	50/0	14.5	--
2	50/50	14.5	34
3	75/0	31.6	--
4	75/50	31.6	34
5	100/0	48.6	--
6	100/50	48.6	34
7	125/0	65.7	--
8	125/50	65.7	34
9	150/0	82.8	--
10	150/50	82.8	34
11	0/0	--	--
12	0/50	--	34
13	100/100	48.6	68
14	100/200	48.6	136

TARGET YIELD CALCULATION
TARGET YIELD = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 and 5.2 bu/acre/inch for Hard Red Spring and Canada Prairie
Spring respectively
PAW = Total Water (inches) - 5 inches of water necessary for vegetative growth
TOTAL WATER = Soil water at seeding (inches) +
[Expected Precipitation (inches - May 1-July 31)]
KATEPWA TARGET YIELD = 4 bu/acre/inch x [(4.62 inches + 8.0 inches)-5]
= 30.48 bu/acre
HY320 TARGET YIELD = 5.2 bu/acre/inch x [(4.62 inches + 8.0 inches)-5]
= 39.62 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 30.48 bu/acre x 2 lb N/bushel*
= 60.96 lb N/acre or 60.96 lb N/acre x 1.12
= 68.27 kg N/ha
Soil N = 19.63 kg/ha
Target N Applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield
*HY320 is assumed to have the same N requirements as Katepwa, however it will yield 30% more with approximately 30% less protein.

TABLE A4. C071 D-IH, D-IP TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS00/GS31	FERTILIZER N APPLIED (KG/HA) N AT SEEDING	N AT GS 31
1	50/100	14.5	68
2	50/150	14.5	102
3	75/200	31.6	136
4	75/0	31.6	--
5	100/0	48.6	--
6	100/50	48.6	34
7	125/0	65.7	--
8	125/50	65.7	34
9	150/0	82.8	--
10	150/50	82.8	34
11	0/0	--	--
12	0/50	--	34

TARGET YIELD CALCULATION
TARGET YIELD = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 and 5.2 bu/acre/inch for Hard Red Spring and Canada Prairie Spring respectively
PAW = Total Water (inches) - 5 inches of water necessary for vegetative growth
TOTAL WATER = Soil water at seeding (inches) + [Expected Precipitation (inches - May 1-July 31)]
KATEPWA TARGET YIELD = 4 bu/acre/inch x [(4.62 inches + 8.0 inches)-5]
= 30.48 bu/acre
HY320 TARGET YIELD = 5.2 bu/acre/inch x [(4.62 inches + 8.0 inches)-5]
= 39.62 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 30.48 bu/acre x 2 lb N/bushel*
= 60.96 lb N/acre or 60.96 lb N/acre x 1.12
= 68.27 kg N/ha
Soil N = 19.63 kg/ha
Target N Applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield
*HY320 is assumed to have the same N requirements as Katepwa, however it will yield 30% more with approximately 30% less protein.

C071 IH RESULTS AND DISCUSSION

The results are found in Table A5. The extra N applied as a topdressed (split) application at G.S. 31 increased the yield over the initial N treatment by an average of 537 kg/ha from 2336 kg/ha to 2873 kg/ha. Protein level was also increased by an average of 1.40 percentage points from 11.66 to 13.06%.

When treatments with the same total N are compared (trmt.2 with trmt.5, trmt.4 with trmt.7, trmt.6 with trmt.9) the yields while not significantly different tended to be higher with the split N treatments compared to the treatments having the total amount applied as a single application prior to seeding. The average difference was ~ 300 kg/ha in favour of the split N applications. Thus the application of an extra 50% of the target yield N required gave an average yield increase of 537 kg/ha when compared to the base treatment only. However when treatments of the same total N are compared, the split application treatments yield ~ 300 kg/ha more. Therefore topdressing N at G.S.31 can be a useful tool to increase yield. Evaluation of crop maturity data shows a trend for plots receiving a high initial N rate +/or split N treatment to be slightly delayed in maturity. However if one compared treatments with the same total N, treatments which received the single N application matured slightly sooner than those receiving only the split N application.

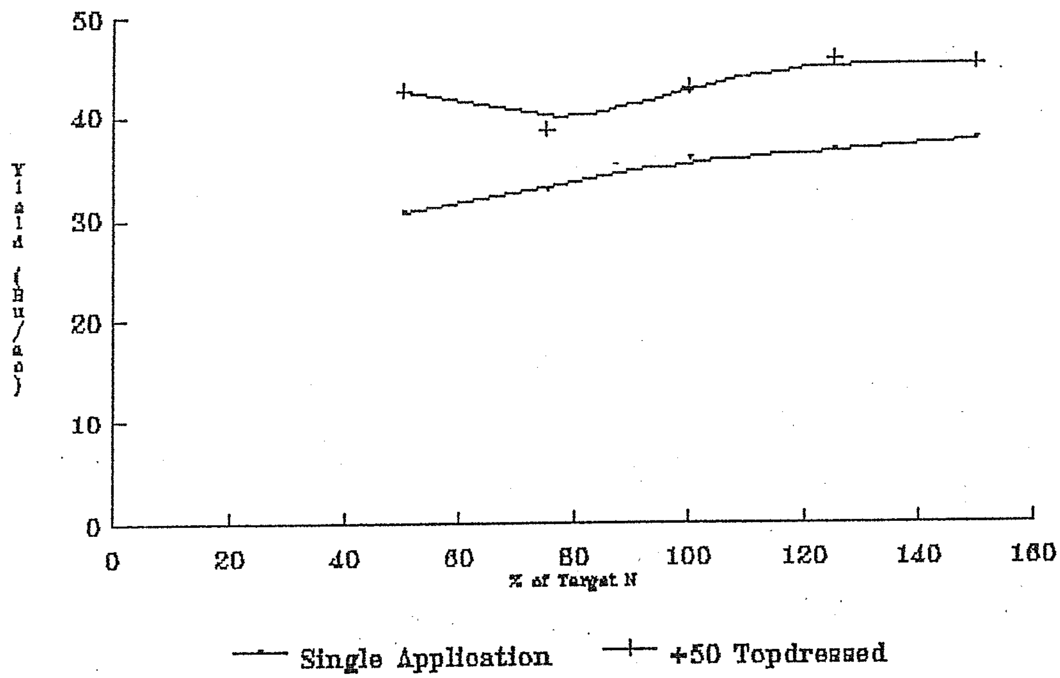
The late maturity treatments did not consistently result in higher yields compared to the early maturing treatments. Evaluation of yield components generally indicate that treatments with higher initial N rates had more heads/m2, more spikelets/head. TKW and kernels/head were not significantly influenced by treatments. Split N treatments tended to have lower plant stands but high numbers of heads/m2. Kernels size (TKW) tended to be smaller with the split N treatments.

TABLE A5 C071 IH EFFECT OF TOPDRESSED N ON KATEPWA GROWN AT VARIOUS INITIAL N LEVELS, HIGH MOISTURE CONDITIONS, MINTO, 1990

TRMT	N APPLICATION % OF TARGET N GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNTS /M2 JUNE11	HEAD COUNTS /M2 JULY18	MATURITY RATING 0-9 AUG.16	SPIKE LETS/ HEAD AUG.30	#KERNELS /100 HEAD AUG.30	TKW GRAMS AUG.30	PROT %
1	50/0	2062e*	234a	416a	4.3c	12.2a	2252a	33.7a	11.8cde
2	50/50	2863a-d	187ab	423a	4.6bc	11.8a	2136a	33.3a	12.5bc
3	75/0	2217de	191ab	438a	4.4bc	12.3a	2192a	33.1a	11.6cde
4	75/50	2590a-e	164b	410a	4.9abc	12.6a	2247a	33.3a	12.2bcd
5	100/0	2407b-e	205ab	422a	4.8abc	12.7a	2291a	34.0a	12.4bc
6	100/50	2888abc	201ab	441a	5.3abc	12.1a	2235a	33.3a	13.2ab
7	125/0	2458a-e	184ab	437a	5.5abc	12.8a	1852a	34.1a	11.2de
8	125/50	3086a	176ab	466a	5.0abc	12.9a	2266a	33.5a	13.8a
9	150/0	2522a-e	195ab	456a	6.1a	12.6a	2278a	33.2a	12.0cde
10	150/50	3034ab	192ab	464a	5.5abc	12.6a	2095a	32.7a	14.1a
11	Check/0	2352cde	185ab	410a	5.8ab	11.9a	1966a	33.6a	11.0e
12	Check/50	2777a-d	188ab	466a	5.3abc	12.3a	2164a	32.1a	12.6bc
C.V.		15.03	18.40	14.24	16.97	5.39	13.44	3.69	5.79

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A1. Response of Katepwa to Single &
Split N Application High Moisture



Minto 1990

C071 NH RESULTS AND DISCUSSION

Applying extra N as a topdressed (split) application at G.S. 31 increased the yield compared to the initial N treatment by an average of 749 kg/ha from 2322 kg/ha to 3077 kg/ha. Protein level was also increased by an average of 1.38% from 10.80 to 12.18% (Table A6).

When treatments with the same total N are compared (2 vs 5, 4 vs 7, 6 vs 9), the yields while not significantly different (except for 6 vs 9) tended to be higher with the total amount applied as a split application rather than as a single application prior to seeding. The average difference was ~ 728 kg/ha in favour of the split application of N at G.S.31. Thus the application of an extra 50% of the target yield N required gave an average yield increase of 749 kg/ha when compared to the base treatment only. However when treatments of the same total N are compared, the split application treatments yielded ~728 kg/ha more. Protein levels were significantly higher from the split N applications than that from single N application when treatments (N=50/50 vs 100/0; N=75/50 vs 125/0; N=100/50 vs 150/0) with same total N are compared. Topdressing N at G.S.31 can be a useful tool to increase yield over the single N application.

Evaluation of crop maturity data shows no consistency between plots receiving a high initial N rate +/or split N treatment. In comparing treatments with the same total N, treatments 2 and 6 which received single applications tended to mature sooner than treatments 5 and 9 respectively. The later maturing treatments did not necessarily give the higher yields.

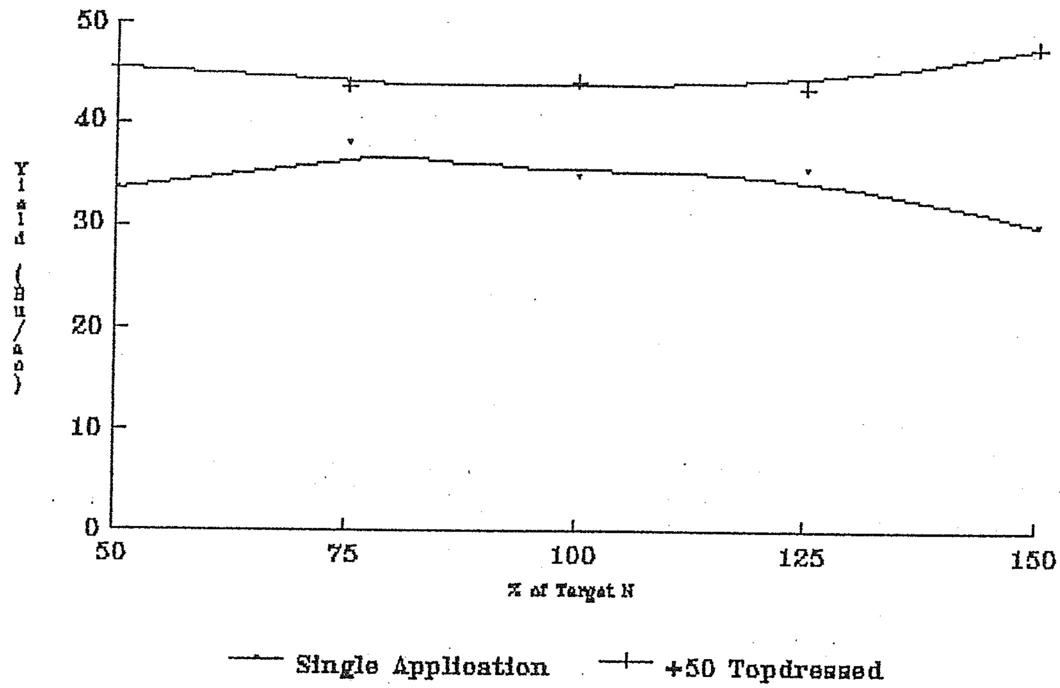
Evaluation of the yield components generally indicate that heads/m2 and kernels/head, while not significantly different tended to be higher with split applications rather than single applications. However split N application did not exhibit a consistent effect on TKW or plants/m2.

Table A6. C071 NH EFFECT OF TOPDRESSED N ON KATEPWA GROWN AT VARIOUS INITIAL N LEVELS, MEDIUM MOISTURE CONDITIONS, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 JUNE11	HEAD COUNT /M2 JULY24	MATURITY RATINGS 0-9 AUG.16	SPIKE LETS/ HEAD AUG.30	#KERNELS /100 HEAD AUG.30	TKW G AUG15	PROTEIN %
1	50/0	2260bc*	218a	440a	4.5ab	12.3ab	2011cd	34.2a	10.6d
2	50/50	3056ab	194a	449a	5.1a	12.7a	2241ab	33.5a	12.1abc
3	75/0	2559abc	201a	414a	5.1a	12.1ab	2003cd	34.2a	11.7c
4	75/50	2940ab	223a	466a	4.1ab	12.5ab	2246ab	34.2a	12.5ab
5	100/0	2346bc	206a	415a	4.5ab	12.0ab	2039bcd	33.9a	10.7d
6	100/50	2973ab	194a	435a	4.0ab	12.6ab	2157abc	33.4a	11.9bc
7	125/0	2403bc	206a	397a	4.4ab	12.3ab	2013cd	34.7a	10.4d
8	125/50	2945ab	206a	469a	3.9ab	12.3ab	2250ab	33.9a	12.1abc
9	150/0	2037c	184a	384a	3.9ab	11.9ab	2073bcd	34.2a	10.6d
10	150/50	3219a	197a	464a	4.1ab	12.5ab	2208abc	34.7a	12.7a
11	CHECK/0	2324bc	186a	411a	4.3ab	11.8b	1926d	33.8a	10.8d
12	CHECK/50	3291a	207a	460a	3.8b	12.4ab	2292a	34.6a	11.8bc
C.V.		17.71	17.50	14.49	17.74	4.03	6.15	3.84	4.35

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A2. Response of Katepwa to Single & Split N Application Medium Moisture



Minto 1990

C071 DH RESULTS AND DISCUSSION

As indicated in Table A7, applying extra N at G.S.31 increased yields compared to the initial N treatment by an average of 476 kg/ha from 2554 to 3030 kg/ha. The protein content was also increased by 1.33% from 11.25 to 12.58%.

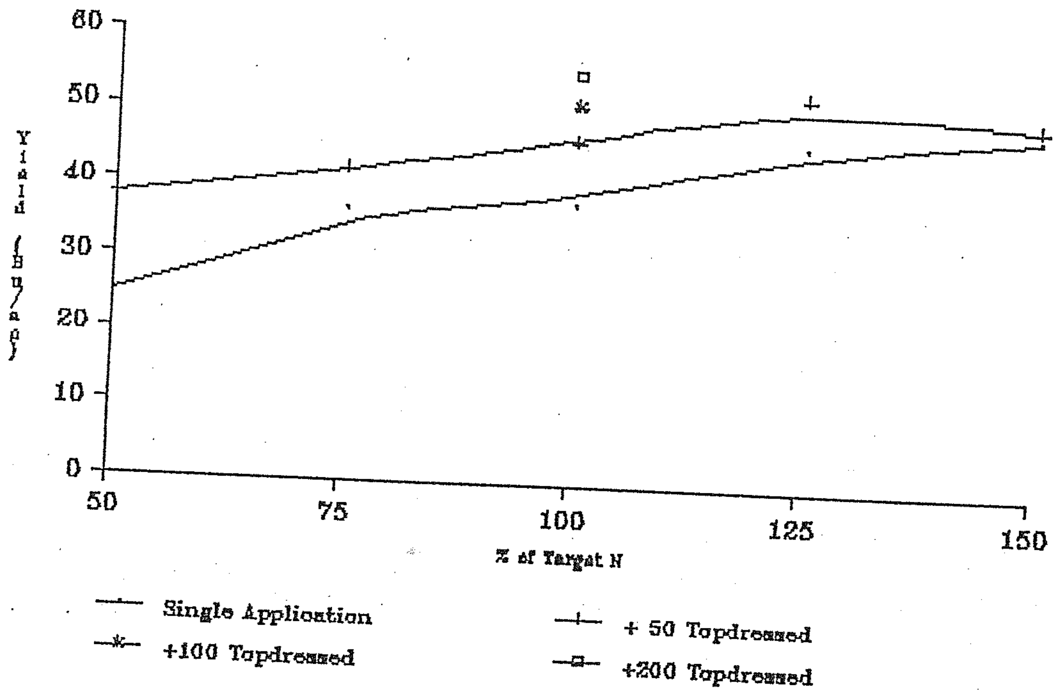
When treatments with the same total N are compared (2,5; 4,7; 6,9) the yields while not significantly different tended to be higher with the total amount applied as a single (except for treatment 2 vs 5) application rather than as a split application. The yields also tended to increase with increasing amounts of topdressed N (Initial N=100/Split N=50; 100; and 200). Maturity tended to be delayed with increasing rates of initial N and/or split N application. The treatment that received the heaviest N application (N=300) was significantly later in maturity compared to treatments that received lower N rates (N<150). Highest yield was obtained from treatment 14. Split N treatments appeared to consistently result in higher heads/m2, spikelets/head and kernels/head. Generally, there were no differences in TKW with the exception of Initial N=100/Split N=100 which was significantly lower than the other treatments.

TABLE A7 C071 DH EFFECT OF TOPDRESSED N ON KATEPWA GROWN AT VARIOUS INITIAL N LEVELS, LOW MOISTURE CONDITIONS, MINTO, 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 JUNE11	HEAD COUNT /M2 JULY19	MATURITY RATINGS 0-9 AUG16	SPIKELETS /HEAD AUG.29	#KERNELS /100 HEAD AUG.29	TKW G	PROTEIN %
1	50/0	1674f*	205b	384c	4.6a	11.6e	1957d	32.6a	11.0fg
2	50/50	2562de	220ab	475ab	4.1a-d	12.2b-e	2228a-d	33.6a	12.5cd
3	75/0	2455e	234ab	411abc	4.4ab	12.1cde	2120bcd	34.4a	10.8g
4	75/50	2818cde	221ab	475ab	4.3abc	12.9abc	2479a	34.4a	11.8def
5	100	2542de	235ab	449abc	4.8a	11.9de	2239a-d	34.1a	11.4efg
6	100/50	3110bcd	211ab	491a	3.6b-f	12.6a-d	2331abc	34.9a	12.3cde
7	125/0	3106bcd	233ab	442abc	4.1a-d	12.6a-d	2198a-d	34.8a	11.2fg
8	125/50	3549ab	226ab	490ab	3.3ef	13.2a	2436ab	34.5a	13.1bc
9	150/0	3263abc	259a	473ab	3.8b-e	12.7a-d	2207a-d	33.8a	12.3cde
10	150/50	3358abc	203b	450abc	3.4def	12.8abc	2306abc	33.8a	13.5b
11	0/0	2287e	212ab	401bc	4.4ab	11.8e	2081cd	33.5a	10.8g
12	0/50	2787cde	212ab	486ab	4.0a-e	12.3b-e	2318abc	34.0a	12.3cde
13	100/100	3426ab	213ab	486ab	3.5c-f	12.7abc	2371abc	25.6b	13.6b
14	100/200	3693a	194b	495a	2.9f	13.0ab	2419ab	34.2a	14.5a
C.V.		12.23	12.96	11.49	13.32	3.84	8.27	13.06	4.87

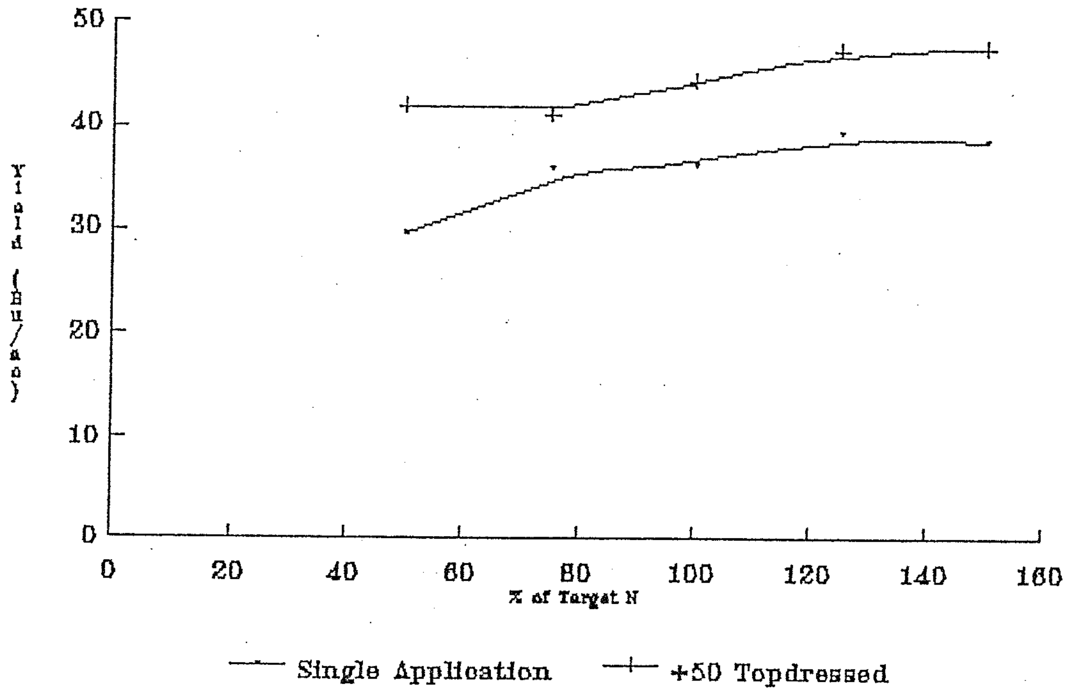
*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A3. Response of Katepwa to Single & Split N Application Low Moisture



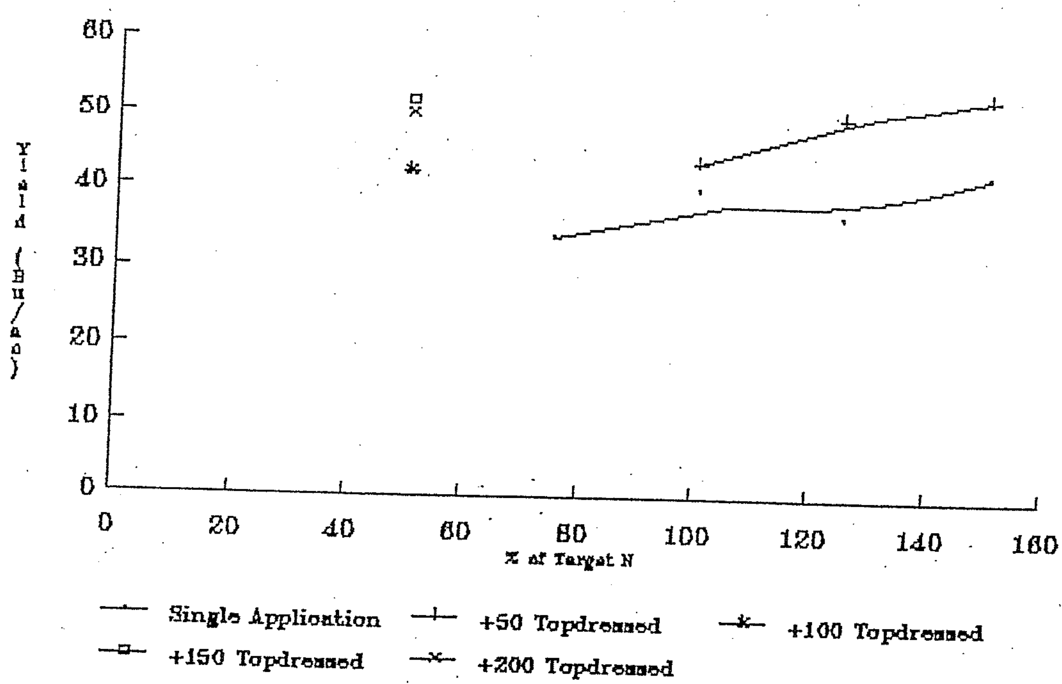
Minto 1990

Fig. A4. Response of Katepwa to
Single & Split N Application



Low, Medium, High Moisture, Minto 1990

Fig. A5. Response of Katepwa to Single &
Split N Application Dry-Irrigated



Minto 1990

C071 D-IH RESULTS AND DISCUSSION

The results are indicated in Table A8. Topdressing (split application) the extra N at G.S.31 increased the yield over the initial N treatment by an average of 729 kg/ha from 2516 to 3245 kg/ha. Yields were increased by as much as 1077 kg/ha when N was topdressed. Protein level was also higher by 1.84% from 11.34 to 13.18% using the extra N applied as a topdressing over the initial N treatment. Overall, as initial N levels were increased, so did the protein levels. When treatments with the same N are compared (1 vs 6 vs 9 and 2 vs 10) the yields are not significantly different among treatments 1, 6, 9 and between treatments 2 and 10. Protein was significantly higher for the split application (N=100/50) than that from (N=150) single N application.

Maturity tended to delay slightly with split N application and/or higher N rates. Yield components (heads/m2, spikelets/head and kernels/head) appeared to be higher while TKW tended to be lower with split N applications compared to single N applications.

TABLE A8 C071 D-IH EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, DRY SOIL/HIGH RAINFALL, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 JUNE11	HEAD COUNT /M2 JULY24	MATURITY RATINGS 0-9 AUG16	SPIKELETS /HEAD AUG29	#KERNELS /100 HEAD AUG29	TKW G	PROTEIN %
1	50/100	2857bcd*	188c	492a	2.9d	12.5ab	2468a	32.3c	13.4b
2	50/150	3483a	203bc	465a	3.0cd	12.3ab	2194bc	32.8bc	14.5a
3	75/200	3373ab	231ab	481a	3.3bcd	12.5ab	2360ab	32.3c	14.6a
4	75/0	2296de	201bc	405a	4.1a	12.3ab	2166bc	35.1a	10.9e
5	100/0	2694cde	215abc	448a	3.8abc	12.0b	2147bc	34.8a	11.3de
6	100/50	2950abc	214abc	450a	3.8abc	12.7a	2303abc	34.4ab	12.4c
7	125/0	2493cde	206bc	463a	4.0ab	12.8a	2201bc	34.8a	11.5de
8	125/50	3372ab	228abc	465a	3.8abc	12.6ab	2225bc	34.3ab	12.9c
9	150/0	2846b-e	253a	501a	3.9ab	12.3ab	2092c	35.4a	11.7d
10	150/50	3500a	188c	421a	3.5a-d	12.3ab	2181bc	33.7abc	13.4b
11	CHECK/0	2251e	197bc	403b	3.8abc	11.9b	2112bc	34.5ab	11.3de
12	CHECK/50	3032abc	223abc	422a	3.6a-d	12.2ab	2236abc	34.3ab	12.6c
C.V.		12.73	11.97	15.86	13.36	3.35	6.82	3.48	2.96

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

C071 IP RESULTS AND DISCUSSION

Topdressing (split application) the extra N at G.S.31 increased the yield over the initial N treatment by an average of 312 kg/ha from 3722 to 4034 kg/ha. Protein level was also higher by .58% from 10.60 to 11.18 using the extra N applied as a topdressing over the initial N treatment. Overall, as initial N levels were increased, so did the protein levels. When treatments with the same N are compared (2 vs 5, 4 vs 7, 6 vs 9) the yields are not significantly different between split vs single application. Generally yields tended to be higher with the total amount applied as a split application, compared to the single N treatments (Table A9).

The application of an extra 50% of the target yield N required gave an average yield increase of 312 kg/ha when compared to the base treatment only. However when treatments of the same total N are compared, the split application treatments tended to yield slightly more. Topdressing N at G.S.31 can be a useful method to increase yield. Evaluation of crop maturity data shows no significant difference between treatments in terms of initial N rate or in single vs split application for the same total N. Evaluation of yield components generally showed that heads/m2 and spikelets/head increased with higher initial N rates. There was no consistency with the kernels/head. TKW tended to be slightly lower with split N treatments.

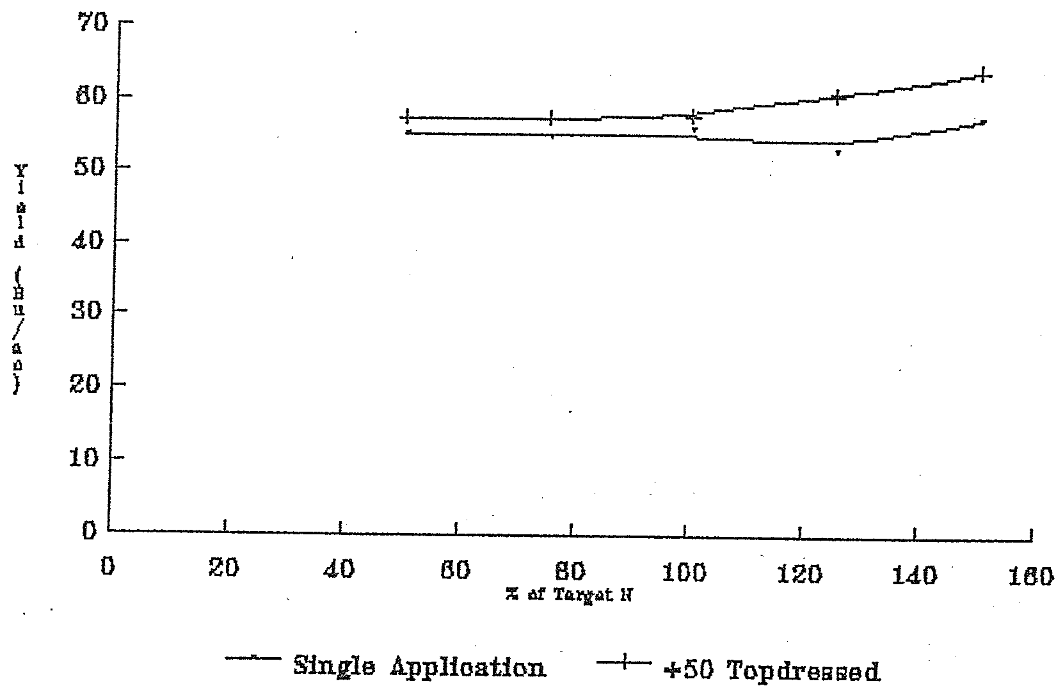
Split N treatments did not result in a consistent increase in heads/m2 and kernels/head overall initial N levels. Spikelets/head were higher with split N applications only when treatments with the same total N are compared.

TABLE A9 C071 IP EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, HIGH MOISTURE CONDITIONS, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 JUNE1	HEAD COUNT /M2 JULY19	MATURITY RATINGS 0-9 AUG17	SPIKELETS /HEAD AUG24	#KERNELS /100 HEAD AUG24	TKW G	PROTEIN %
1	50/0	3717ab*	216ab	290c	6.9a	13.9e	3213ab	44.8abc	10.6ab
2	50/50	3857ab	209ab	299bc	5.3cde	14.1b-e	3276ab	42.1cd	10.8abc
3	75/0	3680ab	202ab	297bc	5.6b-e	13.9de	3303ab	45.4a	10.3b
4	75/50	3869ab	226ab	369ab	5.5b-e	13.8e	3201ab	43.3a-d	11.2ab
5	100/0	3755ab	220ab	318abc	5.9a-d	14.0cde	3058ab	44.9ab	10.6ab
6	100/50	3893ab	239a	315abc	4.6e	14.4b-e	3382ab	42.1cd	11.2a
7	125/0	3574b	185b	344abc	6.1abc	14.8ab	3301ab	43.9a-d	10.6ab
8	125/50	4090ab	230ab	335abc	5.3cde	14.7abc	3343ab	41.2d	11.8a
9	150/0	3858ab	221ab	342abc	5.0de	14.7abc	3488a	42.9a-d	10.9ab
10	150/50	4300a	199ab	359abc	4.9de	15.1a	3413ab	41.9cd	11.2ab
11	CHECK/0	3748ab	226ab	327abc	6.4ab	14.3b-e	3033b	44.0abc	10.6ab
12	CHECK/50	4194ab	205ab	375a	4.9de	14.6a-d	3248ab	42.6bcd	10.9ab
C.V.		10.70	12.58	12.93	11.86	2.91	8.09	3.87	6.68

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A6. Response of HY320 to Single &
Split N Application High Moisture



Minto 1990

C071 NP RESULTS AND DISCUSSION

The results are found in Table A10. Applying extra N as a topdressed (split) application at G.S.31 increased the yield over the initial N treatment by an average of 548 kg/ha from 3784 to 4332 kg/ha. At low initial N levels, the yield increases due to topdressed N were as high as 815 kg/ha. Protein level also increased by .42% from 11.05% for single N applications to 11.47% for split N application treatments. When treatments with the same total N are compared (2 vs 5, 4 vs 7, 6 vs 9) the yields while not significantly different, (except 2 vs 5 which were significantly different) tended to be more with split N application compared to single N application.

The average difference was ~530 kg/ha in favour of split N application at G.S.31. The difference in yield was particularly largest at the low N level 50/50. Thus where the base nitrogen was not adequate, split N tended to be more advantageous than single N. When adequate N is applied initially, the data indicates no big advantage of split over single application.

Evaluation of crop maturity data shows that plots receiving a high initial N rate +/or split N treatment did not differ significantly in maturity. However if treatments with the same total N are compared, maturity tended to be delayed with split N application at the lower N levels.

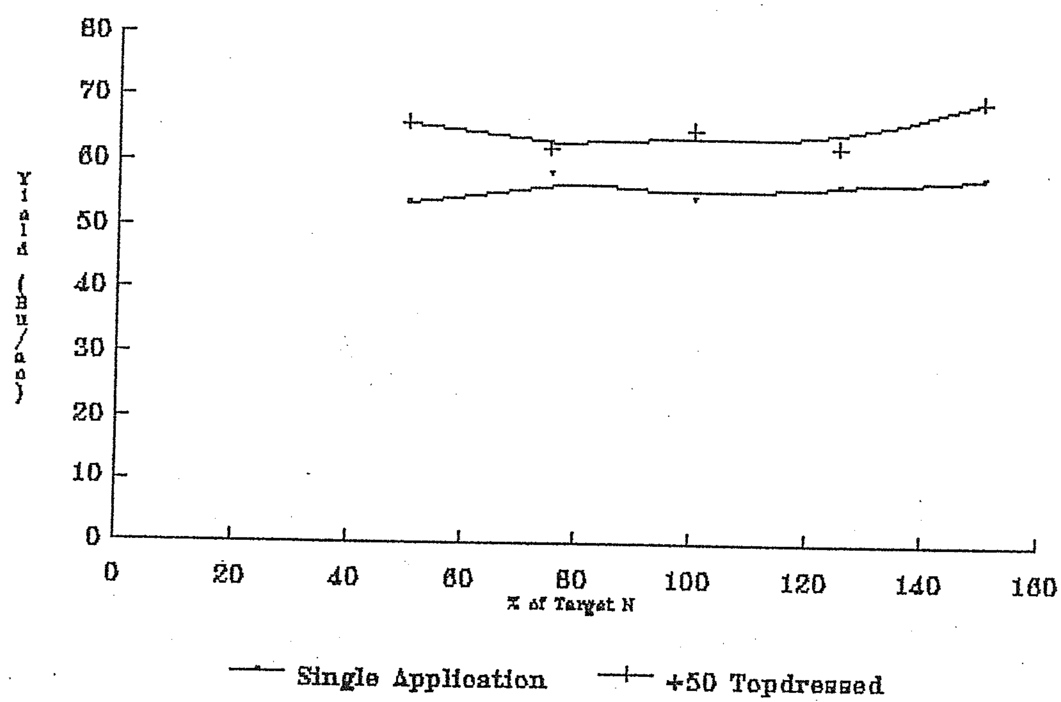
Maturity data appears to be complimentary to yield data, with the later maturing treatments giving the higher yields when treatments with the same total N are compared. Evaluation of yield components generally indicate that there were no differences in heads/m2 or kernels/head. Meanwhile, spikelets/head tended to be more with single N application only when treatments with same total N are compared. TKW appeared to be more with single N application compared to split N application.

TABLE A10. C071 NP EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, MEDIUM MOISTURE CONDITIONS, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 JUNE1	HEAD COUNT /M2 JULY19	MATURITY RATINGS 0-9 AUG17	SPIKELETS /HEAD AUG10	#KERNELS /100 HEAD AUG 11	TKW G AUG22	PROTEIN %
1	50/0	3626e*	208b	303a	4.5a	14.1bcd	3231a	45.6a	10.9a
2	50/50	4441ab	213a	374a	4.5a	14.3a-d	3397a	42.9bcd	11.7a
3	75/0	3918cde	239a	330a	4.9a	14.1bcd	3293a	44.2abc	11.1a
4	75/50	4172bcd	215a	361a	4.6a	13.7d	3238a	43.5abc	11.5a
5	100/0	3672e	214a	374a	4.9a	14.4abc	3269a	44.1abc	11.0a
6	100/50	4377abc	225a	367a	4.9a	13.9cd	3285a	43.6abc	11.3a
7	125/0	3822de	217a	340a	4.8a	14.7ab	3355a	45.1ab	11.3a
8	125/50	4223bcd	209a	361a	5.0a	15.0a	3349a	43.7abc	11.2a
9	150/0	3905cde	231a	369a	4.8a	14.6abc	3490a	44.7abc	10.9a
10	150/50	4706a	218a	368a	4.6a	14.9a	3552a	40.9d	11.7a
11	CHECK/0	3763de	242a	318a	4.6a	14.0bcd	3251a	44.5abc	11.1a
12	CHECK/50	4073b-e	232a	340a	4.6a	14.5abc	3419a	42.7cd	11.4a
C.V.		7.24	10.31	12.74	7.19	3.16	5.64	3.09	5.35

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A7. Response of HY320 to Single & Split N Application Medium Moisture



Minto 1990

C071 DP RESULTS AND DISCUSSION

The results are found in Table All. The extra 50% N applied as a topdressed (split) application at G.S. 31 increased yield over the initial N treatment by 131 kg/ha on average and by as much as 375 kg/ha for the 100/50 treatment. Protein level was higher with the additional topdressed N compared to the initial N treatments. There were no significant differences in the protein levels between treatments however the treatment with Initial = 100/split = 200 resulted in significantly more protein compared to treatments with lower N (<150).

When treatments with the same total N are compared (2,5; 4,7; 6,9) the yields while not significantly different, generally tended to be higher at the lower N levels with the total amount applied as a single application. However at the higher N level, more yield was attained with split N application. The data seems to indicate that when initial soil moisture is low, single N application may be advantageous at low N rates. However at higher N rates, split N applications may be a better choice for increased yield.

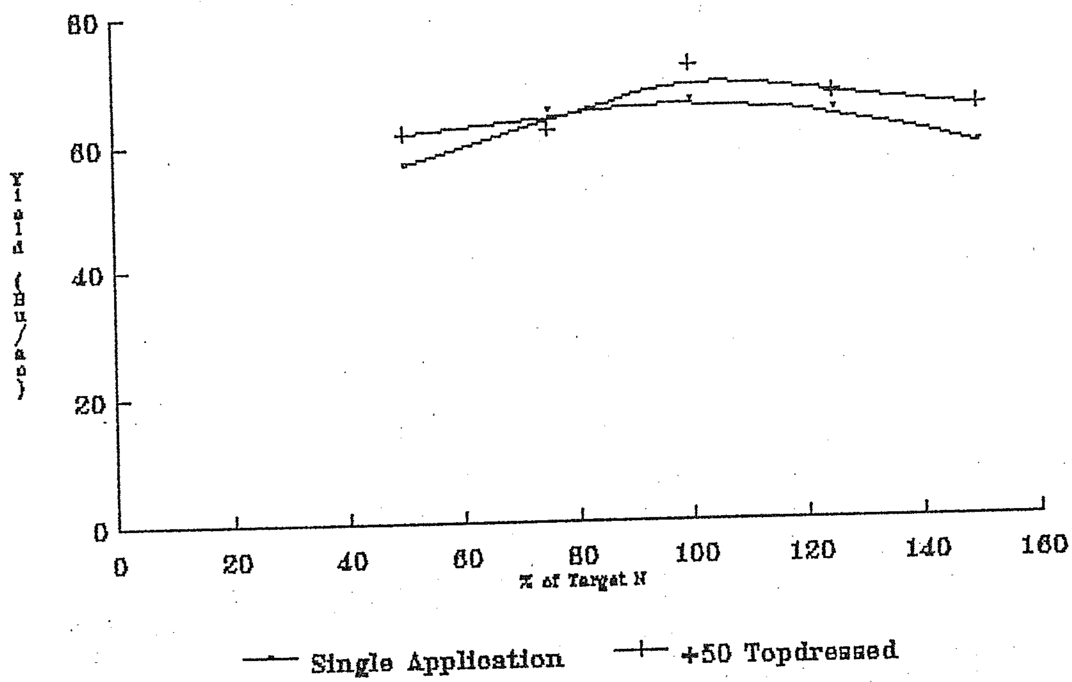
Evaluation of crop maturity data indicates no significant differences due to initial N rates or split N applications. However Initial N=100, Split N=200 was one of the latest to mature. At 125 and 150 total N levels, heads/m2 and kernels/head though not significantly different tended to be higher with split N applications compared to single N applications. Meanwhile, TKW tended to be lower with split N application at these total N levels. At the 100 total N level, kernels/head and TKW were higher, while heads/m2 were lower with split N application compared to single N application.

TABLE All C071 DP EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, LOW MOISTURE CONDITIONS, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 MAY28	HEAD COUNT /M2 JULY18	MATURITY RATINGS 0-9 AUG17	SPIKELETS /HEAD AUG29	#KERNELS /100 HEAD AUG 29	TKW G	PROTEIN %
1	50/0	3817b*	236ab	353bc	5.8a	14.0d	3351a	43.8a	11.6cd
2	50/50	4138ab	235ab	395abc	4.6a-d	14.3cd	3387a	41.2a-d	11.5d
3	75/0	4338ab	261a	400abc	5.5ab	14.3cd	3157a	41.4a-d	11.5d
4	75/50	4145ab	234ab	419abc	4.4a-d	14.3bcd	3507a	40.6a-d	11.7bcd
5	100/0	4439ab	236ab	455a	4.4a-d	15.3a	3411a	41.3a-d	11.5d
6	100/50	4814a	240ab	411abc	4.6a-d	15.1abc	3478a	39.0b-e	11.8bcd
7	125/0	4325ab	243ab	429ab	4.1bcd	14.9abc	3361a	41.1a-d	11.3d
8	125/50	4499ab	240ab	396abc	4.5a-d	14.8a-d	3168a	39.8bcd	12.0bcd
9	150/0	3967b	230ab	344c	4.1bcd	14.9abc	3248a	42.3ab	11.7bcd
10	150/50	4338ab	210b	394abc	5.3abc	15.1ab	3337a	38.5de	12.5abc
11	0/0	4308ab	251ab	383abc	4.0cd	14.4bcd	3051a	42.6ab	11.2d
12	0/50	4044ab	206b	409abc	4.1bcd	14.3bcd	3390a	42.2abc	11.8bcd
13	100/100	4103ab	250ab	403abc	3.8d	15.3a	3260a	38.6cde	12.5ab
14	100/200	4259ab	243ab	448a	3.6d	15.1abc	3355a	36.1e	13.2a
C.V.		10.68	11.36	11.80	19.47	3.45	8.94	5.35	4.97

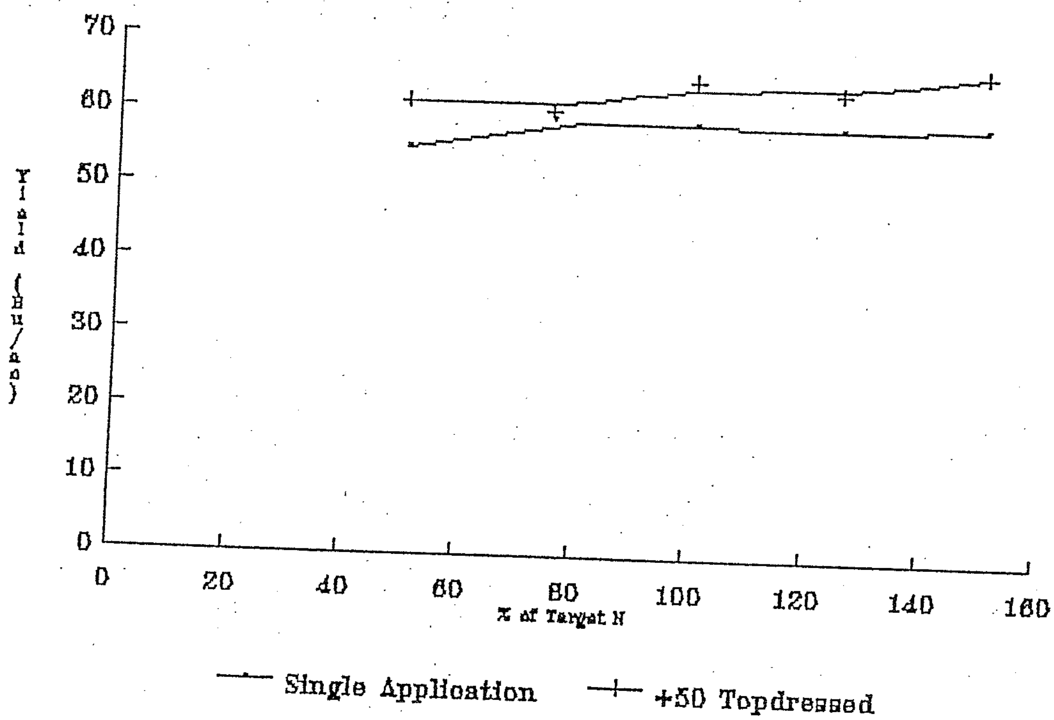
*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Fig. A8. Response of HY320 to Single &
Split N Application Low Moisture



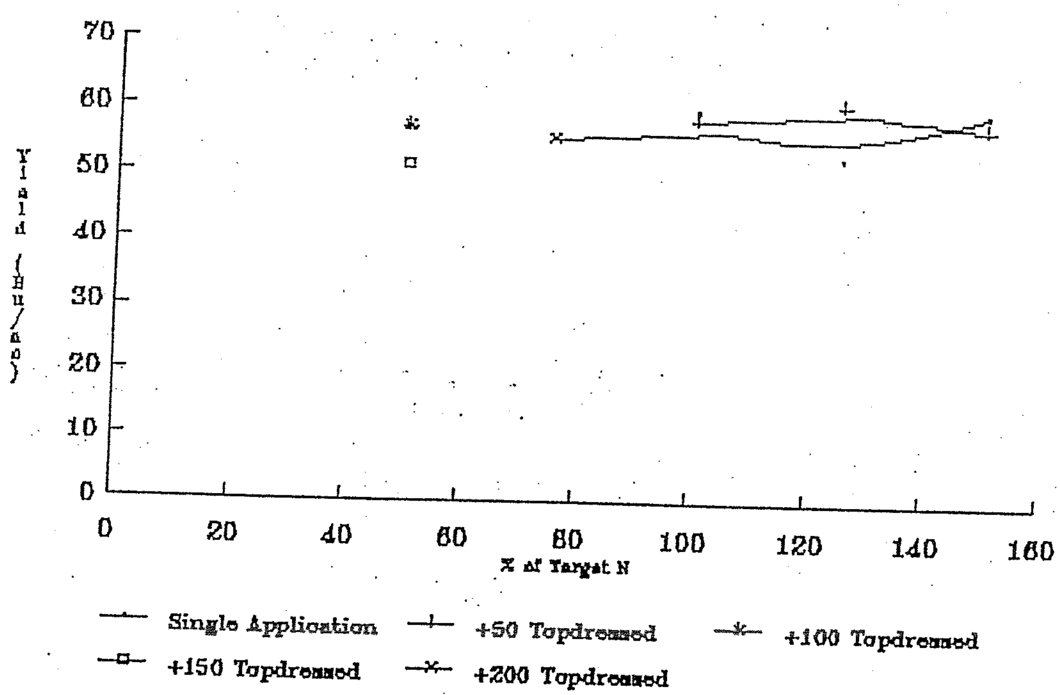
Minto 1990

Fig. A9. Response of HY320 to Single & Split N Application



Low, Medium, High Moisture, Minto 1990

Fig. A10. Response of HY320 to Single & Split N Application Dry-Irrigated



Minto 1990

C071 D-IP

Topdressing N (split application) did not consistently result in an increase in yield over the initial N treatment. However, protein level was higher by .76% from 11.56 to 12.32. Overall, as initial N levels were increased, so did the protein levels. When treatments with the same N are compared (1 vs 6 vs 9 and 2 vs 10) the yields are not significantly different. Maturity was not consistently delayed with high initial N and/or split application treatments. However, the treatment with the highest N (Initial N=75/split N = 200) matured significantly later than the treatment with Initial N = 75.

Split N application of total N = 150 resulted in higher TKW, number of heads/m2, lower spikelets and kernels/head. However the differences were insignificant.

TABLE A12 C071 D-IP EFFECT OF TOPDRESSED N ON HY320 GROWN AT VARIOUS INITIAL N LEVELS, DRY SOIL/HIGH RAINFALL, MINTO 1990

TRMT	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA SEPT3	PLANT COUNT /M2 MAY28	HEAD COUNT /M2 JULY18	MATURITY RATINGS 0-9 AUG17	SPIKELETS /HEAD AUG29	#KERNELS /100 HEAD AUG 29	TKW G	PROTEIN %
1	50/100	3844a*	185a	397a	4.5bc	14.4bc	3655a	41.3a	12.8ab
2	50/150	3467a	218a	367a	4.6bc	13.8c	3273ab	39.6	12.8ab
3	75/200	3737a	210a	385a	4.3c	14.6ab	3346ab	39.6a	13.0a
4	75/0	3653a	214a	343a	6.0a	14.4bc	3354ab	43.1a	11.1e
5	100/0	3972a	224a	380a	4.9bc	14.9ab	3242ab	42.4a	11.2e
6	100/50	3923a	224a	374a	5.0b	14.8ab	3329ab	42.0a	11.9cde
7	125/0	3547a	199a	315a	4.6bc	14.8ab	3573ab	41.2a	11.9cde
8	125/50	4097a	208a	389a	4.8bc	15.3a	3366ab	41.0a	12.1bcd
9	150/0	4003a	210a	336a	4.9bc	15.1ab	3664a	40.3a	12.1bcd
10	150/50	3866a	206a	335a	4.8bc	15.0ab	3504ab	39.6a	12.5abc
11	0/0	3755a	210a	331a	5.0b	14.4bc	3163b	43.0a	11.5de
12	0/50	3580a	205a	368a	4.6bc	14.5bc	3124b	42.8a	12.1bcd
C.V.		12.24	11.8	13.48	7.87	3.04	8.02	5.11	4.12

*Means followed by the same letter do not differ significantly at the 5% level according to Duncan's Multiple Range Test.

Data for use in yield tracking where the yield was estimated at G.S.31 was obtained from certain treatments in C0971 trials as shown in the following Table A13. The information was used in Section E of this report.

TABLE A13. TILLER & SPIKELET COUNTS ON ALL C071 TRIALS, MINTO 1990

EXPERIMENT	TREATMENT	PLANT COUNTS/M2	TILLER COUNTS/M2	SPIKELET COUNTS /TILLER
C071 IH	1	234	458	13.9
	5	205	635	13.5
	9	195	669	14.3
C071 NH	1	218	530	13.6
	5	206	517	13.4
	9	184	505	13.4
C071 DH	5	235	501	13.2
	9	259	588	13.2
	11	212	486	13.1
C071 D-IH	1	188	456	13.4
	5	215	598	14.0
	9	253	647	14.0
C071 IP	1	216	484	16.3
	5	220	464	16.8
	9	221	572	16.9
C071 NP	1	208	426	16.4
	5	214	466	16.3
	9	231	480	16.2
C071 DP	5	236	485	17.3
	9	230	492	17.5
	11	251	407	16.8
C071 D-IP	1	185	416	16.7
	5	224	476	17.0
	9	210	521	17.2

C071 IH, NH 1990 SUMMARY KATEPWA

The medium and high moisture experiments (NH and IH) for 1990 were combined and the summary is presented in Table A14. Applying extra N as a topdressed (split) application at G.S.31 increased the yield over the initial N treatment by an average of 624 kg/ha from 2328 to 2952 kg/ha. Protein level was also increased by 1.38% from 11.22 to 12.60%.

When treatments with the same total N are compared (N=50/50 vs 100/0; N=75/50 vs 125/0; N=100/50 vs 150/0), split N applications resulted in greater yields compared to yields from single N applications for each level of total N. The differences were only significant for total N=50/50 vs 100/0, and N=100/50 vs 150/0. Protein levels were significantly greater with split N applications for each level of total N compared to protein from single N applications.

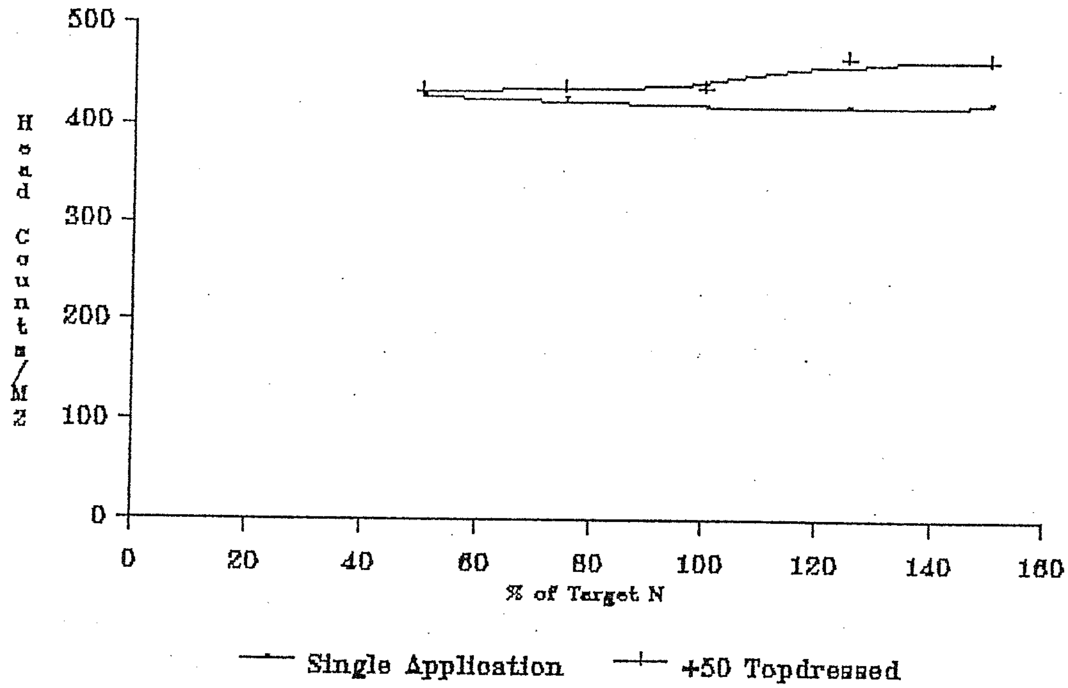
When treatments with same total N are compared, head counts/m2 seemed to be more with split N application compared to head counts from single N application. The differences were particularly greater at the higher N levels (Figure 11). Spikelets/head were slightly more with single N application at the lower N rate (N=100) than with split N application (N=50/50). However at the higher N rate, spikelets/head were either equal to or greater with split N application but differences were marginal (Figure A12). Kernels/head were generally greater with split N application compared to single N application (Figure A13). Meanwhile, TKW seemed to be slightly more with single N application compared to single N application (Figure 14). There seemed to be a slightly delay in maturity with split applications, particularly at the higher N rates.

TABLE A14. SUMMARY OF THE EFFECTS OF TOPDRESSED N ON KATEPWA AT VARIOUS N LEVELS UNDER MEDIUM AND HIGH MOISTURE CONDITIONS, MINTO 1990 2 STATION YEARS

TRMT	YIELD KG/HA	PROTEIN %	PLANT COUNTS/M2	HEAD COUNTS/M2	MATURITY RATING 0-9	SPIKELETS /HEAD	KERNELS /100HEAD	TKW G
1 50/0	2161c*	11.2cd	226	428	4.4	12.2	2131	33.9
2 50/50	2960a	12.3b	190	436	4.8	12.2	2188	33.4
3 75/0	2388bc	11.6c	196	426	4.7	12.2	2097	33.6
4 75/50	2765ab	12.3b	193	438	4.5	12.5	2246	33.7
5 100/0	2376bc	11.5c	205	418	4.6	12.3	2165	33.9
6 100/50	2930a	12.5b	197	438	4.6	12.3	2196	33.3
7 125/0	2430bc	10.8d	195	417	4.9	12.5	1932	34.4
8 125/50	3016a	12.9ab	191	467	4.4	12.6	2258	33.7
9 150/0	2279bc	11.3cd	189	420	5.0	12.2	2175	33.7
10 150/50	3009a	13.4a	194	464	4.8	12.5	2151	33.7
11 Check/0	2338bc	10.9c	185	410	5.0	11.8	1946	33.7
12 Check/50	3033a	12.2b	197	463	4.5	12.3	2228	33.3

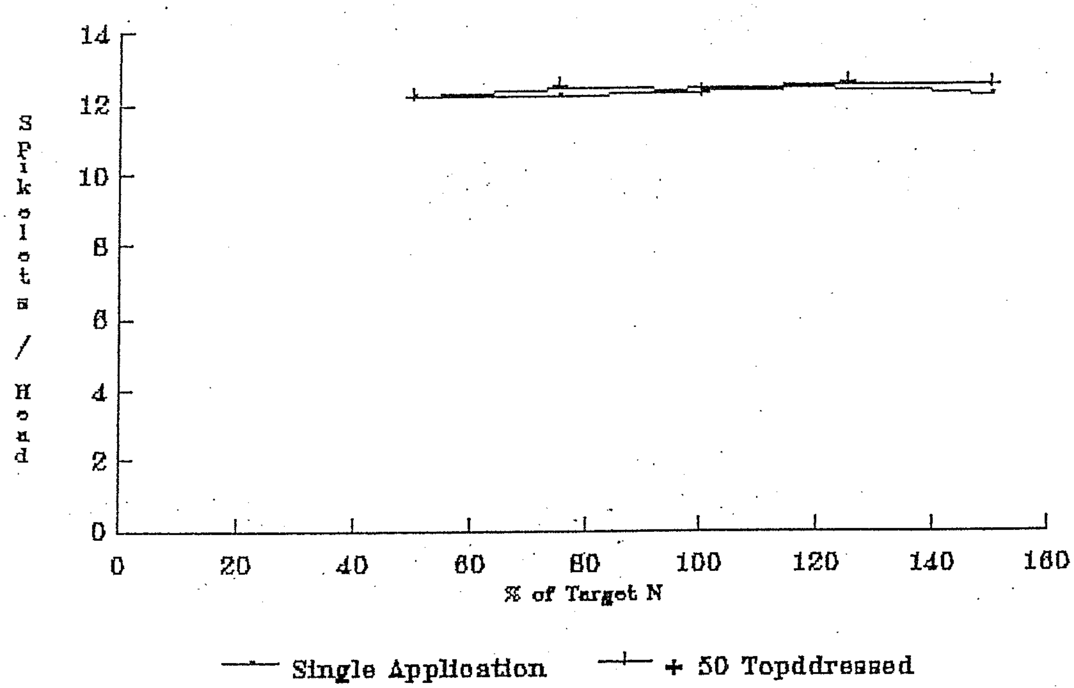
*Means followed by the same letter do not differ significantly (Duncan's MRT, P=.05)

Fig. A11 Response of Head Counts in Katepwa to Single & Split N Application



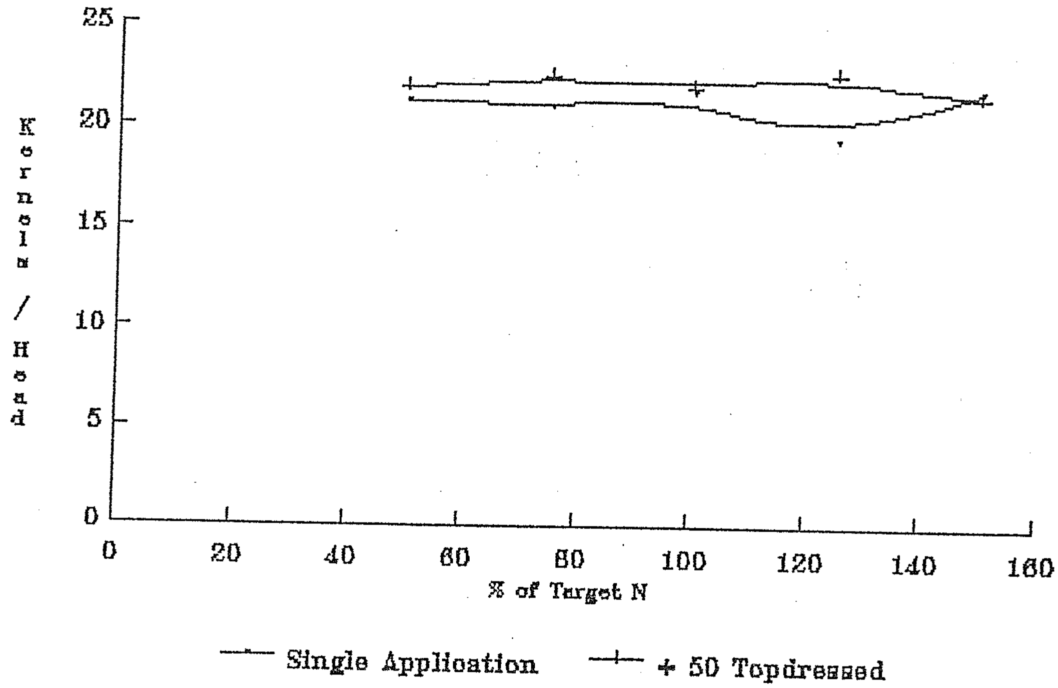
High & Medium Moisture Minto 1990

Fig. A12 Response of Spikelets in Katepwa to Single & Split N Application



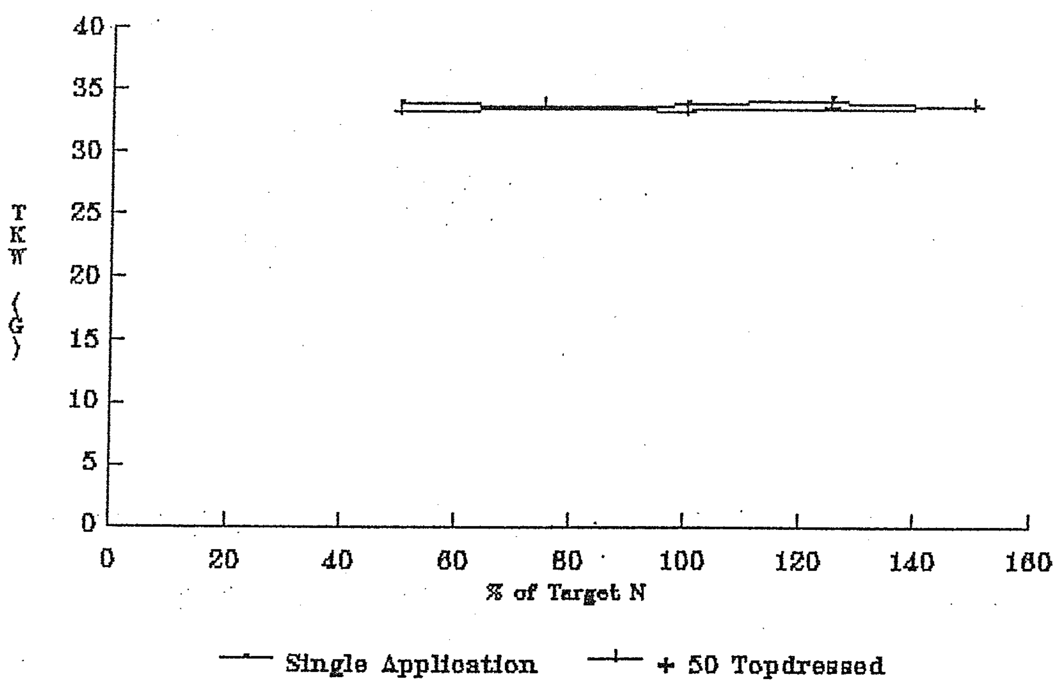
High & Medium Moisture Minto 1990

Fig. A13 Response of Kernels in Katepwa To Single & Split N Application



High & Medium Moisture Minto 1990

Fig. A14 Response of TKW in Katepwa to Single & Split N Application



High & Medium Moisture Minto 1990

C071 IP NP 1990 SUMMARY - HY320

Summary results are presented in Table A15. The extra N applied a topdressed (split) application at G.S.31 increased the yield over all the initial N treatments by an average of 367 kg/ha from 3127 to 3494 kg/ha. Protein level was also generally increased by 0.18% from 9.25 to 9.43%.

When treatments with the same total N are compared (N=50/50 vs 100/0; N=75/50 vs 125/0; N=100/50 vs 150/0) split N consistently produced higher yields compared to yields from single N applications for each level of total N. The differences were only significant at the lower total N levels (N=50/50 vs 100/0; and N=75/50 vs 125/0). Protein levels were not significantly more with split N applications for each level of total N compared to protein from the single N application.

Split N application seemed to produce more heads/m2 at lower N levels. However at higher N levels, there were no marked differences between number of heads/m2 from split application compared to single application (Figure A15). At lower N levels, spikelets/head from split and single N applications were equal. Whereas, at the higher N levels, spikelets/head were greater from single N application compared to split N application but the differences were marginal (Figure A16). Similarly kernels/head were slightly greater with single N application at higher N levels (Figure A 17). Thousand kernel weight was consistently greater with single N application compared to single N application (Figure A18).

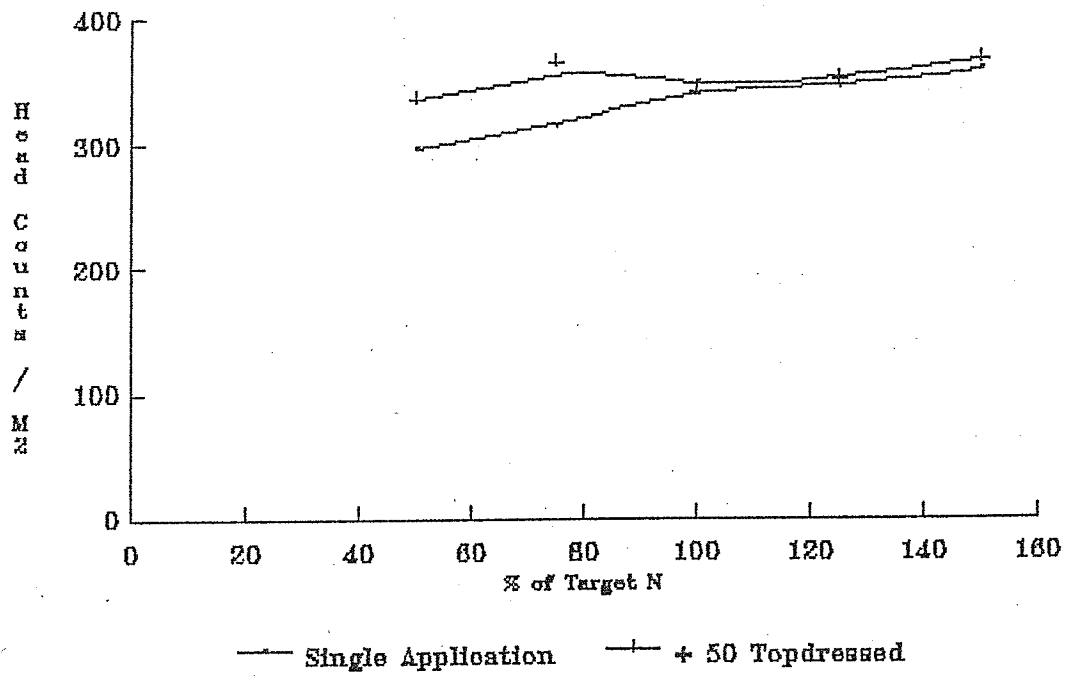
Maturity semed to be delayed with split N application.

TABLE A15. SUMMARY OF THE EFFECT OF TOPDRESSED N ON HY320 AT VARIOUS N LEVELS UNDER MEDIUM & HIGH MOISTURE CONDITIONS, MINTO 1990
2 STATION YEARS

TRMT	YIELD KG/HA	PROTEIN %	PLANT COUNTS/M2	HEAD COUNTS/M2	MATURITY RATING0-9	KERNELS /100HEAD	SPIKELETS /HEAD	TKW G
1 50/0	3671d*	10.7a	212	296	5.7	3222	14.0	45.2
2 50/50	4149ab	11.2a	211	336	4.9	3336	14.2	42.5
3 75/0	3799d	10.7a	220	313	5.2	3298	14.0	44.8
4 75/50	4020bc	11.3a	220	365	5.0	3219	13.7	43.4
5 100/0	3713d	12.3a	217	346	5.4	3163	14.2	44.5
6 100/50	4135ab	11.2a	232	341	4.7	3333	14.1	42.8
7 125/0	3698d	10.9a	201	342	5.4	3328	14.7	44.5
8 125/50	4156ab	11.5a	219	348	5.1	3346	14.8	42.4
9 150/0	3881bcd	10.9a	226	355	4.9	3489	14.6	43.8
10 150/50	4503a	11.4a	208	363	4.7	3482	15.0	41.4
11 Check/0	3755cd	10.8a	234	322	5.5	3142	14.1	44.2
12 Check/50	4133d	11.1a	218	357	4.7	3333	14.5	42.6

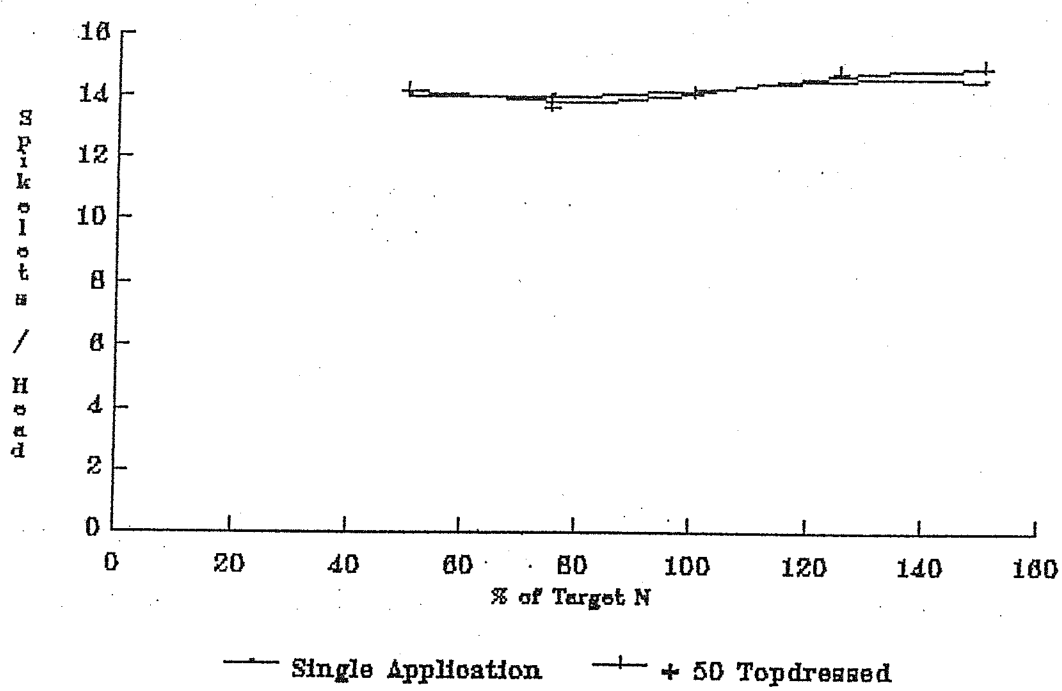
*Means followed by the same letter do not significantly differ (Duncan's MRT, P=.05)

Fig. A15 Response of Head Counts in HY 320 to Single & Split N Application



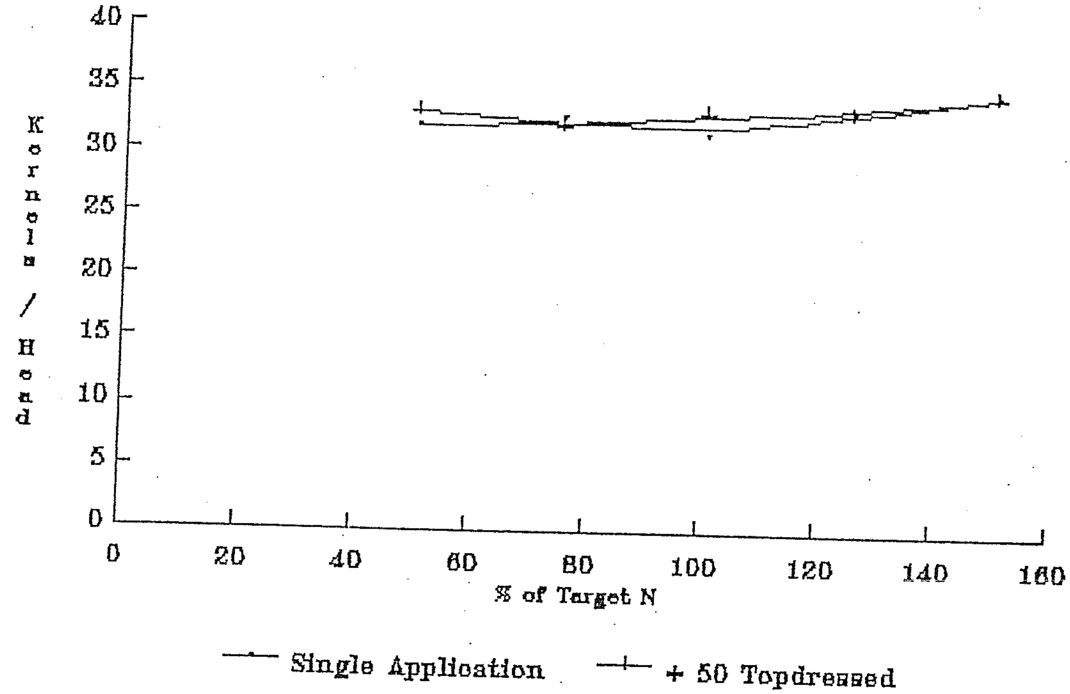
High & Medium Moisture Minto 1990

Fig. A16 Response of Spikelets in Katepwa to Single & Split N Application



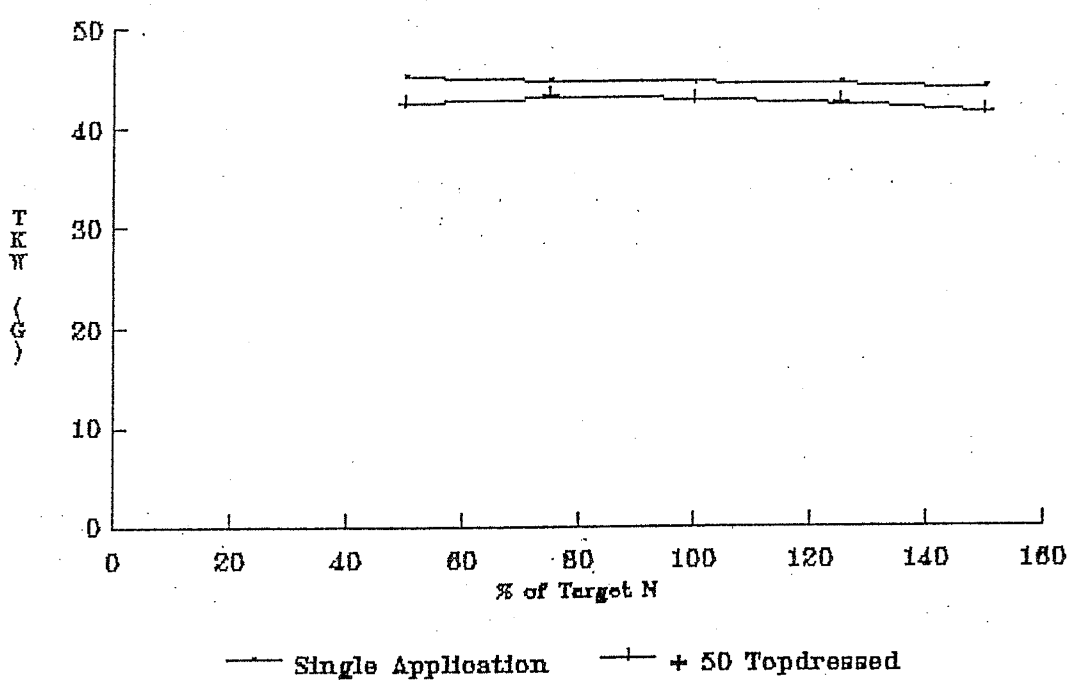
High & Medium Moisture Minto 1990

Fig. A17 Response of Kernels in HY 320
To Single & Split N Application



High & Medium Moisture Minto 1990

Fig. A18 Response of TKW in HY 320
To Single & Split N Application



High & Medium Moisture Minto 1990

C071, C971 & C871 IH, NH   3 YEAR SUMMARY - KATEPWA

Data was combined from two experiments (high and medium moisture) over a period of three years (1988-1990). As indicated in Table A16, extra nitrogen applied as a split application at G.S.31 resulted in higher yields (3068 kg/ha) than when N was applied as a single application prior to seeding (2676 kg/ha), an average increase of 392 kg/ha. Similarly, protein levels also increased from 12.5% to 13.9%, an increase of 1.4%, when extra N was applied as a split application compared to N applied as a single application.

When treatments with the same total N are compared (N=50/50 vs 100/0; N=75/50 vs 125/0; N=100/50 vs 150/0) yields tended to be more from split N application compared to yield from single N application. The difference was significant at the lower N level. Similarly, protein levels seemed to be higher with split N application compared to protein from single N application. At the lower N rate, maturity seemed to be delayed with single N application. Meanwhile at higher N rates, plots that received split N application matured slightly later or just about the same time compared to plots that received single N application.

TABLE A16. THREE YEAR SUMMARY OF THE EFFECT OF TOPDRESSED N ON KATEPWA AT VARIOUS N LEVELS UNDER MEDIUM AND HIGH MOISTURE CONDITIONS, MINTO 1988 - 1990, 6 STATION YEARS

TREATMENT	YIELD (KG/HA)	% PROTEIN	MATURITY RATING (0-9.0)
1. 50/0	2383d*	12.0	6.6
2. 50/50	3043ab	13.7	6.8
3. 75/0	2745c	12.7	6.8
4. 75/50	3044ab	13.9	6.5
5. 100/0	2737c	12.8	6.5
6. 100/50	3076ab	14.1	6.7
7. 125/0	2904bc	12.9	6.7
8. 125/50	3126ab	14.4	6.4
9 150/0	2889bc	13.3	6.7
10. 150/50	3205a	14.7	6.5
11. Check/0	2398d	11.3	6.9
12. Check/50	2917bc	12.7	6.7

*Means followed by the same letter do not significantly differ (Duncan's MRT, P = .05).

C071, C971 & C871 IP, NP 3 YEAR SUMMARY - HY320

The summary data from two experiments (high and medium moisture) during three years (1988-1990) is indicated in Table A17. Applying extra N as a split application at G.S.31 resulted in higher yields (3426 kg/ha) than when N was applied as a single application prior to seeding (3076 kg/ha), an average increased of 350 kg/ha. Protein levels also increased from 12.03% to 12.53%, an increase of 0.5% when extra N was applied as a split application, compared to N applied as a single application.

When treatments with the same total N are compared (N=50/50 vs 100/0; N=75/50 vs 125/0; N=100/50 vs 150/0) yields while not significantly different seemed to be more from split N application compared to yield from single N application. Protein levels tended to be higher from split N application at the higher N levels compared to single N application. However, at the lower N levels (N=50/50 vs 100/0) single N application resulted in more protein compared to protein from split N application.

Maturity appeared to be consistently delayed with split N application at all levels of same total N.

TABLE A17. THREE YEAR SUMMARY OF THE EFFECT OF TOPDRESSED N ON HY320 AT VARIOUS N LEVELS UNDER MEDIUM AND HIGH MOISTURE CONDITIONS, MINTO 1988-90, 6 STATION YEARS

TREATMENT	YIELD (KG/HA)	% PROTEIN	MATURITY RATING (0-9)
1. 50/0	2892e*	11.3	7.2
2. 50/50	3215cd	12.4	6.8
3. 75/0	3072de	11.8	7.0
4. 75/50	3373abc	12.6	6.7
5. 100/0	3062de	13.0	6.9
6. 100/50	3440abc	12.7	6.5
7. 125/0	3189cd	12.4	6.9
8. 125/50	3558b	13.0	6.5
9. 150/0	3357bcd	12.4	6.6
10. 150/50	3654a	12.9	6.3.
11. Check/0	2885e	11.3	7.0
12. Check/50	3317bcd	11.6	6.3

*Means followed by the same letter do not significantly differ (Duncan's MRT, P = .05)

THREE YEAR OVERALL SUMMARY

Over the three years, eight experiments were conducted to determine the effects of topdressing N on Katepwa and HY320 grown at various N levels under different moisture regimes. The data indicates that the extra N applied as a topdressing (split) at G.S.31 resulted in higher yields (3247 kg/ha) than when the base N level was applied as a single application prior to seeding (2876 kg/ha) by an average of 371 kg/ha in both Katepwa and HY320 trials.

When treatments of the same total N are compared, the yields were not significantly different whether N was applied as a split (3198 kg/ha) or a single application (3023 kg/ha)(Table A18).

TABLE A18. COMPARISON OF YIELD ON SPLIT N VS SINGLE N TREATMENTS

TREATMENTS (SAME TOTAL N)	% OF TARGET	SPLIT N APPLICATION YIELD (KG/HA)	SINGLE N APPLICATION YIELD (KG/HA)
2 vs 5	50/50 VS 100/0	3129	2899
4 vs 7	75/50 VS 125/0	3208	3046
6 vs 9	100/50 VS 150/0	3258	3123
$\overline{X}$		3198	3023

GENERAL SUMMARY AND CONCLUSIONS

During the three years (1988,1989 and 1990) nine, six and eight trials respectively were conducted to determine the effect of topdressed nitrogen on Katepwa and HY30 grown at various N levels, under low, medium and high moisture conditions. Eighteen trials were located at Minto, three at Fairfax and two at Wawanesa.

Many split applications at G.S.31 produced more yield compared to that produced when N was applied at seeding. When treatments of the same total N are compared (N=50/50 vs 100/0; N=75/50 vs 125/0; N-100/50 vs 150/0), split N applications produced higher yields than those obtained with single N applications in forty-one out of sixty-seven comparisons.

Split N applications from Katepwa trials consistently tended to result in more yield in 1990 and 1988 under high moisture conditions than single N applications but lowerin 1989. Meanwhile, under high moisture conditions, split N seemed to result in more yield from HY320 trials in 1990 than from single N applications with inconsistent yield responses in teh other two years. Under medium moisture conditions, split N application from Katepwa trials resulted in higher yields for all three years compared to single N applications, whereas yield responses were higher from HY320 trials in 1990 with split N compared to single N applications. In both 1988 and 1989 split N applications resulted in higher yields only at the low N rate (N=50/50 vs 100/0) compared to single N application. This showed that HY320 was only responsive to split N at the lower N rates in dry years such as 1988 and 1989. But when favourable moisture is available as was the case in 1990, split N application can result in good yield responses. HY320 has been shown to be responsive to N application when favourable growing conditions exist (Irvine et al, 1985, Clarke et al, 1990). Generally split N applications did not seem to have a yield advantage over the single N applications in the low moisture trials with both cultivars; differences if any were insignificantly.

Protein levels were generally higher with split N under the three moisture regimes for the three years. On the agerave, HY320 yielded more but with less protein than Katepwa. This data confirms the numerous reports in the literature (Gravelle et al, 1988, String, 1986) that split N applications can result in increased yield and protein.

The three year data has shown that split N application can result in some good yields and protein when growing conditions are favourable. This then poses the questions that:

a) In applying split N at G.S.31, will it be economically worthwhile to do so? and

b) What are the chances of getting favourable yields?

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SECTION A2

LIST OF TABLES

SECTION A2

C071 B, F, G, R

OBJECTIVE: Effect of Topdressed N on Katepwa at various locations in Manitoba.

C071 B

METHODS AND MATERIALS

The trial was established on the Ralph Lowe's farm near Brandon, Manitoba. Katepwa wheat was seeded on May 15, 1990 at a rate of 300 seeds/m2 (96 kg/ha). The soil was a Waskada loam. The seed was treated with Vitavax Dual and seeded in 15 cm rows at a depth of 4 cm.

Nine kg/ha of N and 40 kg/ha of P205 were placed with the seed. Initial applications of N were banded between every second row as 46-0-0 at the appropriate rates (Table 1). The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5 m. Tilt was applied on July 10, at a rate of .125 kg/ha to control tanspot and leaf rust. Additional N was applied on June 21 at GS 31 using 34-0-0 as the N source. The rates of N are shown in Table 1. Plant counts were taken on June 7. Tiller and Spikelet counts were taken on June 21. Heads/m2 were recorded on Aug.1. Plant, tiller and head counts were taken by sampling 6 - 1/2 m rows. A square meter of the centre rows was hand harvested from each plot on August 20. Yields were adjusted to a 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

TABLE 1. C071 B TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS 00/GS 31	FERTILIZER N APPLIED (KG/HA) AT SEEDING KG/HA	N AT G.S. 31
3	100/0	34	--
4	100/50	34	40
5	150/0	74	--

TARGET YIELD CALCULATION
Target Yield = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 bu/acre/inch for Hard Red Spring
PAW = Total water (inches) - 5 inches of water necessary for vegetative growth
Total Water = Soil water at seeding (inches) + [Expected precipitation (inches - May 1-July 31)]
Katepwa Target Yield=4 bu/acre/inch x [(6.6 inches + 7.4 inches)-5]
= 36 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 36 bu/acre x 2 lb N/bushel*
=72 lb N/acre or 72 lb N/acre x 1.12
= 80.64 kg/ha
Soil N = 46.93 kg/ha
Target N applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield

C071B RESULTS AND DISCUSSION

As shown in Table 2, only 3 treatments were analyzed. When treatments with the same total N are compared, the yield while not significantly different tended to be higher with split N application compared with single N application. Protein level was also higher with split N application compared with single N application.

Split N application tended to result in more heads/m2, kernels/head and TKW and less spikelets/head compared with single N application.

TABLE 2 C071 B EFFECT OF TOPDRESSED N ON KATEPWA, BRANDON, 1990

TRMT #	N APPLICATION % OF TARGET GS 00/GS 31	YIELD KG/HA AUG20	PLANT COUNT/M2 JUNE7	HEAD COUNT/M2 AUG 1	SPIKELETS /HEAD JUNE21	KERNELS /100 HEAD AUG20	TKW	PROTEIN %
3	100/0	3189a*	204a	570a	12.13a	2569a	36.08a	13.88a
4	100/50	3092a	225a	539a	12.05a	2526a	36.75a	13.32ab
5	150/0	2938a	225a	495a	12.23a	2405a	36.72a	12.60b
C.V.		12.69	13.07	10.29	6.81	7.20	3.04	5.33

*Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

METHODS AND MATERIALS

The trial was established on the John Omelchuk farm near Fairfax, Manitoba. Katepwa wheat was seeded on May 23, 1990 at a rate of 300 seeds/m2 (96 kg/ha). The soil was a clay loam. The seed was treated with Vitavax Dual and seeded in 15 cm rows at a depth of 4 cm.

Nine kg/ha of N and 40 kg/ha of P205 were placed with the seed. Initial applications of N were banded between every second row as 46-0-0 at the appropriate rates (Table 3). The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5 m. Hoegrass was used to control grassy weeds and Estaprop to control broadleaf weeds. Tilt was applied on July 10, at a rate of .125 kg/ha to control tanspot and leaf rust. Additional N was applied on June 27 at GS 31 using 34-0-0 as the N source. The rates of N are shown in Table 3. Sevin was applied on July 30 at a rate of 1.5-2 l/ha to control grasshoppers. Plant counts were taken on June 7. Tiller and spikelet counts were taken on June 27. Heads/m2 were recorded on August 1. Plant, tiller and head counts were taken by sampling 6 - 1/2 m rows.

Plots were trimmed to a 5 m length and a 1.25 m strip was harvested from the centre of each plot using a Wintersteiger plot combine on September 3. Yields were adjusted to 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

TABLE 3. C071 F TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N GS 00/GS 31	FERTILIZER N APPLIED (KG/HA) N AT SEEDING	N AT GS 31
1	50/0	--	--
2	50/50	--	33
3	100/0	29	--
4	100/50	29	33
5	150/0	62	--

TARGET YIELD CALCULATION
Target Yield = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 bu/acre/inch for Hard Red Spring
PAW = Total water (inches) - 5 inches of water necessary for vegetative growth
Total Water = Soil water at seeding (inches) + [Expected precipitation (inches - May 1-July 31)]
Katepwa Target Yield=4 bu/acre/inch x [(4.4 inches + 8 inches)-5]
= 29.6 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 29.6 bu/acre x 2 lb N/bushel*
= 59.2 lb N/acre or 59.2 lb N/acre x 1.12
= 66.3 kg/ha
Soil N = 37.40 kg/ha
Target N applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield

C071 F RESULTS AND DISCUSSION

The results can be found in Table 4. When treatments with the same N are compared the yield while not significantly different tended to increase with split N applications. Protein level also appeared to increase with split N application, however the differences were not significant. Treatments receiving a high initial N = 150 had significantly higher yield and protein compared to treatments receiving low initial N.

Evaluation of yield components indicates that plots receiving a high initial N rate tended to have more spikelets/head, kernels/head and TKW. At the low N level (50/50 vs 100/0) split application of N tended to result in less spikelets/head, kernels/head and TKW. Heads/m2 were significantly higher with split N application (N=50/50) compared to single N application (N=100).

TABLE 4. C071 F EFFECT OF TIMING ON TOPDRESSING N ON KATEPWA, FAIRFAX, 1990

TREATMENT	YIELD KG/HA SEPT3	PLANTS /M2 JUNE 7	HEADS /M2 AUG 1	SPIKELETS /HEAD JUNE 27	KERNELS /100 HEAD AUG 28	TKW G	PROTEIN %
1. 50/0	1796c*	264a	313b	11.2c	1654a	28.3c	10.8c
2. 50/50	2361b	262a	409a	11.8bc	1694a	29.9bc	11.6ab
3. 100/0	2336b	281a	313b	12.1ab	1804a	30.8ab	11.0bc
4. 100/50	2963a	279a	452a	12.7a	1910a	30.6b	12.1a
5. 150/0	2882a	209b	459a	12.7a	1876a	32.3a	11.5ab
C.V.	11.45	6.70	12.8	3.83	8.65	3.31	3.60

*Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

C071 G

METHODS AND MATERIALS

The trial was established on the Jim Nielson farm near Goodlands, Manitoba. Katepwa wheat was seeded on May 18, 1990 at a rate of 300 seeds/m2 (96 kg/ha). The soil was a Waskada clay loam. The seed was treated with Vitavax Dual and seeded in 15 cm rows at a depth of 4 cm.

Nine kg/ha of N and 40 kg/ha of P205 were placed with the seed. Initial applications of N were banded between every second row as 46-0-0 at the appropriate rates (Table 5). The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5 m. Tilt was applied on July 10 at a rate of .125 kg/ha to control tanspot and leaf rust. Additional N was applied on June 21 at GS 31 using 34-0-0 as the N source. The rates of N are shown in Table 5. Plants counts were taken on June 7. Tiller and spikelet counts were taken on June 21. Heads/m2 were recorded on August 1. Plant, tiller and head counts were taken by sampling 6 - 1/2 m rows. A square metre was hand harvested from each plot. Yields were adjusted to 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

TABLE 5 C071 G TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N	FERTILIZER N AT SEEDING	N APPLIED (KG/HA) N AT GS 31
1	50/0	4	--
2	50/50	4	22
3	100/0	26	--
4	100/50	26	22
5	150/0	48	--

TARGET YIELD CALCULATION
Target Yield = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 bu/acre/inch for Hard Red Spring
PAW = Total water (inches) - 5 inches of water necessary for
vegetative growth
Total Water = Soil water at seeding (inches) +
[Expected precipitation (inches - May 1-July 31)]
Katepwa Target Yield=4 bu/acre/inch x [(3.6 inches + 6.3 inches)-5]
= 19.6 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 19.6 bu/acre x 2 lb N/bushel*
= 39.2 lb N/acre or 39.2 lb N/acre x 1.12
= 43.9 kg/ha
Soil N = 17.92 kg/ha
Target N applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield

C071 G RESULTS AND DISCUSSION

Topdressing (Split N = 50/50) application resulted in a significant yield increase (646 kg/ha) over the single application of N at the same N level (N=100). Meanwhile at the higher N level (150 kg/ha) the yield though not significant tended to be more with single N application. Protein levels though not significantly different, tended to be slightly more with split N compared to single N (Table 6). Treatments receiving a high initial N=150 had significantly higher yield compared to treatments receiving a low initial N=50. At total N=100, split application tended to have more heads/m2, spikelets/head and kernels/head. Whereas at N=150, split N appeared to have less heads/m2, spikelets/head and TKW. The differences were however not significant.

TABLE 6. C071 G EFFECT OF TIMING ON TOPDRESSING N ON KATEPWA, GOODLANDS,1990

TREATMENT	YIELD KG/HA AUG20	PLANTS /M2 JUNE 7	HEADS /M2 AUG 7	SPIKELETS /HEAD JUNE 21	KERNELS /100 HEAD AUG 20	TKW G	PROTEIN %
1. 50/0	1133b*	224b	324a	10.8c	1936b	30.8c	10.8a
2. 50/50	1912a	233ab	367a	11.5ab	2192a	31.6bc	11.0a
3. 100/0	1266b	235ab	311a	11.2bc	2025ab	31.6bc	10.7a
4. 100/50	1688a	259a	380a	11.5ab	2196a	33.7ab	10.4ab
5. 150/0	1747a	247ab	398a	11.7a	2187a	34.4a	9.8b
C.V.	14.42	7.23	21.93	2.83	6.16	5.01	3.95

*Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

C071 R

METHODS AND MATERIALS

The trial was established on the Cliff McKague farm near Rivers, Manitoba. Katepwa wheat was seeded on May 15, 1990 at a rate of 300 seeds/m2 (96 kg/ha). The soil was a Newdale clay loam. The seed was treated with Vitavax Dual and seeded in 15 cm rows at a depth of 4 cm.

Nine kg/ha of N and 40 kg/ha of P205 were placed with the seed. Initial applications of N were banded between every second row as 46-0-0 at the appropriate rates (Table 7). The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5 m. Tilt was applied on July 10 at a rate of .125 kg/ha to control tanspot and leaf rust. Additional N was applied on June 21 at GS 31 using 34-0-0 as the N source. The rates of N are shown in Table 7. Plants counts were taken on June 7. Tiller and spikelet counts were taken on June 21. Heads/m2 were recorded on August 1. Plant, tiller and head counts were taken by sampling 6 - 1/2 m rows. A square metre was hand harvested from each plot. Yields were adjusted to 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

TABLE 7 C071 R TREATMENT LIST

TREATMENT #	N APPLICATION % OF TARGET N	FERTILIZER N AT SEEDING	N APPLIED (KG/HA) N AT GS 31
1	50/0	20	---
2	50/50	20	41
3	100/0	61	---
4	100/50	61	41
5	150/0	102	---

TARGET YIELD CALCULATION
Target Yield = Water Use Efficiency(WUE) x Plant Available Water (PAW)
WUE = 4 bu/acre/inch for Hard Red Spring
PAW = Total water (inches) - 5 inches of water necessary for vegetative growth
Total Water = Soil water at seeding (inches) + [Expected precipitation (inches - May 1-July 31)]
Katepwa Target Yield=4 bu/acre/inch x [(6.6 inches + 7 inches)-5]
= 36.8 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 36.8 bu/acre x 2 lb N/bushel*
= 73.6 lb N/acre or 73.6 lb N/acre x 1.12
= 82.4 kg/ha
Soil N = 21.28 kg/ha
Target N applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield

C071 R RESULTS AND DISCUSSION

As indicated in Table 8, yields tended to be higher with single N application compared to split N applications. Treatments receiving a high initial N=150 had significantly higher yield and protein compared to treatments receiving low initial N=50. When treatments with the same total N are compared, yields while not significantly different tended to be more with single N compared to split N applications. Split N application tended to result in more protein levels compared with single N application, the differences being significant only at the lower N level.

Yield components (heads/m2, spikelets/head and kernels/head) tended to be more with single N application compared to split N application. TKW appeared to be more with split N application compared with single N application. The difference in TKW was significant at the lower N level (N=100).

TABLE 8. C071 R EFFECT OF TIMING ON TOPDRESSING N ON KATEPWA, RIVERS, 1990

TREATMENT	YIELD KG/HA AUG 20	PLANTS /M2 JUNE 7	HEADS /M2 AUG 1	SPIKELETS /HEAD JUNE 21	KERNELS /100 HEAD AUG 20	TKW G	PROTEIN %
1. 50/0	2526b*	238a	466b	12.1a	2182a	36.1ab	11.0b
2. 50/50	2394b	223a	477b	12.0a	2099a	37.3a	13.5a
3. 100/0	2782ab	245a	542ab	12.1a	2447a	34.7b	11.2b
4. 100/50	2882ab	240a	509ab	12.1a	2132a	36.6a	14.0a
5. 150/0	3214a	242a	583a	12.3a	2147a	36.3a	13.6a
C.V.	11.74	10.13	12.27	2.19	12.63	2.63	10.94

*Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

TWO LOCATION SUMMARY OF KATEPWA TRIALS

Data for use in yield tracking where yield was estimated at G.S.31 was obtained from certain treatments in C0971 B, F, G, R as shown in the table below (Table 9). The information was used together with cooperator data (Section E, this report).

TABLE 9. TILLER & SPIKELET COUNTS ON ALL
C071 B, F, G, R TRIALS, 1990

EXPERIMENT	TREATMENT	PLANT COUNTS /M2	TILLER COUNTS /M2	SPIKELET COUNTS /TILLER
C071B	3	204	629	12.5
	5	225	565	12.2
C071F	1	264	438	11.2
	3	281	543	12.1
	5	209	656	12.7
C071G	1	224	401	10.8
	3	235	478	11.2
	5	247	566	11.7
C071R	1	238	747	12.1
	3	245	746	12.1
	5	242	731	12.3

Table 10 contains a summary of data from Fairfax and Goodlands. Results from Rivers were not included in the summary because the response to split N was different from that observed in the other two locations as reported earlier. The Rivers site was very comparable to the Brandon site but not the other sites in terms of initial soil moisture and expected precipitation. Initial N was however relatively lower for the Rivers site. It is possible that under low initial soil N and high initial soil moisture, the treatment with high single N application (N=150) responded well by producing many tillers (Table 9) and fertile heads which in turn contributed to the significantly high yields. This observation indicates that when soil initial moisture is favourable and soil N is low, and growing conditions continue to be favourable as was the case in Rivers, a good yield response can be expected to single N application particularly at heavy N rates. However the split N applications would increase protein content.

As indicated in Table 10 yields increased with increasing N rates. When treatments with the same total N are compared, yields tended to be more with split N application. A significant difference in yield was observed for the N=50/50 vs N=100/0 treatments. Split N application was effective in increasing protein levels significantly at both levels of equal amounts of total N (N=50/50 vs N=100/0; N=100/50 vs N=150/0). The number of heads/m2 also seemed to b higher with split N application but only significant at the lower N level. Although spikelets/head tended to increase significantly with increasing levels of N, differences were not significant when treatments with the same total N are compared. Similarly TKW seemed to increase with increasing N but differences were not significant when treatments with the same total N are compared.

It is to be noted that except for seeding, topdressing N, the application of Tilt, data collection and yields, the plots at Rivers, Goodlands and Brandon were managed in accordance with the farmer's normal practices, in particular weed control.

TABLE 10. TWO LOCATION SUMMARY OF KATEPWA TRIALS - FAIRFAX AND GOODLANDS

TRMT #	N APPLICATION GS00/GS31	YIELD KG/HA	PLANTS /M2	HEADS /M2	SPIKELETS /HEAD	KERNELS /100 HEADS	TKW G	PROTEIN %
1	50/0	1463c*	244bc	318b	11.0c	1795b	29.7d	10.8b
2	50/50	2136a	247b	387a	11.6b	1943a	30.7bc	11.3a
3	100/0	1801b	258ab	312b	11.6b	1914ab	31.2cd	10.9b
4	100/50	2325a	268a	416a	12.1a	2053a	32.2ab	11.2a
5	150/0	2314a	228c	429a	12.2a	2032a	33.3a	10.7b
LSD		215	16	54	.30	156	.95	.69

*Means followed by same letter do not significantly differ (Duncan's MRT, P=.05)

The average yields for the trials as well as those from the cooperators fields within which the trials were conducted as as shown in Table 11.

TABLE 11. AVERAGE YIELDS FROM C071 TRIALS AND COOPERATOR FIELDS

LOCATIONS	AVERAGE YIELDS (KG/HA) C071 TRIALS (COOPERATOR FIELDS)
BRANDON	3073 (3161)
FAIRFAX	2468 (-)
GOODLANDS	1549 (2354)
RIVERS	2760 (3026)

The yields were generally higher at Brandon and Rivers sites than from the other sites, with Fairfax producing moderate yield and Goodlands the lowest. The generally low yield at Goodlands indicates that moisture was limiting yield. This is expected as Goodlands is situated at the driest corner of Manitoba.

The Cooperator yield from Brandon site compared fairly well with that form the trial at that site, a difference of 88 kg/ha in favour of cooperator data. At this site, Katepwa was seeded in both cases. Meanwhile, at Rivers though the cooperators field had 266 kg/ha more yield, Roblin was the seeded cultivar. The Goodlands site had the largest yield difference in favour of the cooperators data where Columbus was the cultivar seeded. Unless Columbus and Roblin have similar responses to N and moisture as those exhibited by Katepwa, the above comparisons may not mean much but the results are nonetheless presented for record purposes.

SECTION B TIMING FOR N TOPDRESSING

LIST OF TABLES

SECTION B TIMING FOR N TOPDRESSING

C075 H, P

OBJECTIVE: To determine the effect of timing on topdressing nitrogen on Katepwa and HY320.

METHODS AND MATERIALS

Katepwa wheat was seeded near Minto, Manitoba on May 11, 1990 at a rate of 300 seeds/m2 (96 kg/ha for Katepwa and 111 kg/ha for HY320) with 15 cm row spacing at a depth of 4 cm. The soil was a Ryerson clay loam (27% sand, 48% silt, 25% clay with a clay subsoil). Organic matter was 4.7%; pH was 7.5. Rainfall and temperature data can be found in Appendix A. The growing season can be described as having a wet spring, normal June and a hot dry July and August.

30 kg/ha of P205 was applied with the seed. 34-0-0 was broadcast at rates of 40 and 80 kg/ha at G.S. 0, 12-13, 14-21, 31, 37 and 49 according to experimental design. The experimental design was a split plot with 4 replicates and a plot size of 2 x 7.5 m. Broadleaf weeds were controlled with Estaprop at .400 kg/ha on June 12. Tilt was applied at .125 kg/ha on July 9 to control foliar diseases. Head counts were done on July 18 using 6 - 1/2 m rows/plot. Plots were harvested on September 3. Plots were trimmed to a 5 m length and a 1.25 m strip was harvested from the centre of each plot using a Wintersteiger plot combine. Yields were adjusted to the 14.5% moisture level. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

C075 H RESULTS AND DISCUSSION

Table B1 and B2 contain the results of this trial. The different timings of application of 34-0-0 broadcast showed some significant differences in the number of heads/m2. The highest number of heads/m2 (480) was obtained from application of N at G.S. 14-21 (4leaf/tiller) over all rates of N application. There was a general decrease in heads/m2 as timing was delayed from G.S.31 through to G.S.49.

There was also no significant difference (over all application timings) in the number of heads between the 40 kg/ha (435 heads/m2) and the 80 kg/ha (433 heads/m2).

The timing of application of 34-0-0 also affected yield. Yield tended to increase as timing was delayed up to G.S.41-21 (4 leaf/tiller). As the growth stage advanced, the yield appeared to decrease. Highest yield was achieved when N was applied at G.S. 14-21 (4 leaf/tiller). Over all timings of N application, the 40 and 80 kg/ha N resulted in yields of 2651 and 2951 kg/ha respectively. Thus, the use of higher rate of N increased yield by 300 kg/ha. Kernel weight was not significantly affected by the rate of N application over all timing applications. Kernel weight was greatest with N applied at G.S.31. Protein levels tended to increase as timing was delayed. The highest protein level (15.08%) was attained when N was applied at G.S.49. Over all timing applications, protein level was higher (14.46%) with the higher rate of N (80 kg/ha) over the lower rate of N (40 kg/ha) at 12.97%.

An examination of the Timing X Rate interaction revealed that timing 4 leaf/tiller (G.S.14-21) and N application at a rate of 80 kg/ha resulted in the highest yield (3284 kg/ha). Protein level was highest (15.61%) when N was applied at G.S.49 at a rate of 80 kg/ha.

TABLE B1 C075 H MAIN EFFECTS OF NITROGEN TIMING TRIAL, KATEPWA, MINTO 1990

TREATMENT	HEAD COUNTS/M2 JULY 18	YIELD (KG/HA) SEPT 3	TKW (G)	PROTEIN (%)
TABLE OF A MEANS				
Timing 0	412ab*	2854ab	35.0a	12.57e
Timing 2-3 leaf	481a	2896ab	34.8a	13.10de
Timing 4 leaf/tiller	480a	3057a	34.9a	13.38cd
Timing G.S.31	441ab	2760ab	35.2a	13.86bc
Timing G.S.37	405ab	2610b	35.1a	14.33b
Timing G.S.49	386b	2628b	35.4a	15.08a
L.S.D. .05	145.9	170.5	.84	.73
TABLE OF B MEANS				
40 kg/ha	435	2651	35.2	12.97
80 kg/ha	433	2951	34.9	14.46

TARGET YIELD CALCULATION
Target Yield = Water Use Efficiency (WUE) x Plant Available Water (PAW)
WUE = 4 and 5 bu/acre/inch for Hard Red Spring Wheat and Canada Prairie Spring respectively
PAW = Total water (inches) - 5 inces of water necessary for vegetative growth
Total Water = Soil water at seeding (inches) +
[Expected Precipitation (inches - May 1-July 31)]
Katepwa Target Yield = 4 bu/acre/inch x [(5.1 inches + 8 inches)-5]
= 32 bu/acre
HY320 Target Yield = 5 bu/acre/inch x [(5.1 inches + 8 inches)-5]
= 40 bu/acre
Katepwa N requirements based on Target Yield
Target N = Target Yield x N requirement/bushel
= 32 bu/acre x 2 lb N/bushel*
= 64 lb N/acre or 64 lb N/acre x 1.12
= 72 kg/ha
Soil N = 37 kg/ha
Target N applied = Total N required - Soil N
*Katepwa total N requirements are assumed to be 2 lb/bushel of yield
*HY320 is assumed to have the same N requirements as Katepwa, however it will yield 30% more yield with approximately 30% less protein.

NOTE: The yields obtained were generally much higher than would have been target yields for both Katepwa and HY320.

TABLE B2 C075 H NITROGEN TIMING STUDY, KATEPWA, MINTO 1990

TREATMENT	HEAD COUNTS/M2	YIELD(KG/HA)	TKW(G)	PROTEIN(%)
1. Timing O, 40 kg/ha	420ab*	2672bc	35.7a	11.64g
2. Timing O, 80 kg/ha	404ab	3036ab	34.2a	13.51cde
3. Timing 2-3 leaf, 40 kg/ha	488ab	2822abc	35.3a	11.93fg
4. Timing 2-3 leaf, 80 kg/ha	474ab	2970ab	34.2a	14.27bc
5. Timing 4 leaf/tiller 40 kg/ha	461ab	2830ab	34.9a	12.65ef
6. Timing 4 leaf/tiller 80 kg/ha	499a	3284a	34.8a	14.10bcd
7. Timing G.S.31, 40 kg/ha	411ab	2635bc	34.9a	13.09de
8. Timing G.S.31, 80 kg/ha	471ab	2886abc	35.4a	14.63ab
9. Timing G.S.37, 40 kg/ha	435ab	2394c	35.4a	13.99bcd
10. Timing G.S.37, 80 kg/ha	375b	2826abc	34.7a	14.66b
11. Timing G.S.49, 40 kg/ha	398ab	2552bc	35.0a	14.55bc
12. Timing G.S.49, 80 kg/ha	374b	2704bc	35.8a	15.61a
L.S.D. .05	95	473	1.5	.95
C.V.	15.3	11.4	2.85	4.66

*Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

C075 P RESULTS AND DISCUSSION

The results of this trial can be found in Tables B3 and B4. The different timings of application of 34-0-0 broadcast did not have any significant effect on the number of heads although timing 2-3 leaf stage had the highest number of heads/m2 (353) over all rates of N application. There was a general decrease in head numbers as timing was delayed.

Over all application timings, the number of heads/m2 was greater with the higher N rate (80 kg/ha) compared to the lower N rate (40 kg/ha).

Yield was affected by the timing of application of 34-0-0. Over all rates of N application, yield tended to decrease as timing was delayed through to G.S.37. Highest yield was achieved when N was applied at G.S.0. Over all timings of N application, the 40 and 80 kg/ha N resulted in yields of 3947 and 4389 kg/ha respectively. Thus the use of higher rate of N increased yield by 442 kg/ha. Kernel weight was significantly greater when N was applied at G.S.49. Protein level increased as timing was delayed. The highest protein level 12.46% was observed when N was applied at G.S.49 at a rate pf 80 kg/ha. Over all timing applications, protein level was higher (12.29%) with the higher rate of N (80 kg/ha) over the lower rate of N (40 kg/ha) at 11.50%. The Timing X Rate interaction showed that the highest yield (4769 kg/ha) was obtained when N was applied at G.S.0 at a rate of 80 kg/ha. Meanwhile the highest protein 12.78% was observed when N was applied at G.S.49 at a rate of 80 kg/ha.

TABLE B3 C075 P MAIN EFFECTS OF NITROGEN TIMING TRIAL, HY320, MINTO 1990

TREATMENT	HEAD COUNTS/M2 JULY 18	YIELD (KG/HA) SEPT 3	TKW (G)	PROTEIN (%)
TABLE OF A MEANS				
Timing 0	334a*	4435a	41.1b	11.49bc
Timing 2-3 leaf	353a	4402a	41.7b	11.19c
Timing 4 leaf/tiller	342a	4273ab	41.9b	11.74b
Timing G.S.31	338a	3872b	40.7b	12.23a
Timing G.S.37	315a	3835b	41.1b	12.26a
Timing G.S.49	316a	4191ab	44.4a	12.46a
L.S.D. .05	39.8	490.1	1.5	0.49
TABLE OF B MEANS				
40 kg/ha	323	3947	43.1	11.50
80 kg/ha	343	4389	40.5	12.29

TABLE B4 C075 P NITROGEN TIMING STUDY, HY320, MINTO 1990

TREATMENT	HEAD COUNTS/M2	YIELD(KG/HA)	TKW(G)	PROTEIN(%)
1. Timing O, 40 kg/ha	323ab*	4100bcd	43.8ab	11.28def
2. Timing O, 80 kg/ha	345ab	4769a	38.5d	11.69cde
3. Timing 2-3 leaf, 40 kg/ha	339ab	4303abc	44.0ab	10.73f
4. Timing 2-3 leaf, 80 kg/ha	367a	4501ab	39.4cd	11.66cde
5. Timing 4 leaf/tiller 40 kg/ha	318ab	3973bcd	43.8ab	11.20ef
6. Timing 4 leaf/tiller 80 kg/ha	365ab	4573ab	40.0cd	12.27abc
7. Timing G.S.31, 40 kg/ha	339ab	3681cd	40.7bcd	11.84cd
8. Timing G.S.31, 80 kg/ha	336ab	4062bcd	40.7bcd	12.61ab
9. Timing G.S.37, 40 kg/ha	309b	3621d	42.4abc	11.80cde
10. Timing G.S.37, 80 kg/ha	321ab	4049bcd	39.8cd	12.72ab
11. Timing G.S.49, 40 kg/ha	311ab	4002bcd	44.2ab	12.14bc
12. Timing G.S.49, 80 kg/ha	321ab	4379ab	44.7a	12.78a
L.S.D. .05	49.6	561.1	3.1	0.55
C.V.	10.03	9.06	5.05	3.13

*Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

C975 H & C075 H - TWO YEAR SUMMARY 1989-90

Results of this trial can be found on Tables B5 and B6. The different timings of application of 34-0-0 broadcast did not show any significant differences in the number of heads although timing 4 leaf/tiller had the highest number of heads/m2 (586), over all rates of N application. There was a general decrease in head numbers as timing was delayed from G.S.31 through to Growth Stage 49 (507).

There was also no significant difference (over all application timings) in the number of heads between the 40 kg/ha (546 heads/m2) and the 80 kg/ha (553 heads/m2) rates of N applied though the heavier rate had slightly more heads.

Yield was affected by the timing of application of 34-0-0. Over all rates of N application, yield was greatest when N was applied at Growth Stage 14-21(4 leaf/tiller)(3011 kg/ha). As the growth stage of the wheat advanced, the yield tended to decrease through to Growth Stage 49 (2575 kg/ha). Applying 34-0-0 at timing 0 had ~ 277 kg/ha disadvantage over applying the N at Growth Stage 14-21 (4 leaf/tiller). Over all timings of N application, the rate of N used resulted in 2696 kg/ha at the 40 kg/ha of N and in 2844 kg/ha at the 80 kg/ha. The use of the higher rate of N increased yield by 148 kg/ha. Over all rates of N applied, the kernel weight did tend to increase as N was applied later in the growing season. Kernel weight was greatest with N application at GS 49. Over all timing applications, protein level was higher with the higher rate of N (80 kg/ha at 15.05% over the lower rate of N (40 kg/ha) of 13.95%. Over all rates of N applied, the percent protein was less when N was applied earlier in the growing season than Zadoks Growth Stage 31.

The Timing X Rate interaction showed that the highest yield (3127 kg/ha) resulted when N was applied at 4 leafs/tiller at a rate of 80 kg/ha, whereas protein was highest (15.10%) when N was applied at G.S.49 at a rate of 80 kg/ha.

TABLE B5 C075H MAIN EFFECTS OF NITROGEN TIMING TRIAL, KATEPWA, MINTO 1989-90

TREATMENT	HEAD COUNTS/M2	YIELD (KG/HA)	TKW (G)	PROTEIN (%)
TABLE OF A MEANS				
Timing 0	566ab*	2734bc	31.3b	14.22a
Timing 2-3 leaf	581a	2904ab	31.8b	14.31a
Timing 4 leaf/tiller	586a	3011a	32.0ab	14.59a
Timing G.S.31	539ab	2745bc	32.2ab	14.77a
Timing G.S.37	519ab	2650c	32.7a	14.39a
Timing G.S.49	507b	2575c	32.8a	14.71a
L.S.D. .05	22.9	206.5	0.86	0.49
TABLE OF B MEANS				
40 kg/ha	546	2696	32.2	13.95
80 kg/ha	553	2844	32.0	15.05

TABLE B6 C075H NITROGEN TIMING STUDY, KATEPWA, MINTO, 1989-90

TREATMENT	HEAD COUNTS/M2	YIELD(KG/HA)	TKW(G)	PROTEIN(%)
1. Timing O, 40 kg/ha	581abc*	2673bcd	31.9ab	13.40e
2. Timing O, 80 kg/ha	551abc	2794bcd	30.7c	15.04ab
3. Timing 2-3 leaf, 40 kg/ha	567abc	2837abcd	32.2ab	13.64de
4. Timing 2-3 leaf, 80 kg/ha	595a	2971ab	31.4bc	14.98ab
5. Timing 4 leaf/tiller 40 kg/ha	584ab	2895abc	32.0ab	14.10cd
6. Timing 4 leaf/tiller 80 kg/ha	587ab	3127a	32.1ab	15.09ab
7. Timing G.S.31, 40 kg/ha	515abc	2689bcd	32.0ab	14.14cd
8. Timing G.S.31, 80 kg/ha	563abc	2801bcd	32.4ab	15.41a
9. Timing G.S.37, 40 kg/ha	533abc	2543d	32.7a	14.09cd
10. Timing G.S.37, 80 kg/ha	505bc	2557bcd	32.8a	14.76bc
11. Timing G.S.49, 40 kg/ha	498c	2537d	32.7a	14.31c
12. Timing G.S.49, 80 kg/ha	517abc	2613cd	33.0a	15.10ab
L.S.D. .05	71.4	276.2	1.03	0.58
C.V.	12.81	9.83	3.18	3.96

*Means followed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test.

GENERAL SUMMARY

The data from the timing experiment showed that N applied at a higher rate (80 kg/ha) resulted in more yield from Katepwa by 11.3% and HY320 by 11.2% in 1990. Protein was also higher at the higher N rate for both cultivars. This observation is similar to the general response reported in the target nitrogen trials (Section A this report) that yield and protein levels tend to increase with increasing levels of N.

The Timing x Rate interaction revealed that timing 4 leaf/tiller (G.S.14-21) and N application at a rate of 80 kg/ha resulted in the highest yield (3284 kg/ha). Maximum protein was however achieved when N was applied at a later stage (G.S.49) at high N rate in 1990. This observation was similar to that obtained in 1989 in a similar trial at the same location (Minto). Similarly from HY320, maximum protein was achieved when N was applied at G.S.49 at a rate of 80 kg/ha. Meanwhile, highest yield was achieved when N was applied at G.S.0 at a rate of 80 kg/ha. More data would be required for HY320 to confirm consistency in response if any.

Generally the results from these trials have shown that for maximum yield, sufficient N should be applied earlier (ranging from seeding to 4 leaf/tiller) and a later application would be required for increased protein. Spratt (1974) speculated that N applied early (at sowing) gave maximum leaf and stem growth while N applied prior to flowering would insure high protein levels.

REFERENCE

Spratt, E.D. 1974. Effect of Ammonium and Nitrate forms of Fertilizer N and their time of Application on Utilization of N by Wheat. Agron. J. 66:57-61.

SECTION C

LIST OF TABLES

SECTION C C072 H, N, L

OBJECTIVE: To test the reliability of early tissue testing, Katepwa.

Field plots were established at two locations near Minto. C072 N and L were on normal and low spots within a farmer's field. Meanwhile, C072H was on a normal plot in a separate field. The sites had been seeded with Katepwa wheat using an air seeder on May 24 (C072 N and L) and May 29 (C072 H). Forty-five kg/ha N and 40 kg/ha P205 had been applied at seeding.

The experimental design was a randomized complete block with 4 replicates and a plot size of 2 x 7.5 m. Additional N was applied at G.S.31 and 49 using 34-0-0 as the N source. The rates are as shown in Tables C1, C2 and C3. Prior to topdressing N, ten plants were sampled/plot for N-tissue analysis.

Plant and tiller counts were taken on June 29 (C072 N and L) and on June 27 (C072H). Spikelet counts were determined on June 28 (C072 N and L) and on June 27 (C072H). Plant, tiller and head counts were taken by sampling 6 - 1/2 m rows. A 1.25 m strip was harvested from the centre of each plot using a Wintersteiger plot combine. Yields were adjusted to 14.5% moisture. Data was analyzed at the 5% level using Duncan's Multiple Range Test.

TABLE C1 C072 H TREATMENT LIST

TREATMENT #	N APPLICATION	FERTILIZER N APPLIED (KG/HA) AT SEEDING	GS 31	GS 49
1	Target	45		
2	Target & Yield G.S.31	45	22.4	
3	Target & Yield G.S.49	45		22.4

Yields (bu/acre) were predicted at G.S.31 and 49 using the yield tracking formula.
Plants/m2 x tillers/plant x spikelets/tiller x .392/67.25
eg. 167 plants/m2 x 3.5 tillers/plant x 14.5 spikelets/tiller x .392/67.25
=50 bu/acre
Original target yield at seeding was 40 bu/acre
Extra yield expected 10 bu/acre
New target N at G.S.31
=Yield estimated at G.S.31 x N requirement/bu
=50 bu/acre x 2 lb N/bu*
=100 lb N/acre
Soil N at seeding = 40 lb/acre
Fertilizer N applied at seeding = 40 lb/acre
Total N at seeding = Soil N at seeding + Fertilizer N applied at seeding
= 40 lb/acre + 40 lb/acre
N required for the extra 10 bu/acre estimated at G.S.31;
= Extra bu/acre x N requirement/bu
10 bu/acre x 2 lb N* x bu = 20 lb/acre or
=New target N at G.S.31 - total N at seeding
100 lb N/acre - 80 lb N/acre = 20 lb/acre
*Katepwa total N requirements are assumed to be 2 lbs of N/bushel of yield

TABLE C2 C072 N TREATMENT LIST

TREATMENT #	N APPLICATION	FERTILIZER N APPLIED (KG/HA) AT SEEDING	GS 31	GS 49
1	Target	45		
2	Target & Yield G.S.31	45	6.7	
3	Target & Yield G.S.49	45		6.7

Yields (bu/acre) were predicted at G.S.31 and 49 using the yield tracking formula.
Plants/m2 x tillers/plant x spikelets/tiller x .392/67.25
eg. 161 plants/m2 x 3.1 tillers/plant x 13.6 spikelets/tiller x .392/67.25
=40 bu/acre
Original target yield at seeding as 37 bu/acre
Extra yield expected 3 bu/acre
New target N at G.S.31
=Yield estimated at G.S.31 x N requirement/bu
=40 bu/acre x 2 lb N/bu*
=80 lb N/acre
Soil N at seeding = 34 lb/acre
Fertilizer N applied at seeding = 40 lb/acre
Total N at seeding = Soil N at seeding + Fertilizer N applied at seeding
= 74 lb/acre
N required for the extra 3 bu/acre
= Extra bu/acre x N requirement/bu
3 bu/acre x 2 lb N* x bu = 6 lb/acre or
=New target N at G.S.31 - total N at seeding
80 lb N/acre - 74 lb N/acre = 6 lb/acre
*Katepwa total N requirements are assumed to be 2 lbs of N/bushel of yield

TABLE C3 C072 L TREATMENT LIST

TREATMENT #	N APPLICATION	FERTILIZER N APPLIED (KG/HA) AT SEEDING	GS 31	GS 49
1	Target	45		
2	Target & Yield G.S.31	45	26.88	
3	Target & Yield G.S.49	45		26.88

Yields (bu/acre) were predicted at G.S.31 and 49 using the yield tracking formula.
Plants/m2 x tillers/plant x spikelets/tiller x .392/67.25
eg. 161 plants/m2 x 3.7 tillers/plant x 14.1 spikelets/tiller x .392/67.25
=49 bu/acre
Original target yield at seeding as 37 bu/acre
Extra yield expected 12 bu/acre
New target N at G.S.31
=Yield estimated at G.S.31 x N requirement/bu
=49 bu/acre x 2 lb N/bu*
=98 lb N/acre
Soil N at seeding = 34 lb/acre
Fertilizer N applied at seeding = 40 lb/acre
Total N at seeding = Soil N at seeding + Fertilizer N applied at seeding
= 74 lb/acre
N required for the extra 12 bu/acre
= Extra bu/acre x N requirement/bu
12 bu/acre x 2 lb N* x bu = 24 lb/acre or
=New target N at G.S.31 - total N at seeding
98 lb N/acre - 74 lb N/acre = 24 lb/acre
*Katepwa total N requirements are assumed to be 2 lbs of N/bushel of yield

C072 H RESULTS AND DISCUSSION

The results are shown in Table C4. The highest yield was obtained from the treatment that received target N at seeding and N at G.S.49 compared to the control and the treatment that received target N at seeding and N at G.S.31. However no significant yield responses were observed. Protein level was significantly higher (.9%) from the two topdressed treatments and N at G.S.49 compared to that from the control. The two topdressed treatments resulted in equal amount of protein.

Consistent with highest yields in treatment that received target N at seeding and N at G.S.49, were the highest number of tillers and heads/m2 observed for this treatment.

The results incidate that split N at G.S.31 or 49 can increase yield as well as protein.

The tissue N analysis for samples collected at G.S.31 and 49 were not available at the time of compiling this report.

TABLE C4. C072 H RELIABILITY OF EARLY TISSUE TESTING KATEPWA, MINTO 1990

TRMT	N APPLICATION	YIELD KG/HA SEPT4	PLANTS /M2 JUNE27	TILLERS /M2 JUNE27	HEADS /M2 JULY31	PROTEIN %	TISSUE N GS31	TISSUE N GS49
1	Target	3085a*	173ab	519a	461a	12.8b		
2	Target & Yield G.S.31	3214a	149b	468a	463a	13.7a		
3	Target & Yield G.S.49	3259a	183a	486a	470a	13.7a		
L.S.D.		425	29	54	33	0.6		
C.V.		7.72	10	6.05	4.11	2.55		

C072 N RESULTS AND DISCUSSION

Table C5 contains the results of this trial. There were no significant yield responses to the N applied, however the highest yield was obtained from the treatment that received target N at eseding and N at G.S.31 compared to the control and the treatment that received target N at seeding and N at G.S.49. Protein levels were not significantly different for all treatments, but were highest from the treatment receiving target N at seeding and at G.S.49.

All treatments did not significantly differ in terms of tillers and heads/m2. The highest tiller and head counts were consistent with the highest yield as observed in treatments that received target N at seeding and at G.S.31.

Based on the observed results in this trial, applying N at G.S.31 appeared to result in high yields and protein.

The tissue N analysis for samples collected at G.S.31 and 49 were not available at the time of report preparation.

TABLE C5 C072 N RELIABILITY OF EARLY TISSUE TESTING KATEPWA, NORMAL TOPOGRAPHY, MCKINNONS, MINTO 1990

TRMT	N APPLICATION	YIELD KG/HA SEPT5	PLANTS /M2 JUNE29	TILLERS /M2 JUNE29	HEADS /M2 JULY31	PROTEIN %	TISSUE N GS31	TISSUE N GS49
1	Target	2208a	201a	495a	448a	12.4a		
2	Target & Yield G.S.31	2658a	204a	490a	470a	12.4a		
3	Target & Yield G.S.49	2572a	204a	489a	444a	12.8a		
L.S.D.		439	42	62	69	0.5		
C.V.		10.24	11.98	7.29	8.83	2.48		

C072 L RESULTS AND DISCUSSION

A significant yield increased (413 kg/ha) was observed from the treatment that received target N at seeding and N at G.S.31 compared to that from the control. Yield obtained from the treatment that received target N at seeding and N at G.S.49 was not significantly different from the rest of the treatments. Protein levels were not significantly different for all treatments but tended to increase with a delay in topdressing. The highest protein was obtained from the treatment that was latest in receiving N at G.S.49.

A look at tiller and head counts did not reveal any significant differences for all treatments. The highest tiller and head counts coincided with the highest yield as observed in treatment that received target N at seeding and N at G.S.31.

The results show that topdressing at G.S.31 can result in high yield and protein. The tissue N analysis for samples collected at G.S.31 and 49 were not available at the time of report preparation.

TABLE C6 C072 L RELIABILITY OF EARLY TISSUE TESTING KATEPWA
LOW TOPOGRAPHY, MCKINNONS, MINTO 1990

TRMT	N APPLICATION	YIELD KG/HA SEPT5	PLANTS /M2 JUNE29	TILLERS /M2 JUNE29	HEADS /M2 JULY31	PROTEIN %	TISSUE N GS31	TISSUE N GS49
1	Target	1967b*	210a	456b	484a	12.2a		
2	Target & Yield G.S.31	2380a	235a	558a	513a	12.6a		
3	Target & Yield G.S.49	2062ab	199a	518ab	469a	12.7a		
L.S.D.		388	37	68	61	2.6		
C.V.		4.22	9.97	7.74	7.16	4.84		

*Means followed by the same letter do not significantly differ (DUncan's MRT, P=.05)

SECTION D

LIST OF TABLES

SECTION D COOPERATOR DATA COLLECTION PROJECT

The objective of this project is to collect data from individual farmers and organizations to be used in the establishment of target yields and yield tracking formulas on a field specific basis. This data is to be used in the development of a Risk Management Guide for Wheat Production in Western Canada. By developing strategies for setting target yields or tracking yield during the season, fertilizer and chemical inputs can be adjusted to achieve optimum economic yield for that particular year. Hopefully the RMG will eventually allow for more rational use of farm inputs, helping to maximize farm incomes and minimize the environmental concerns. This was the second year of the cooperator project which will run for 3 years. In the third season a preliminary RMG will be available for cooperators to evaluate.

METHODS AND MATERIALS

Cooperators agreed to participate in the data collection phase of the project to develop a Risk Management Guide for Wheat Production. Approximately 60 kits were sent out in April for the upcoming cropping season. Cooperators ranged in location from the Red River Valley to the dark brown soil zone to the Parkland region near Edmonton. The kits included the tools necessary to assist in monitoring the crop at different growth stages as well as written material explaining 11 phases of the project, sampling procedures and data recording. The written portion of the 1990 Cooperator Kit is given in Appendix C.

RESULTS AND DISCUSSION

Of the 60 cooperators sent kits, 20 sets of useful data were collected. Other cooperators sent incomplete data information, were hailed out or just failed to initiate the data collection. Data collected from the cooperators as well as yield estimates at G.S.31 are given in Table D1. The yield tracking formula used for Katepwa was:

plants/m2 x tillers/plant x spikelets/plant x .392/67.25 = bu/acre.

The correlation of RMG predicted yields at G.S.31 and harvested yields was low (r=.42). This may have been due to lack of experience and expertise of cooperator sampling at the critical growth stages (Figure J1). Data was also obtained from the cooperators on target yield calculations based on the plant available water at seeding and the expected rainfall for the area (May 1-July 31). For Katepwa the formula is:

Target Yield = (Soil water at seeding + expected rainfall) - 5" x WUE

(WUE = 4 bu/acre/inch of water)

Table D2 illustrates the projected target yields and actual harvested yields from the cooperator data. (See Yield Tracking Section for further information).

TABLE D1. COOPERATORS YIELD COMPONENTS, ESTIMATED YIELD, HARVESTED YIELD 1990

COOPERATOR	PLANTS/M2	TILLERS/PLANT	SPIKELETS/PLANT	EST.YIELD BU/ACRE	HARVESTED YIELD BU/ACRE
1	216	4.3	12.44	67	49
2	190	2.3	11.48	29	55
3	172	1.5	12.84	19	80
4	144	2.2	12.08	22	34
5	192	2.6	11.84	34	39
6	180	3.0	12.92	41	50
7	190	2.4	11.56	31	48
8	182	4.6	12.04	59	38
9	180	3.5	12.44	46	24
10	244	2.2	14.50	45	45
11	320	2.0	11.37	42	57
12	348	2.2	11.37	51	56
13	343	1.4	14.65	41	74
14	354	1.2	15.82	39	63
15	224	1.8	11.50	27	17
16	235	2.0	12.60	39	19
17	247	2.3	12.60	41	26
18	238	3.1	13.00	56	37
19	245	3.0	13.20	57	41
20	242	3.0	13.10	56	48
21	204	2.5	12.80	38	47
22	225	2.5	13.20	43	44
23	341	2.3	13.60	62	52
24	327	2.3	14.50	63	50
25	264	1.6	12.60	32	27
26	281	1.9	13.40	42	35
27	209	3.1	14.10	54	43

TABLE D2. TARGET YIELD VS HARVEST YIELD COOPERATOR DATA 1990

COOPERATOR	TARGET YIELD(BU/ACRE)	HARVESTED YIELD(BU/ACRE)
1	28	49
2	17	55
3	46	80
4	21	34
5	34	39
6	23	48
7	15	38
8	39	24
9	27	45
10	36	56
11	36	56
12	46	74
13	46	63
14	78	80
15	32	34
16	20	20
17	37	42
18	36	45
19	42	51
20	30	35

SECTION E

SUMMARY YIELD TRACKING

LIST OF FIGURES

LIST OF TABLES

SUMMARY YIELD TRACKING

TARGET YIELD CALCULATIONS

Target yields can be determined based on plant available water in the soil at seeding time, the expected amount of rainfall during the growing season and the water use efficiency of the crop. Information was taken from various trials and correlations run to assess the reliability of the target yield formula.

TARGET YIELD = Plant Available Water (PAW) X Water Use Efficiency (WUE)

PAW = Soil water at seeding + expected rainfall - 5"

WUE = 4 bu/acre/inch for HRSW
5.2 bu/acre/inch for CPS

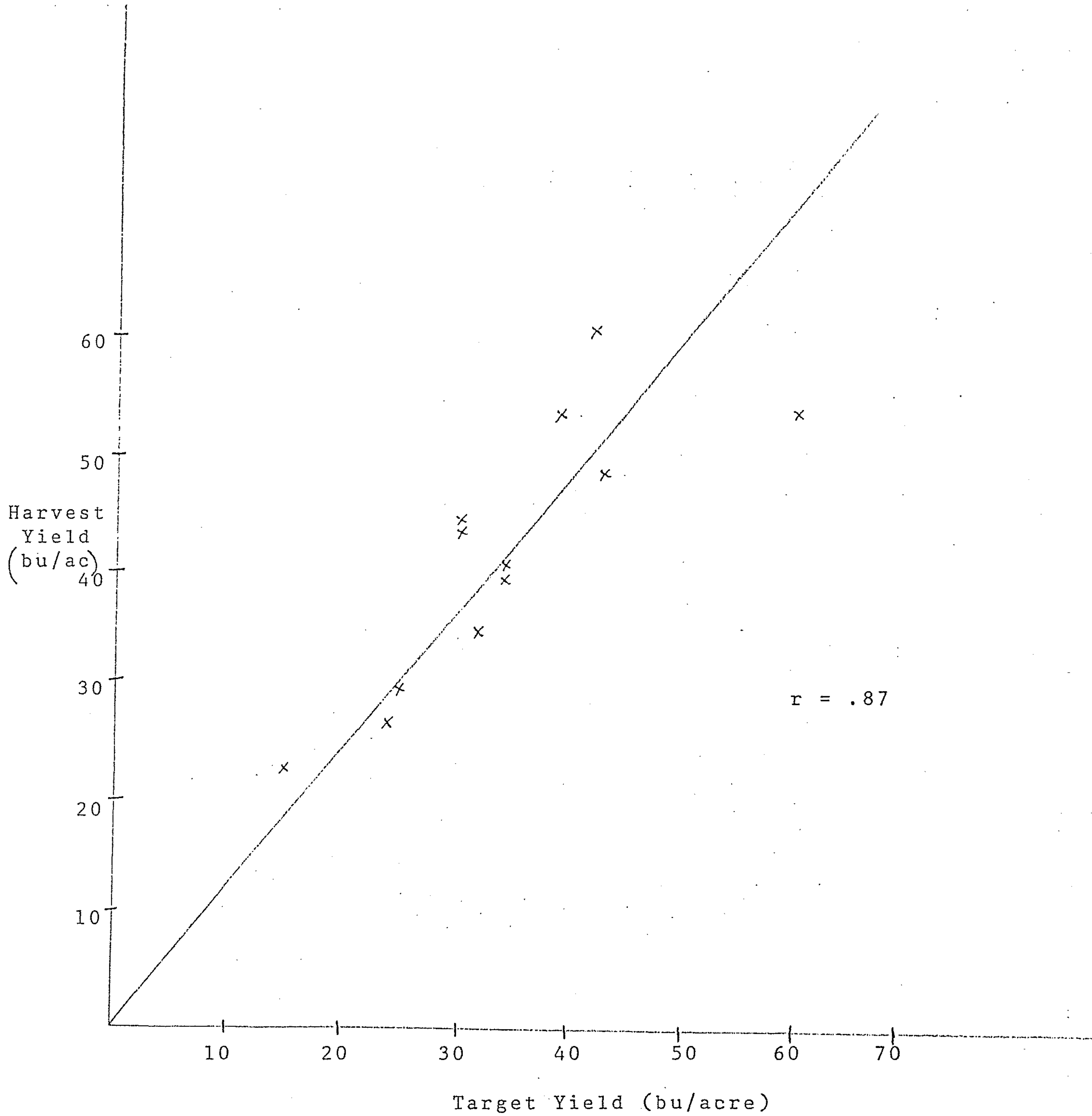
The plant available water at seeding is determined with the aid of the Brown soil moisture probe. Table El shows the calculated Target Yields and the actual harvested yields in 1988 -1990 from trials with Katepwa wheat.

TABLE El. TARGET YIELD AND HARVESTED YIELD, KATEPWA, MINTO 1988-90

TARGET YIELD (BU/ACRE)	HARVESTED YIELD (BU/ACRE)
10	1
15	22
24	26
25	29
32	34
39	53
42	60
43	48
60	53
30	43
30	43
34	40
34	39

Figure El shows the correlation of the Target Yield compared to the harvested yield for Katepwa over 3 years.

FIGURE E1. CORRELATION OF RMG TARGET YIELD AND HARVESTED YIELD KATEPWA, MINTO 1988-90



While the fit is not perfect, it appears to be within reasonable limits for most situations (r=.87). r is the correlation coefficient which has a value between 1 and -1. 1 or -1 means data has a perfect fit. A value close to 0 would mean there is little or no correlation within the data set. Noteable cases where the yield was underestimated was one which was a low area of the field (highly productive) and another which was a trial established on summerfallow. In these cases we have probably underestimated the water +/or nitrogen supply. Data from the 1990 cooperator trials show the correlation coefficient to be slightly lower (r=.69, Figure E2) than that found at Minto. (Correlation coefficient obtained from the 1989-90 data (r=.69, Figure E3) was the same as that obtained from 1990 data.

FIGURE E2. CORRELATION OF RMG TARGET YIELD AND HARVESTED YIELD
KATEPWA COOPERATOR DATA 1990

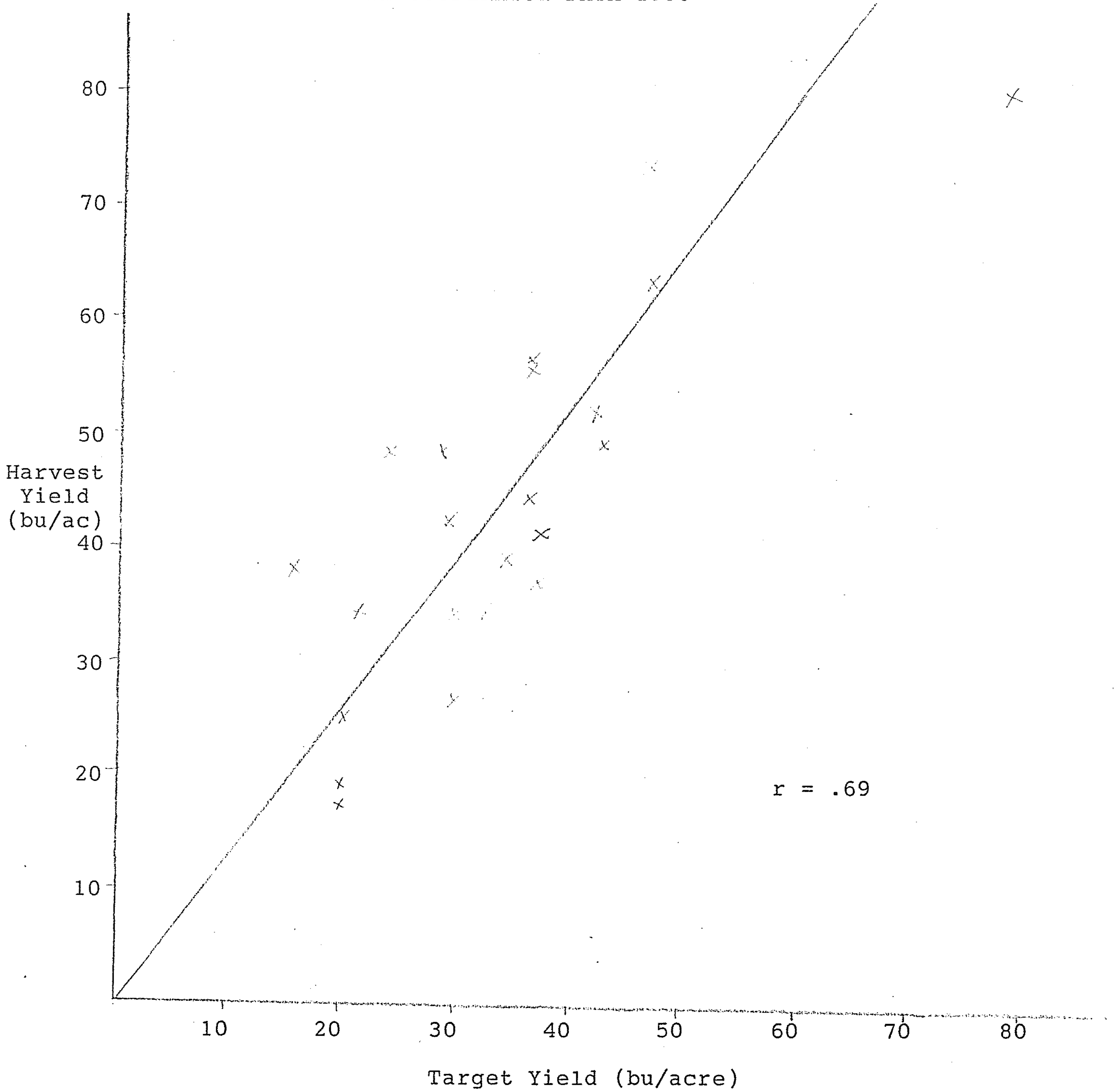
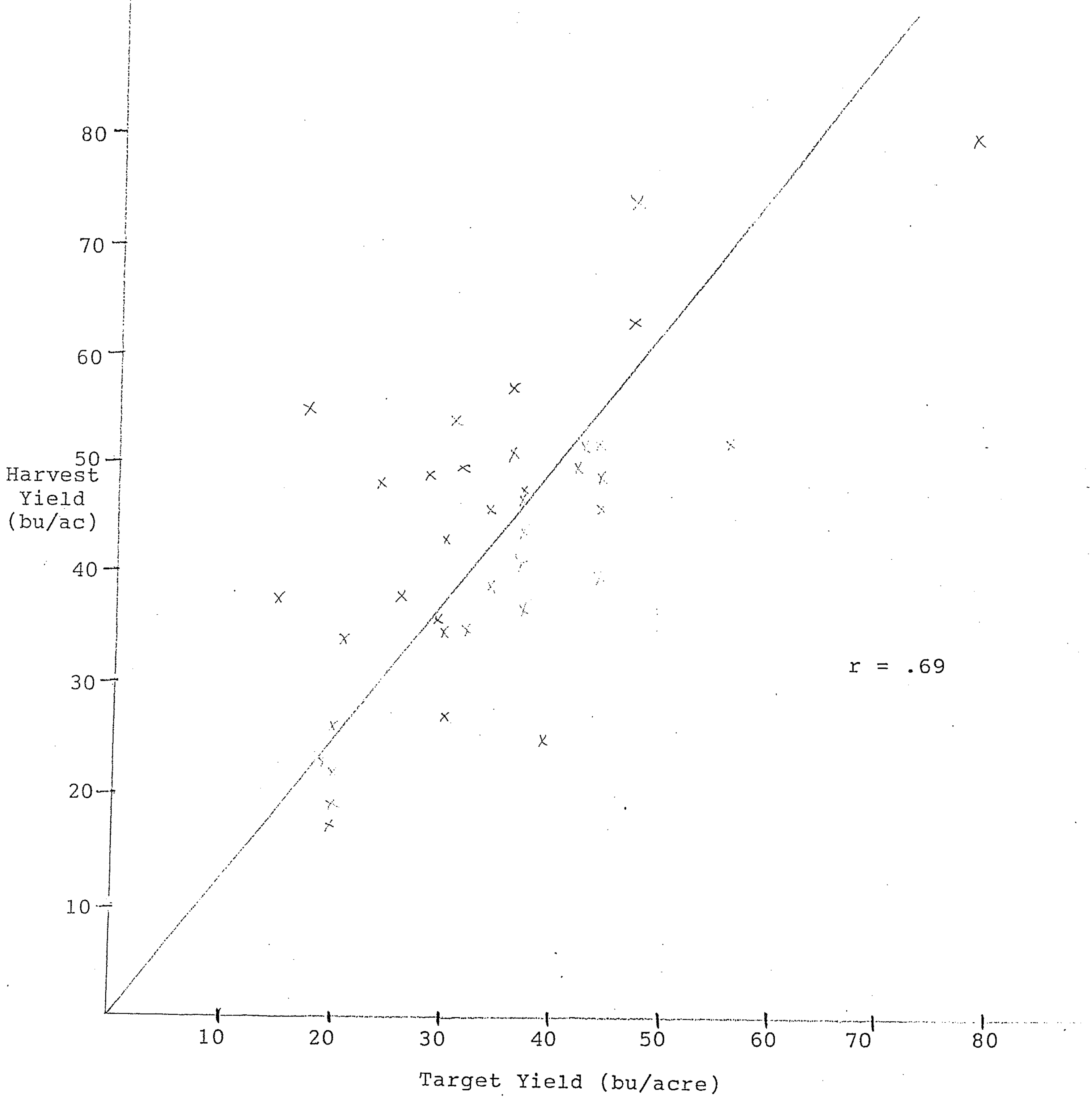


FIGURE E3. CORRELATION OF RMG TARGET YIELD AND HARVESTED YIELD
KATEPWA COOPERATOR DATA 1989-90



The low correlation resulting from cooperator data may be partly attributed to the following reasons:
-a wide range of growing conditions;
-lack of experience in handling the Brown soil probe.

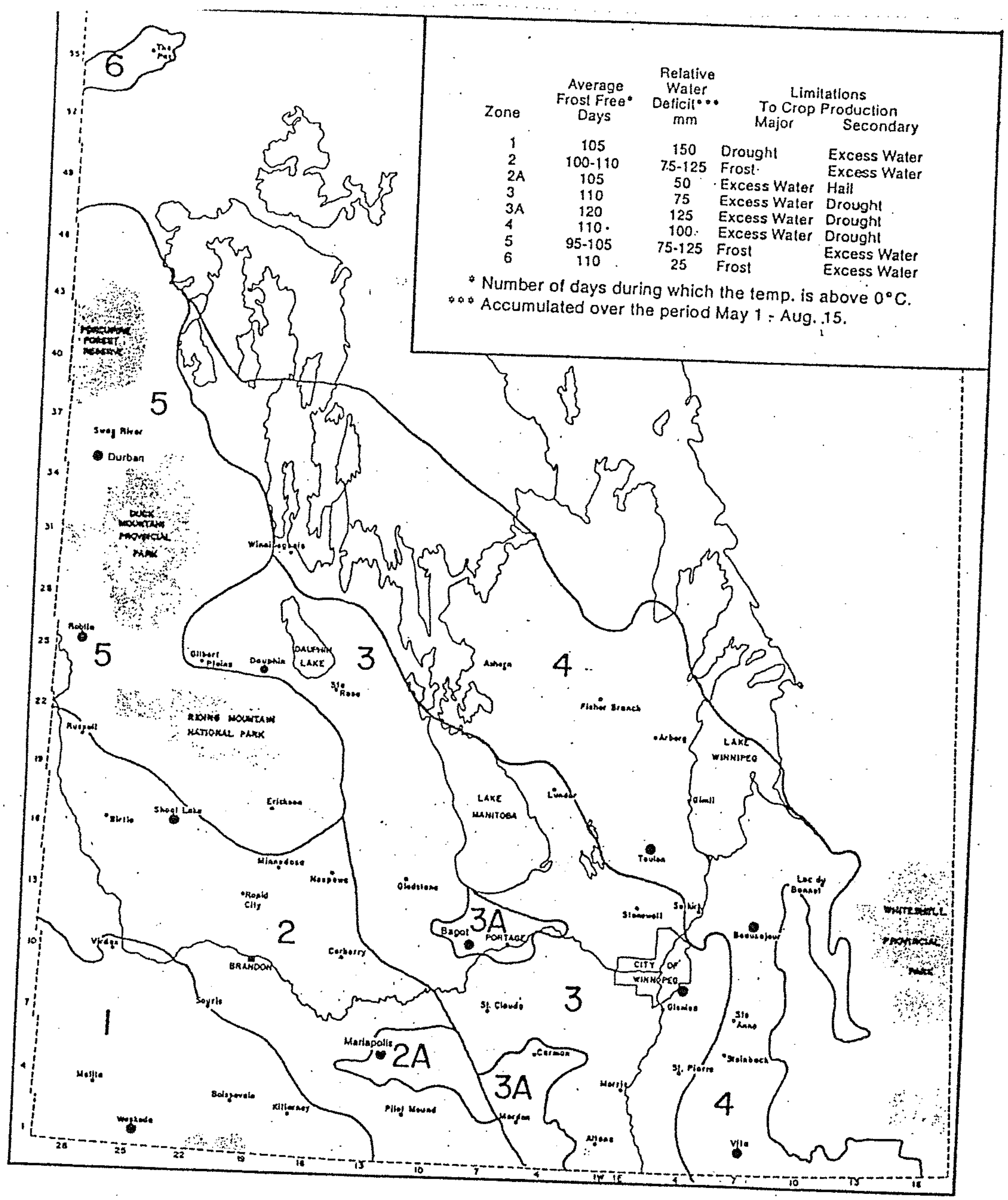
Because of the first reason, data was grouped according to location of origin. Crop variety zone map for Manitoba was used as a guide (FigureE3a) and correlations determined as indicated in Table E2 and E6 (Table #6 to be discussed later). Data from Alberta and Saskatchewan was insufficient for any meaningful grouping but was nonetheless included in the overall correlation.

As indicated in Table E2 correlation coefficient of RMG target yield and harvested yield tended to differ in some zones in a particular year. Data from zone 3 seemed to give slightly higher correlations in both 1989 and 1990 compared to correlation coefficients from the other zones. This tends to show that the target yield formula was relatively more reliable in predicting yield in Zone 3 compared to the other zones. While the reason for such an observation is not clear, data seems to indicate that target yield formula may be limited to a narrow range of environment.

TABLE E2. CORRELATIONS OF RMG TARGET YIELD AND HARVESTED YIELD IN CROP ZONES 1, 2 AND 3 COOPERATOR DATA, 1989-90

CROP ZONES	R VALUES 1989	1990	89/90
1	Insufficient data	0.29	0.36
2	0.47	0.15	0.54
3	0.69	0.71	0.73
All zones	0.73	0.69	0.69

FIGURE E3A CROP VARIETY ZONE MAP FOR MANITOBA



SOURCE, Field Crop Production Guide for Manitoba 1988-90.

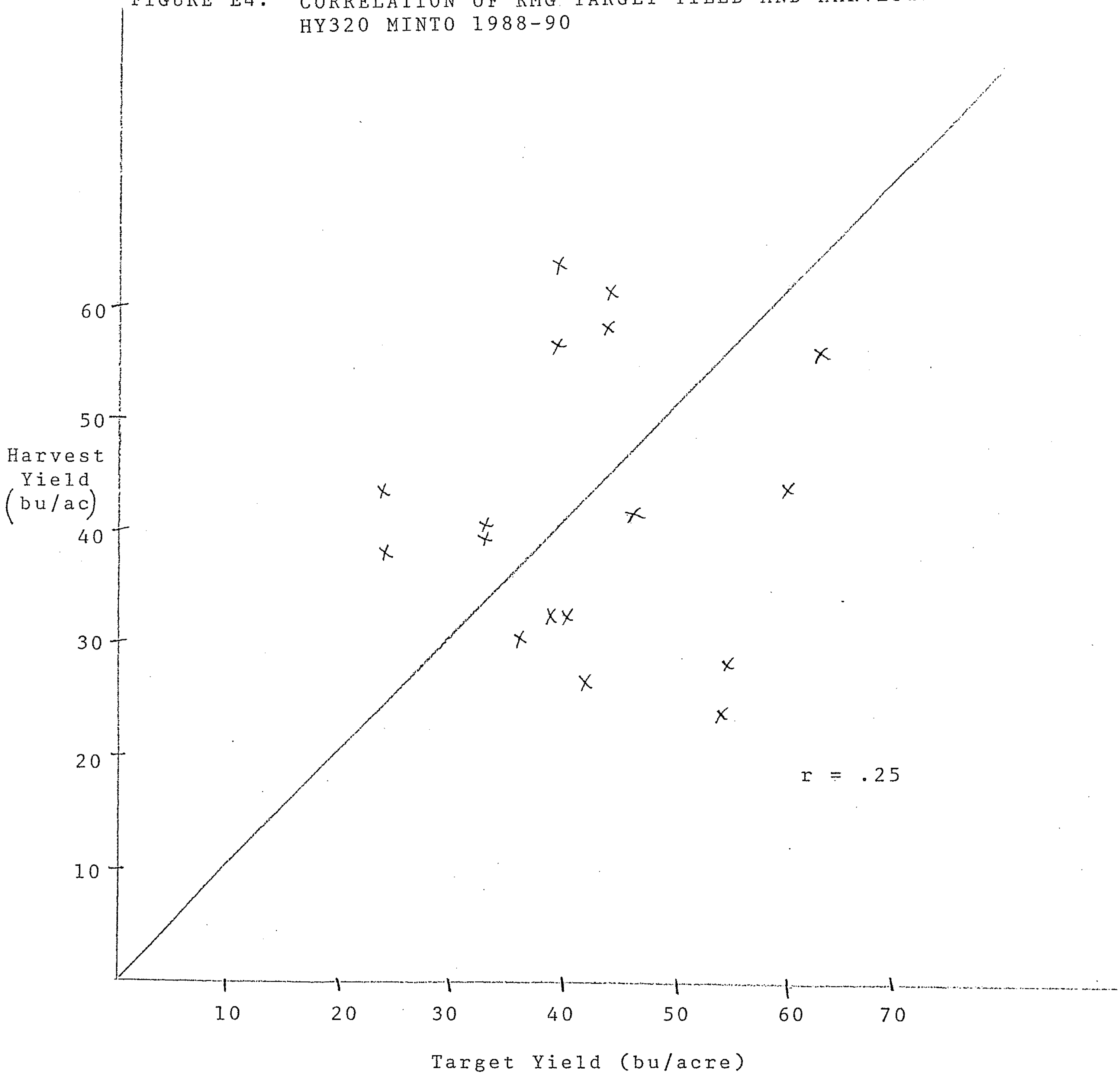
Target yield calculated for HY320 trials were also correlated with harvested yield to determine the reliability of the target yield formula using HY320. The following Table E3 shows the target yields and the actual harvested yields for 1988 - 1990 in HY320.

TABLE E3. TARGET YIELD AND HARVESTED YIELD, HY320, MINTO 1988-90

TARGET YIELD (BU/ACRE)	HARVESTED YIELD (BU/ACRE)
36	30
40	32
54	23
42	26
39	32
46	41
60	43
63	55
60	61
33	40
33	39
24	38
24	43
40	63
40	56
45	60
45	58

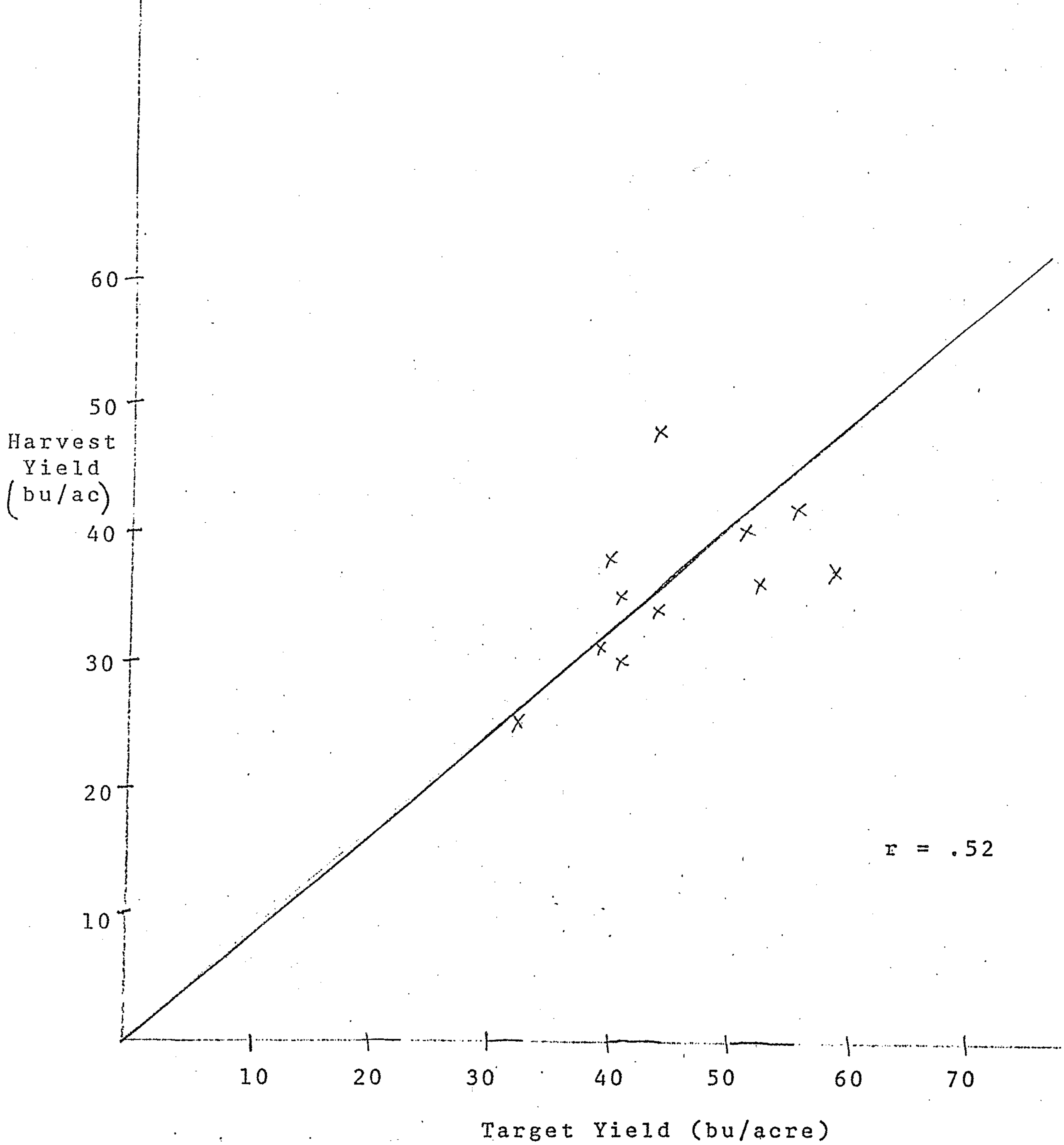
As indicated in Figure E4, a poor correlation coefficient (r=.25) was obtained for target yield and harvested yield for HY320 from the 1988-1990 data. This correlation coefficient (r=.25) is much lower than that obtained for Katepwa. This observation would seem to indicate that there is varietal difference in response to target yield formula. Further refinement to the target yield formula to suit a particular variety may be essential. In refining the target yield formula, factors including water use efficiency and nitrogen requirements may need to be adjusted using moisture deficit rather than rainfall data.

FIGURE E4. CORRELATION OF RMG TARGET YIELD AND HARVESTED YIELD HY320 MINTO 1988-90



The correlation coefficient for the estimated ield at G.S.31 and harvested yield from 1990 Katepwa trials was lower (r=.52, Figure E5) than obtained from 1989 Katepwa data (r=.94, Figure not shown). That the correlation coefficients vary from year to year may be attributed partly to the fact that one year is not exactly identical to the other in terms of environmental factors that influence plant growth. That being the case, data from several years may be required in order to improve the yield tracking formula as evidenced in a reasonably good correlation coefficient obtained from 1988-90 data (r=.89 Figure E6).

FIGURE E5. CORRELATION OF RMG ESTIMATED YIELD AT G.S. 31 AND HARVESTED YIELD, KATEPWA, MINTO 1990



YIELD TRACKING AT GROWTH STAGE 31

Assessment of various yield components such as number of plants, tillers/plant and spikelets/tiller at G.S.31 in various trials has led to the development of a formula to be used in predicting final grain yields. Correlations were run to assess the reliability of the formula for estimating yields at G.S.31. The yield tracking formula for estimating yield at G.S.31 is:

KATEPWA
plants/m2 x tillers/plant x spikelets/head x .392/67.25 = bu/acre

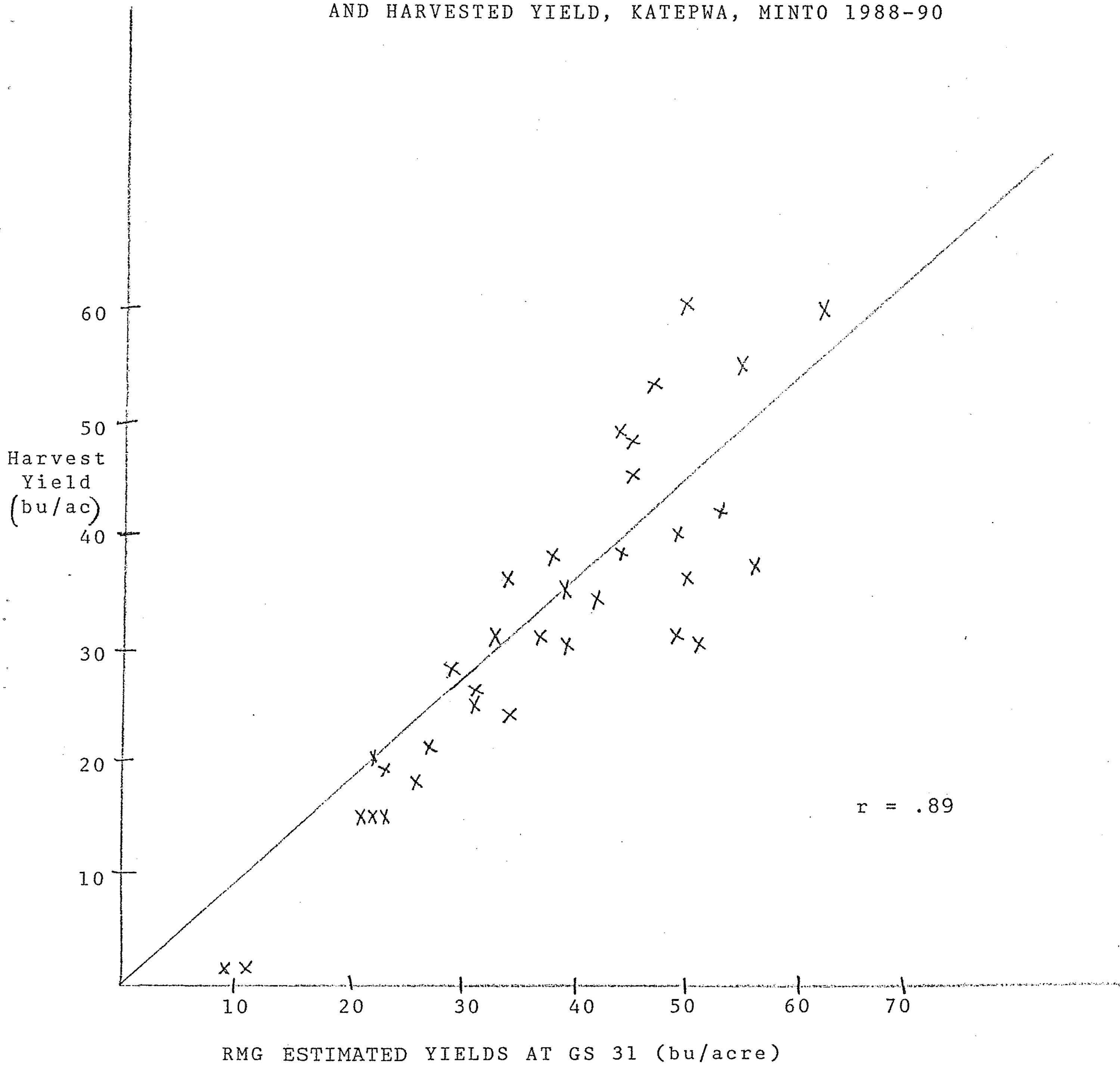
HY320
plants/m2 x tillers/plant x spikelets/head x .480/67.25 = bu/acre

The following Table E4 and Figure E5 show the data used in the yield tracking formula and the estimated yield at G.S.31 that resulted at Minto, 1990 using Katepwa wheat.

TABLE E4. YIELD COMPONENTS, ESTIMATED YIELD at G.S.31, HARVESTED YIELD KATEPWA, MINTO 1990

EXPERIMENT	TRMT#	PLANTS/M2	TILLERS/ PLANT	SPIKELETS/ HEAD	EST.YIELD AT G.S.31 BU/ACRE	HARVESTED YIELD BU/ACRE
C071 DH	1	205	2.05	12.5	31	25
	5	235	2.13	13.2	38	38
	9	259	2.27	13.2	42	48
C071 D-IH	5	215	2.78	14.0	49	40
	9	253	2.55	14.0	53	42
C071 NH	1	218	2.43	13.6	42	34
	5	206	2.50	13.4	39	35
	9	184	2.74	13.4	39	30
C071 IH	1	234	1.95	13.9	37	31
	5	205	3.09	13.5	50	36
	9	195	3.43	14.3	56	37

FIGURE E6. CORRELATION OF RMG ESTTIMATED YIELD AT G.S.31 AND HARVESTED YIELD, KATEPWA, MINTO 1988-90



Yield tracking was also monitored using cooperator data. Table E5 shows the yield components used in the yield tracking formula to establish an estimated yield at G.S.31. Figure E7 illustrates the results obtained when the yield tracking formula was used with data collected from cooperators in 1990. Correlation coefficient was r=.42. As previously mentioned, data from cooperators was grouped according to their location of origin using crop variety zone map for Manitoba as a guide and correlations determined a shown in Table E6. As shown in the table, correlation coefficients were generally poor for all the zones in each year and also for the combined data. A possible explanation for the poor correlation of the estimated yield at G.S.31 and harvested yield seems to evolve around data collection. The main problem as reported by some cooperators appears to be counting and checking the proper growth stage. Perhaps a stick-on calendar (to stick somehwere on the tractor) with approximate dats of growth stages and a reminder of what to do and when might help the cooperators.

TABLE E5. COOPERATORS YIELD COMPONENTS, ESTIMATED YIELD AT G.S. 31 HARVESTED YIELD 1990

COOPERATOR	PLANTS/M2	TILLERS/ PLANT	SPIKELETS/ PLANT	ESTIMATED YIELD BU/A AT G.S. 31	HARVESTED YIELD BU/A
1	216	4.3	12.44	67	49
2	190	2.3	11.48	29	55
3	172	1.5	12.84	19	80
4	144	2.2	12.08	22	34
5	192	2.6	11.84	34	39
6	180	3.0	12.92	41	50
7	190	2.4	11.56	31	48
8	182	2.6	12.04	59	38
9	180	3.5	12.44	46	24
10	244	2.2	14.50	45	45
11	320	2.0	11.37	42	57
12	348	2.2	11.37	51	56
13	343	1.4	14.65	41	74
14	354	1.2	15.82	39	63
15	224	1.8	11.50	27	17
16	235	2.0	12.60	39	19
17	247	2.3	12.60	41	26
18	238	3.1	13.00	56	37
19	245	3.0	13.20	57	41
20	242	3.0	13.10	56	48
21	204	2.5	12.80	38	47
22	225	2.5	13.20	43	44
23	341	2.3	13.60	62	52
24	327	2.3	14.50	63	50
25	264	1.6	12.60	32	27
26	281	1.9	13.40	42	35
27	209	3.1	14.10	54	43

FIGURE E7. CORRELATION OF RMG ESTIMATED YIELD AT G.S. 31 AND HARVESTED YIELD KATEPWA COOPERATOR DATA 1990

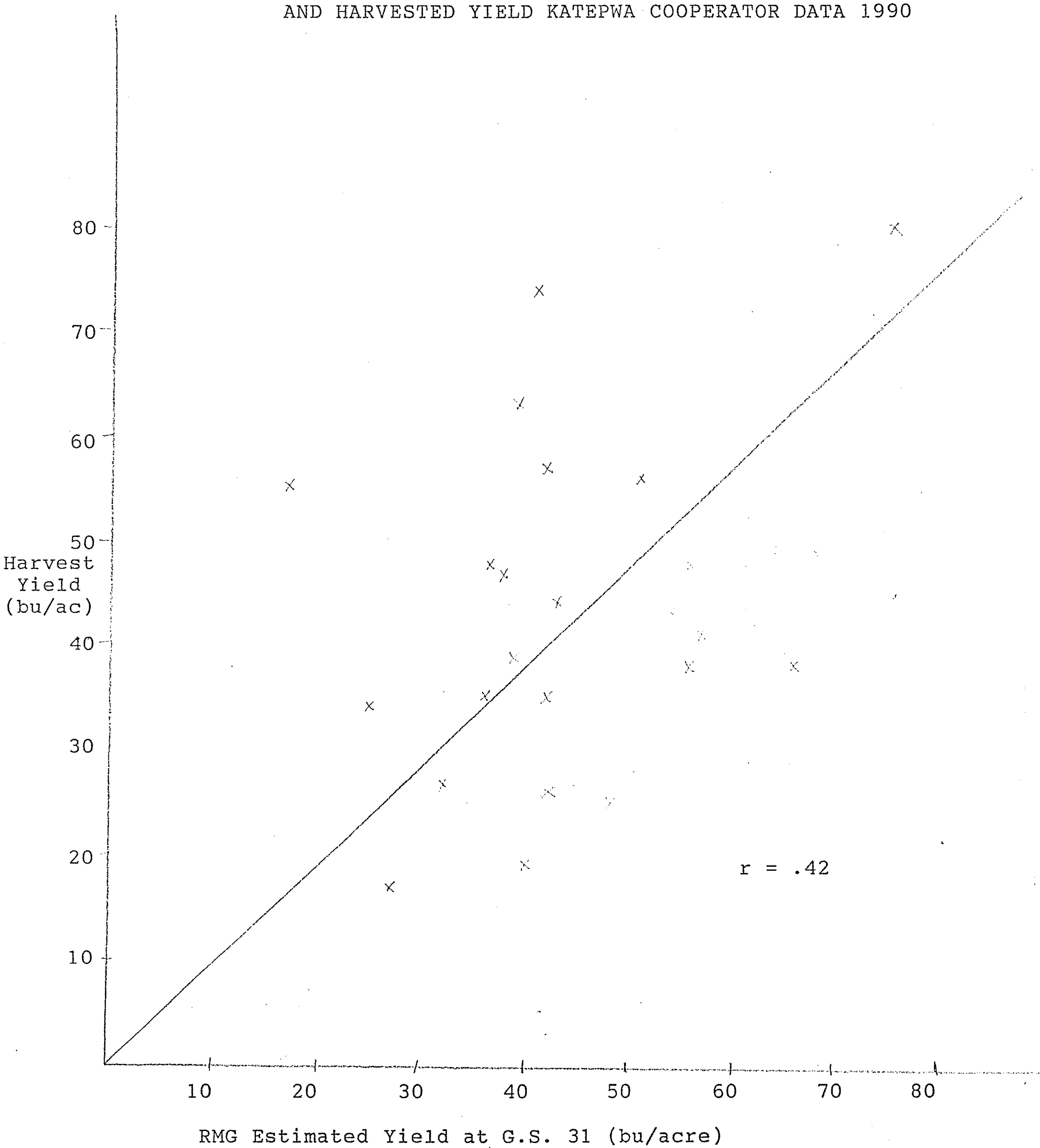


FIGURE E8. CORRELATION OF RMG ESTIMATED YIELD AT G.S. 31 AND HARVESTED YIELD KATEPWA COOPERATOR DATA 1989-90

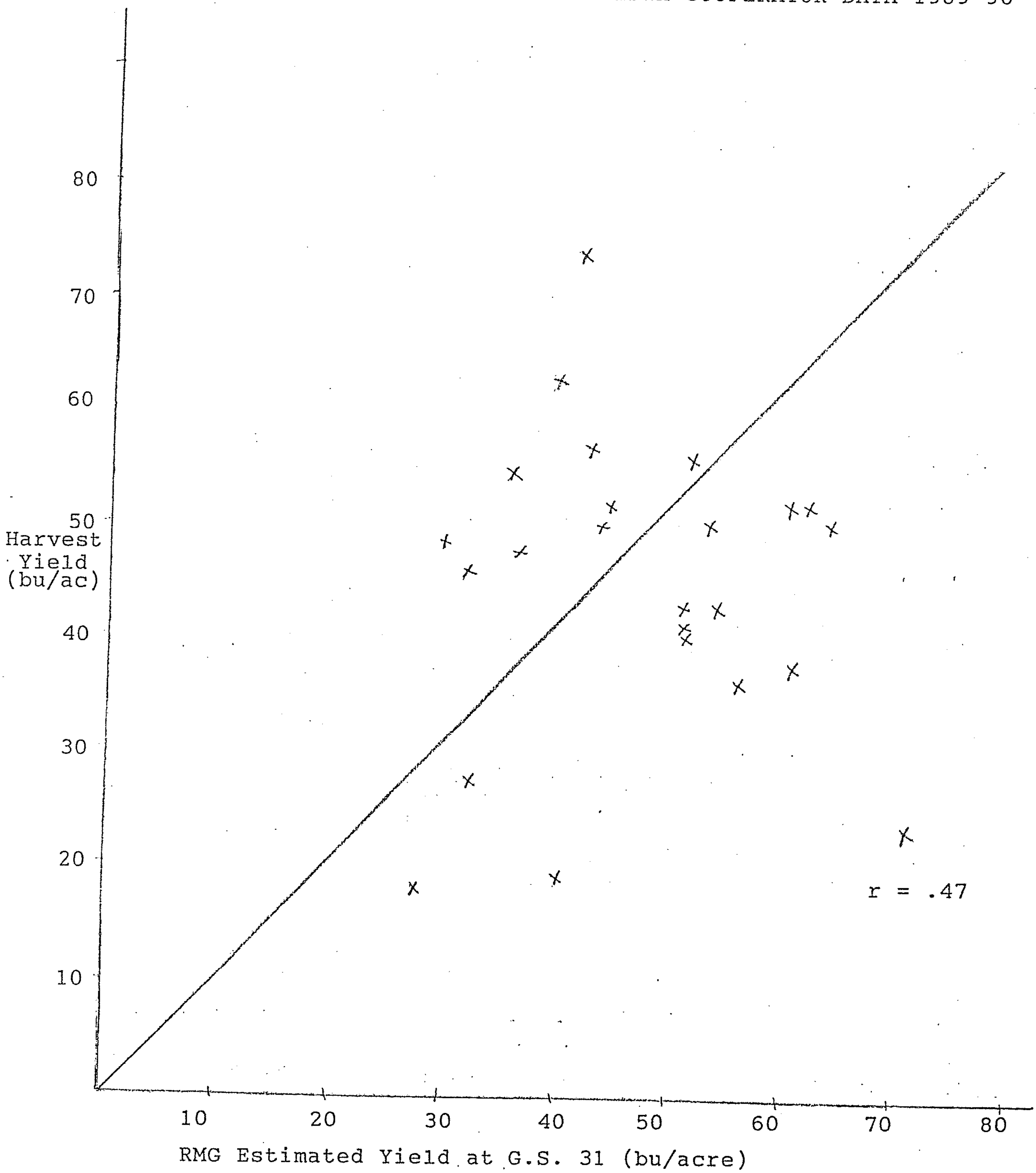


TABLE E6 CORRELATIONS OF RMG ESTIMATED YIELD AT G.S.31 AND HARVESTED YIELD IN CROP ZONES 1, 2 AND 3, COOPERATOR DATA 1989-90

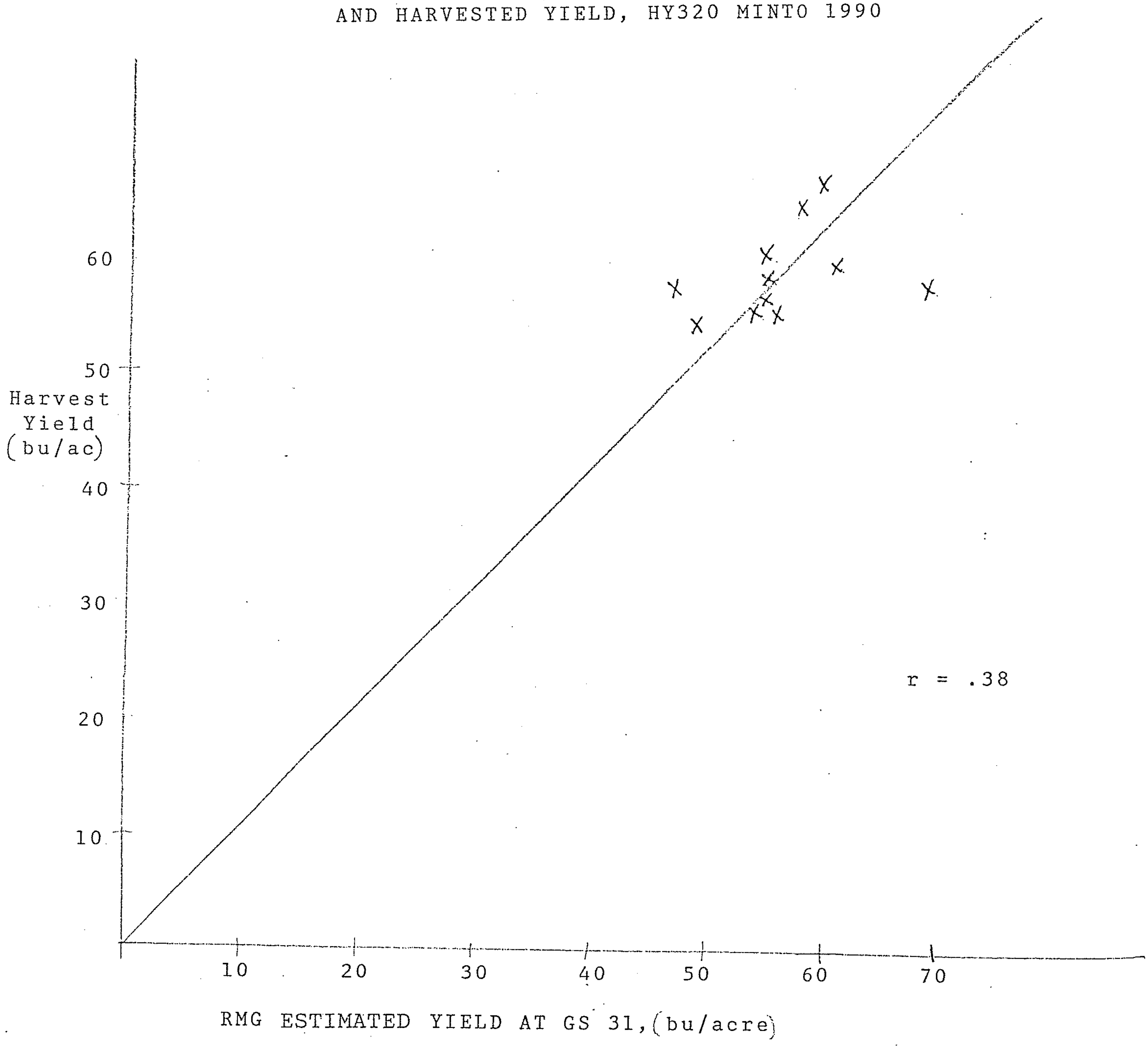
CROP ZONE	R VALUES 1989	1990	1989/90
1	Insufficient data	0.57	0.27
2	0.46	0.16	0.46
3	0.31	0.23	0.06
All zones	0.45	0.42	0.47

Table E7 and Figure E9 illustrate the data used in the yield tracking formula for HY320 in 1990 and the resulting correlation.

TABLE E7. YIELD COMPONENTS, ESTIMATED YIELD AT G.S.31, HARVESTED YIELD, HY320 MINTO 1990

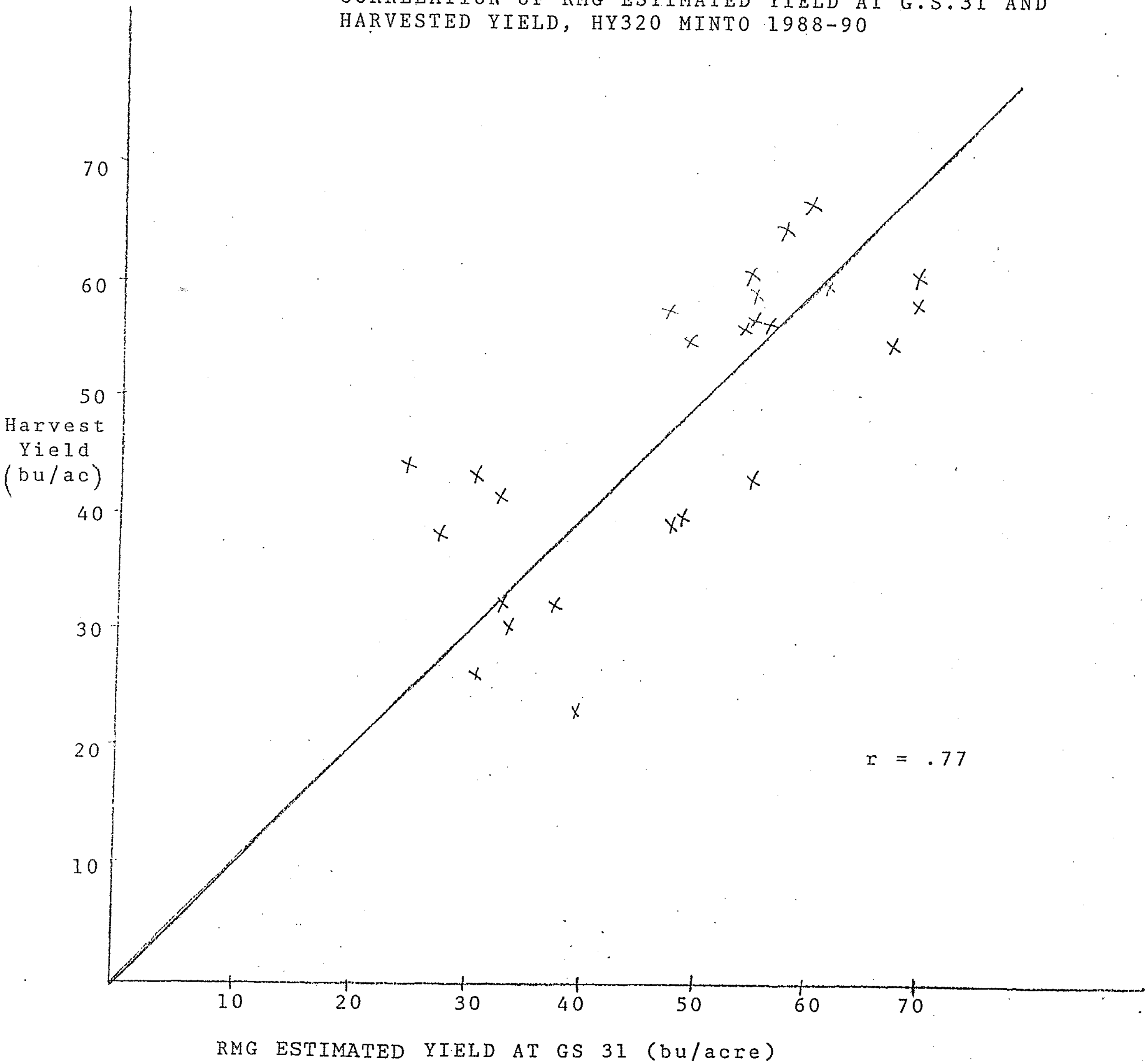
EXPERIMENT	TRMT	PLANTS/M2	TILLERS/ PLANT	SPIKELETS/ HEAD	ESTIMATED YIELD BU/ACRE	HARVESTED YIELD BU/ACRE
C071 DP	1	236	1.69	16.5	47	57
	5	236	2.05	17.3	60	66
	9	230	2.13	17.5	61	59
C071 D-IP	5	224	2.12	17.0	57	59
	9	210	2.48	17.2	55	59
C071 NP	1	208	2.04	16.4	49	54
	5	214	2.17	16.3	54	55
	9	231	2.07	16.2	55	58
C071 IP	1	216	2.24	16.3	56	55
	5	220	2.10	16.8	55	56
	9	221	2.58	16.9	69	57

FIGURE E9. CORRELATION OF RMG ESTIMATED YIELD AT G.S. 31 AND HARVESTED YIELD, HY320 MINTO 1990



The correlation between estimated yield at G.S.31 and harvested yield (r=.38 Figure E9) from the data collected in the 1990 HY320 trials was much lower than that obtained in 1989 (r=.87 Figure not shown). The different correlations from year to year may be explained at least in part by the year to year variations in environmental factors for instance soil nitrogen and moisture. This may seem to suggest data from more years may best test the reliability of the yield tracking formula as shown in a relatively better correlation coefficient obtained from 1988-90 data (r=.77, Figure E10).

FIGURE E10. CORRELATION OF RMG ESTIMATED YIELD AT G.S.31 AND HARVESTED YIELD, HY320 MINTO 1988-90



SECTION F

LIST OF FIGURES

LIST OF TABLES

SECTION F

C976 (VASEY) LEAF PROTEIN EVALUATION PROJECT

OBJECTIVE: To determine the leaf protein at various stages of growth of Katepwa and HY320 to use as a possible indicator of topdressing N requirements.

METHODS AND MATERIALS.

The project was conducted near Minto, Manitoba by taking plant samples from established trials. The trials involving Katepwa were C971 IH, NH, DH, C960, C975 and C978. HY320 trials included C971 IP, NP, DP. Plant samples were taken from the fourth rep using treatments 1, 2, 5, 6, 9, 11, 12 on C971 IH, NH, IP, NP trials, treatments 1, 5, 6, 9, 10, 11 on C971 DH, DP and treatments 2, 4, 6, 8, 10, 12 on C975. On C960 one plot of Katepwa was sampled. Samples were taken on all 15 sites on C978. For further information regarding trials specifics, refer to the appropriate section for each trial in RMG 1989/90 Annual Report. Plant samples were taken at the 4, 5, 6, 7 and 8 leaf stages of growth. A total of 310 samples were collected. The size of the plant sample taken at the 4 and 5 leaf stage was 1/2 m x 2 m at the 6, 7, and 8 leaf stage it was 1/4 m x 2 m. A decrease in the area of the sample size was due to theincreased size of the plants. Total N (soil N + Applied N) is indicated in Table 1. Table 2 shows the sampling dates of the different leaf stages from the trials.

TABLE 1. SOIL N, APPLIED N AND TOTAL N FOR THE VARIOUS EXPERIMENTS SAMPLED FOR TISSUE N ANALYSIS

EXPT #	TRMT	SOIL N(KG/HA)	APPLIED N(KG/HA) G.S.00/G.S.31		TOTAL N(KG/HA)
C971 DH	1	44	10	--	54
	5	44	10	--	54
	6	44	10	27	81
	9	44	37	--	81
	10	44	37	27	108
	11	44	64	--	108
C971 NH	1	44	5.5	--	49.5
	2	44	5.5	49.5	99
	5	44	55	--	99
	6	44	55	49.5	148.5
	9	44	104.5	--	148.5
	11	44	--	--	44
	12	44	--	49.5	93.5
C971 IH	1	44	23	--	67
	2	44	23	67	134
	5	44	90	--	134
	6	44	90	67	201
	9	44	157	--	201
	11	44	--	--	44
	12	44	--	67	111
C971 DP	1	44	10	--	54
	5	44	10	--	54
	6	44	10	27	81
	9	44	37	--	81
	10	44	37	27	108
	11	44	64	--	108
C971 NP	1	44	5.5	--	49.5
	2	44	5.5	49.5	99
	5	44	55	--	99
	6	44	55	49.5	148.5
	9	44	104.5	--	148.5
	11	44	--	--	44
	12	44	--	49.5	93.5
C971 IP	1	44	23	--	67
	2	44	23	67	134
	5	44	90	--	134
	6	44	90	67	201
	9	44	157	--	201
	11	44	--	--	44
	12	44	--	67	111
C975	2	67	G.S.0; 80		147
	4	67	G.S.12-18; 80		147
	6	67	G.S.14-21; 80		147
	8	67	G.S.31; 80		147
	10	67	G.S.37; 80		147
	12	67	G.S.49; 80		147

TABLE 1. CONTINUED

EXPT #	TRMT	SOIL N(KG/HA)	APPLIED N(KG/HA) G.S.00/G.S.31	TOTAL N(KG/HA)
C978 LOW TOPOGRAPHY				
	1	22.4	72.8	95.2
	2	22.4	72.8	95.2
	3	22.4	72.8	95.2
	4	22.4	72.8	95.2
	5	22.4	72.8	95.2
MEDIUM TOPOGRAPHY				
	1	22.4	72.8	95.2
	2	22.4	72.8	95.2
	3	22.4	72.8	95.2
	4	22.4	72.8	95.2
	5	22.4	72.8	95.2
HIGH TOPOGRAPHY				
	1	22.4	72.8	95.2
	2	22.4	72.8	95.2
	3	22.4	72.8	95.2
	4	22.4	72.8	95.2
	5	22.4	72.8	95.2
PT960		156	-- / --	156

TABLE 2. C976 SAMPLING DATES FOR VARIOUS LEAF STAGES, MINTO 1989

TRIAL	LEAF STAGE				
	4 LEAF	5 LEAF	6 LEAF	7 LEAF	8 LEAF
C971 IH	June 9	June 15	June 20	June 28	July 5
IP	June 9	June 15	June 20	June 28	July 5
NH	June 9	June 15	June 20	July 5	---
NP	June 15	June 20	June 23	July 5	---
DH	June 9	June 15	June 21	June 28	July 5
DP	---	June 15	June 21	June 28	July 5
C960	June 9	June 15	June 28	July 5	---
C975	June 20	June 28	July 5	July 11	---
C978 LOW	---	June 9	June 15	June 20	June 30
C978 MED.	June 9	June 15	June 20	June 30	---
C978 HIGH	June 9	June 15	June 20	June 30	---

Samples were sent to Dr. Ed Vasey of NDSU, Fargo, N.D. for analysis. The samples collected constitute a portion of a larger project involving 1 site in Canada and 4 sites in North Dakota and Minnesota. Analysis was not complete at the time of RMG 1989/90 Annual Report, but is now available and is included in this report.

C976 RESULTS AND DISCUSSION

As mentioned earlier, samples from C976 experiment constituted a portion of a larger project involving other sites in North Dakota and Minnesota. The overall corellation coefficient (r=.98of Kjeldalh N and Near Infrared Reflectance (NIR) reading for all the data is shown in Figure 1. However the correlation coefficient (r=.976) of Kjeldahl N and NIR reading for C976 data is indicated in Figure 2. The strong correlation coefficient (r=.976) seems to suggest that NIR analysis is as effective as the traditional Kjeldahl method in determining nitrogen levels in wheat leaf tissues.

Correlations of tissue N for each leaf stage and yield, as well as correlations for total N (Soil N + applied N, see Tabel 1) and tissue N for each leaf stage were run using leaf tissue results (Table 3). The correlation coefficients are summarized in Table 4 and 5 as well as Figures 3, 4, 5 and 6. Based on the good correlation for Kjeldahl and NIR values, only KJeldahl values were used for these correlations, consequently only Kjeldahl values are shown in Table 3.

The correlation coefficients were generally poor when data was combined for the two cultivars (Tables 4 and 5). However on individual cultivar basis, the correlation coefficients seemed to be encouraging for each cultivar Figures 3, 4, 5 and 6. Correlation coefficient of tissue N at the sixth leaf stage and harvested yield was slightly higher than that obtained for Katepwa. Similarly correlation coefficient for total nitrogen and tissue N at the sixth leaf stage was higher for HY320 than that obtained for Katepwa.

A detailed discussion on the use of NIR for improving nitrogen management in spring wheat can be found in a paper by Edwardson et al (1989). They concluded that more research is needed in order to build a database of critical nitrogen concentration levels at various plant development stages and across different yield levels for spring wheat varieties. Such information may be used in determining how much additional nitrogen to apply based on the crop yield potential.

TABLE 3. TISSUE N(%) AT VARIOUS LEAF STAGES AND HARVESTED YIELD FOR VARIOUS EXPERIMENTS

	TISSUE N(%) AT VARIOUS LEAF STAGES 4	5	6	7	8	HARVESTED YIELD BU/ACRE
C971 DH	5.09	4.60	4.67	3.72	2.60	28
	2.18	4.77	4.53	3.83	2.70	27
	5.34	4.91	4.67	3.48	2.00	27
	4.98	4.88	4.63	3.51	2.46	26
	5.23	4.91	4.81	3.62	2.84	26
	5.23	5.02	5.02	3.97	2.88	27
C971 NH	4.56	3.51	2.81	1.69	--	36
	3.97	3.34	2.70	1.93	--	56
	5.06	--	3.65	1.26	--	50
	5.20	4.56	3.65	1.79	--	57
	5.02	4.70	4.63	2.39	--	55
	4.25	4.04	2.84	1.58	--	38
	4.98	4.50	3.44	2.18	--	54
C971 IH	4.63	4.39	3.79	2.53	1.79	45
	4.74	4.46	3.86	2.25	2.21	51
	4.84	4.39	4.28	3.09	2.60	53
	4.67	4.25	--	2.81	2.04	53
	4.77	4.56	4.39	3.19	2.42	59
	4.49	4.04	3.34	2.35	1.54	43
	4.60	4.28	3.86	2.74	1.97	51
C971 DP	--	4.91	5.09	4.28	3.12	22
	--	4.98	5.27	4.21	3.23	30
	--	4.95	5.37	4.39	3.37	30
	--	5.23	5.30	4.25	3.02	32
	--	5.13	5.26	4.53	3.26	28
	--	4.77	5.37	4.70	3.44	23
C971 NP	4.42	4.07	3.34	1.82	--	26
	4.21	4.07	3.44	--	--	34
	4.49	5.06	4.53	2.32	--	32
	4.56	4.88	4.39	2.70	--	36
	4.74	5.02	4.42	2.67	--	41
	4.46	4.32	3.72	2.18	--	33
	4.39	4.70	3.93	3.02	--	39
C971 IP	5.23	4.67	4.18	2.82	2.11	44
	5.37	--	4.53	3.54	2.70	55
	--	4.95	5.13	3.65	2.28	60
	5.27	4.91	5.12	4.07	3.09	71
	5.51	5.02	--	3.72	2.77	72
	5.20	4.70	4.21	2.95	1.79	43
	5.13	4.70	4.32	3.34	2.63	68
C975	4.91	4.25	3.83	3.51	--	38
	4.98	4.21	4.11	3.40	--	45
	4.56	4.18	4.04	3.16	--	43
	5.09	4.53	3.83	3.48	--	41
	4.91	4.00	3.76	2.56	--	40
	5.06	4.21	3.83	2.91	--	38

TABLE 3. CONT'D.

	TISSUE N(%) AT VARIOUS LEAF STAGES 4	5	6	7	8	HARVESTED YIELD BU/ACRE
LOW TOPOGRAPHY						
C978	--	3.51	--	2.11	--	64
	--	4.35	--	--	2.53	68
	--	4.25	--	3.41	--	68
	--	4.53	4.84	3.09	--	30
	--	4.18	--	4.00	2.63	63
MEDIUM TOPOGRAPHY						
	4.91	4.67	4.70	2.98	--	31
	4.95	4.56	4.98	2.88	--	26
	4.53	4.18	4.35	2.56	--	30
	4.81	4.53	4.70	2.56	--	30
	4.98	4.35	--	4.35	--	30
HIGH TOPOGRAPHY						
	4.35	3.79	4.11	2.98	--	25
	4.56	4.04	4.46	2.84	--	27
	4.42	3.93	4.18	2.60	--	24
	4.32	3.86	4.11	2.74	--	19
	4.21	3.90	4.18	2.88	--	22
PT960	5.41	5.06	3.76	2.53	--	54

TABLE 4. CORRELATIONS OF TISSUE N FOR EACH LEAF STAGE AND HARVESTED YIELD MINTO 1989

LEAF STAGE	R VALUES BOTH CULTIVARS	KATEPWA	HY320
4	0.364		
5	-0.038		
6	-0.268	0.579	0.731
7	-0.150		
8	-0.281		

TABLE 5. CORRELATIONS OF TOTAL N AND TISSUE N FOR EACH LEAF STAGE MINTO 1989

LEAF STAGE	R VALUES BOTH CULTIVARS	KATEPWA	HY320
4	0.372		
5	0.171		
6	0.134	0.601	0.722
7	0.112		
8	0.175		

FIGURE 1. CORRELATION OF NIR AND KJELDAHL TISSUE N VALUES
(VARIOUS SAMPLES FROM U.S.A AND CANADA)

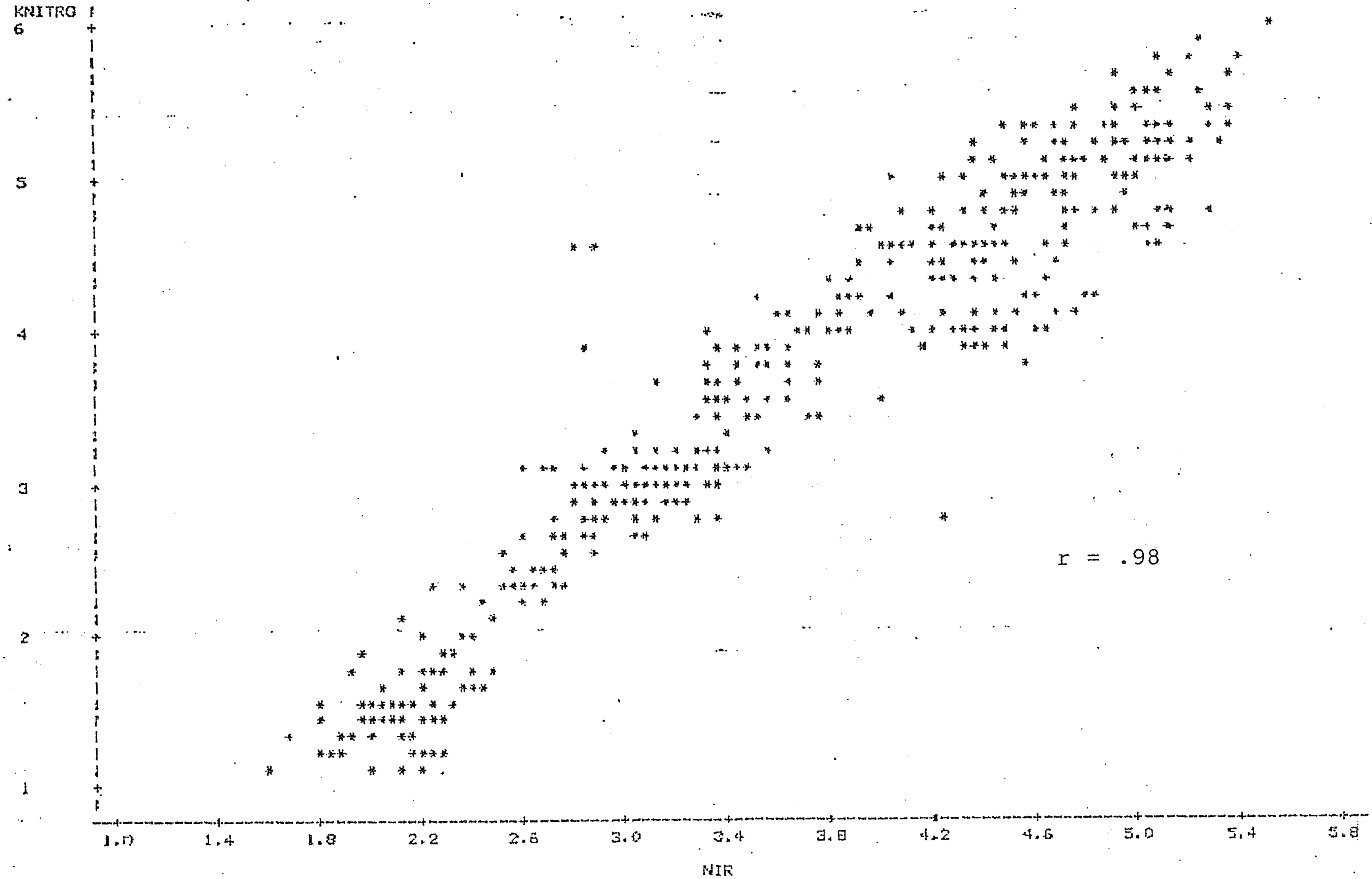


FIGURE 2. CORRELATION OF NIR AND KJELDAHL TISSUE N VALUES
KATEPWA AND HY 320 MINTO 1989

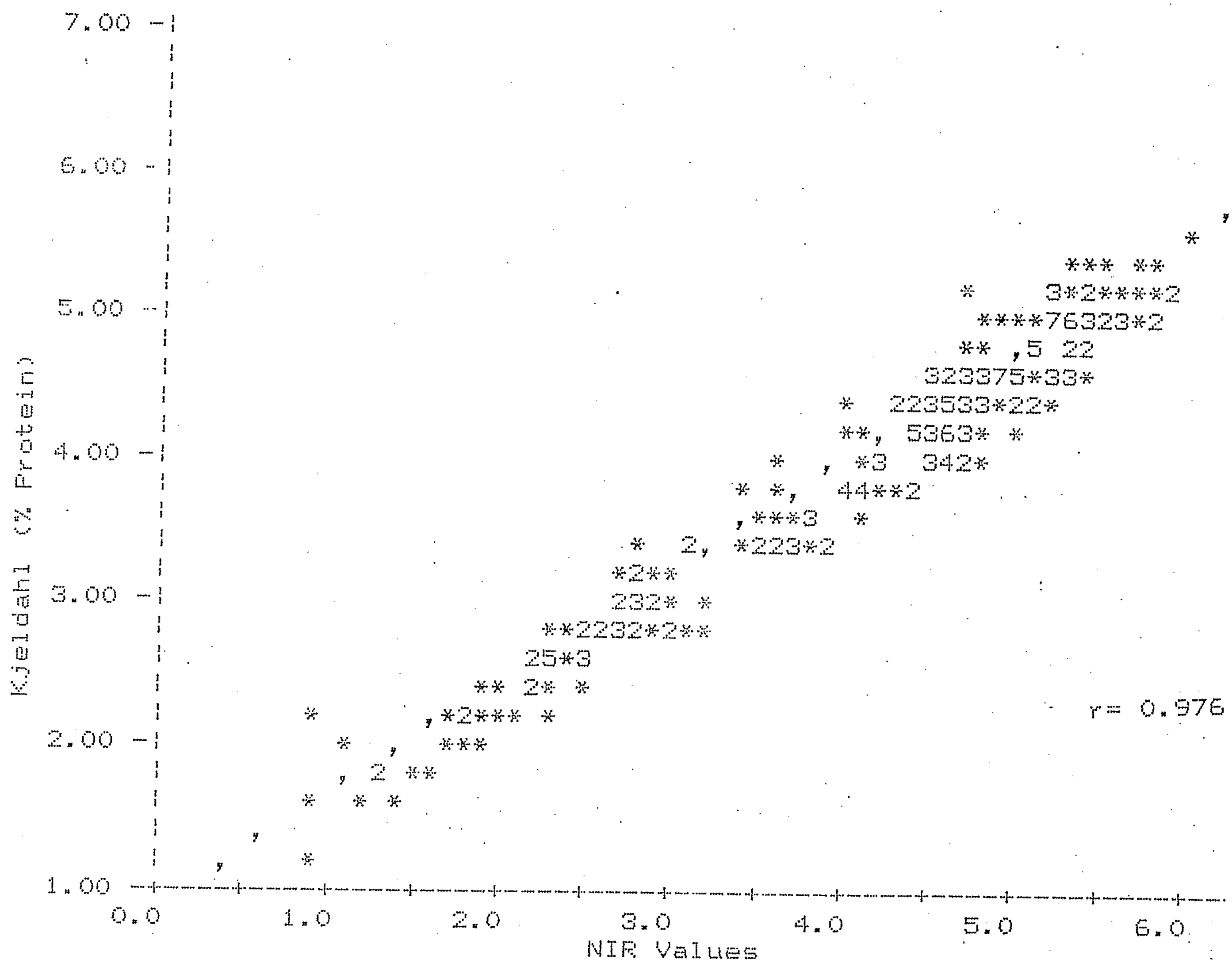


FIGURE 3. CORRELATION OF TISSUE N AT THE SIXTH LEAF STAGE AND HARVESTED YIELD KATEPWA MINTO 1989

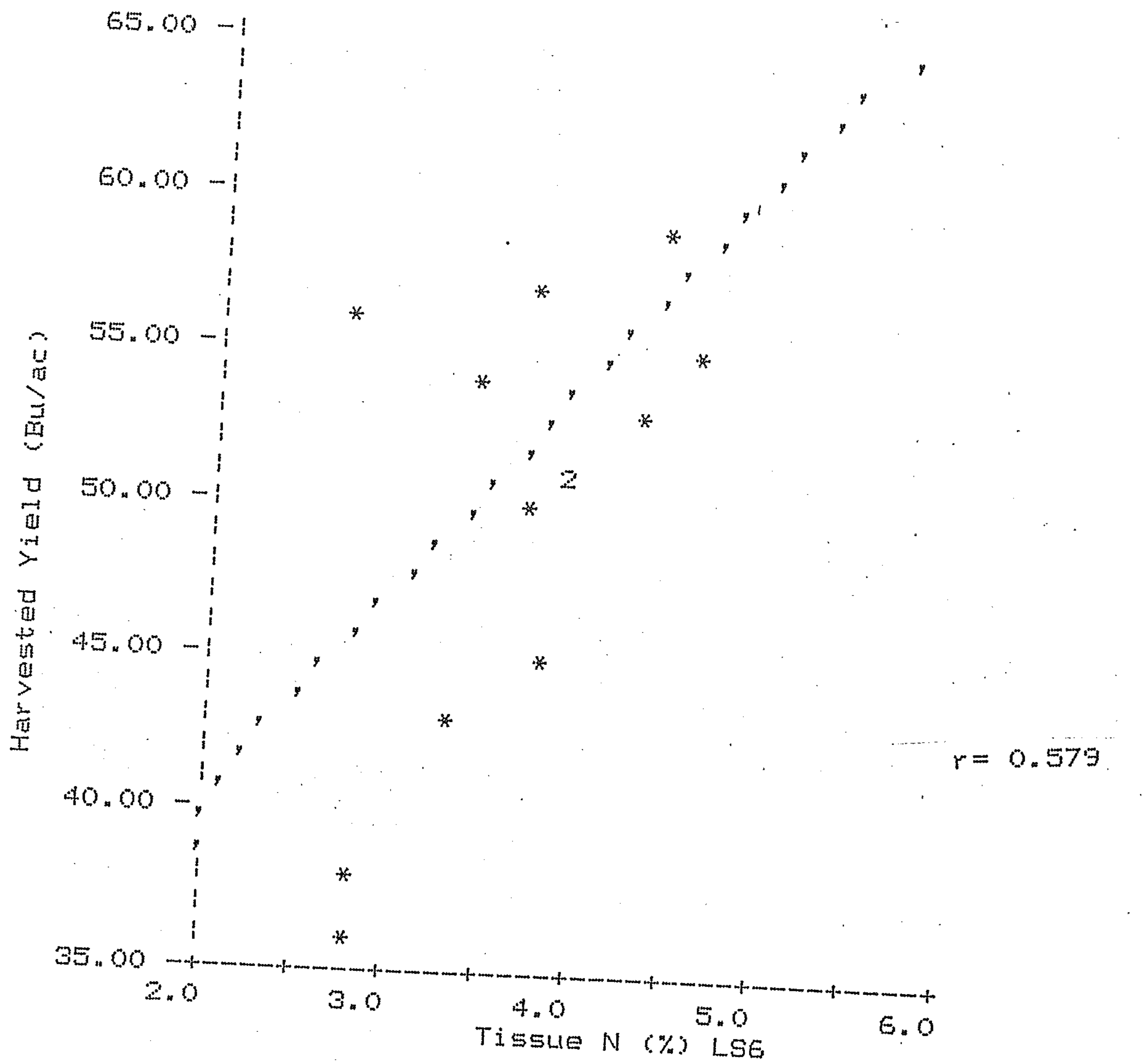


FIGURE 4. CORRELATION OF TISSUE N AT THE SIXTH LEAF STAGE AND HARVESTED YIELD HY 320 MINTO 1989

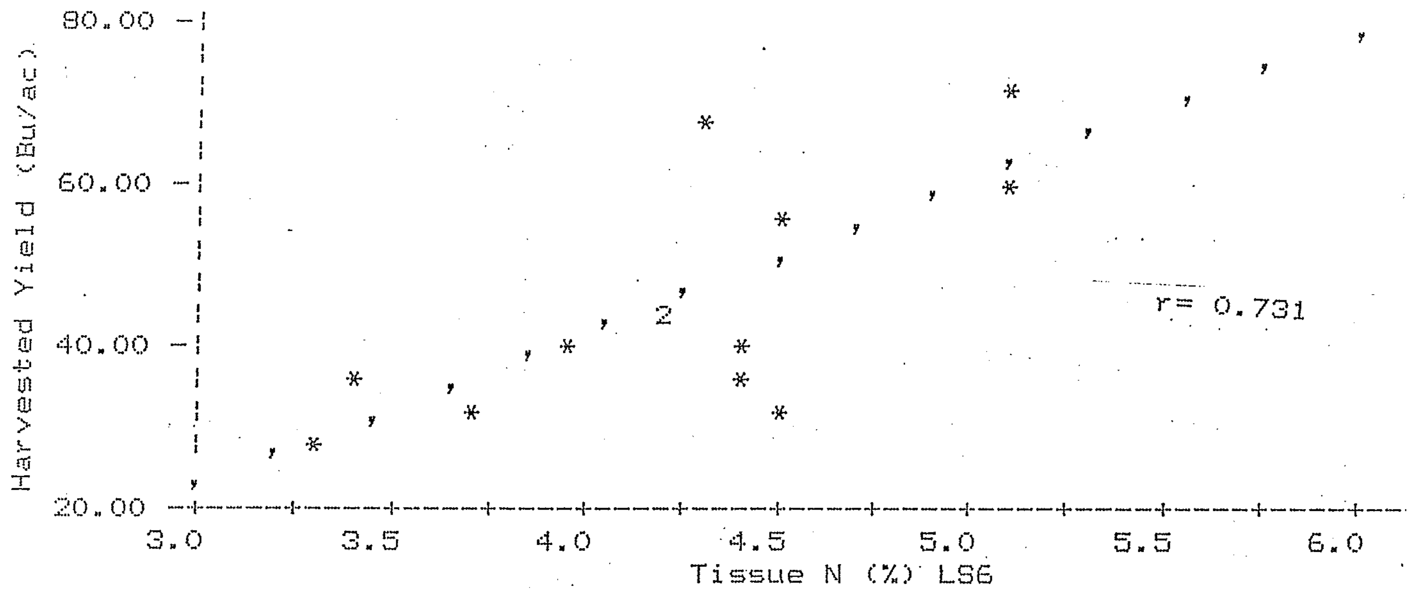


FIGURE 5. CORRELATION OF TOTAL N (SOIL N + APPLIED N) AND TISSUE N AT THE SIXTH LEAF STAGE KATEPWA MINTO 1989

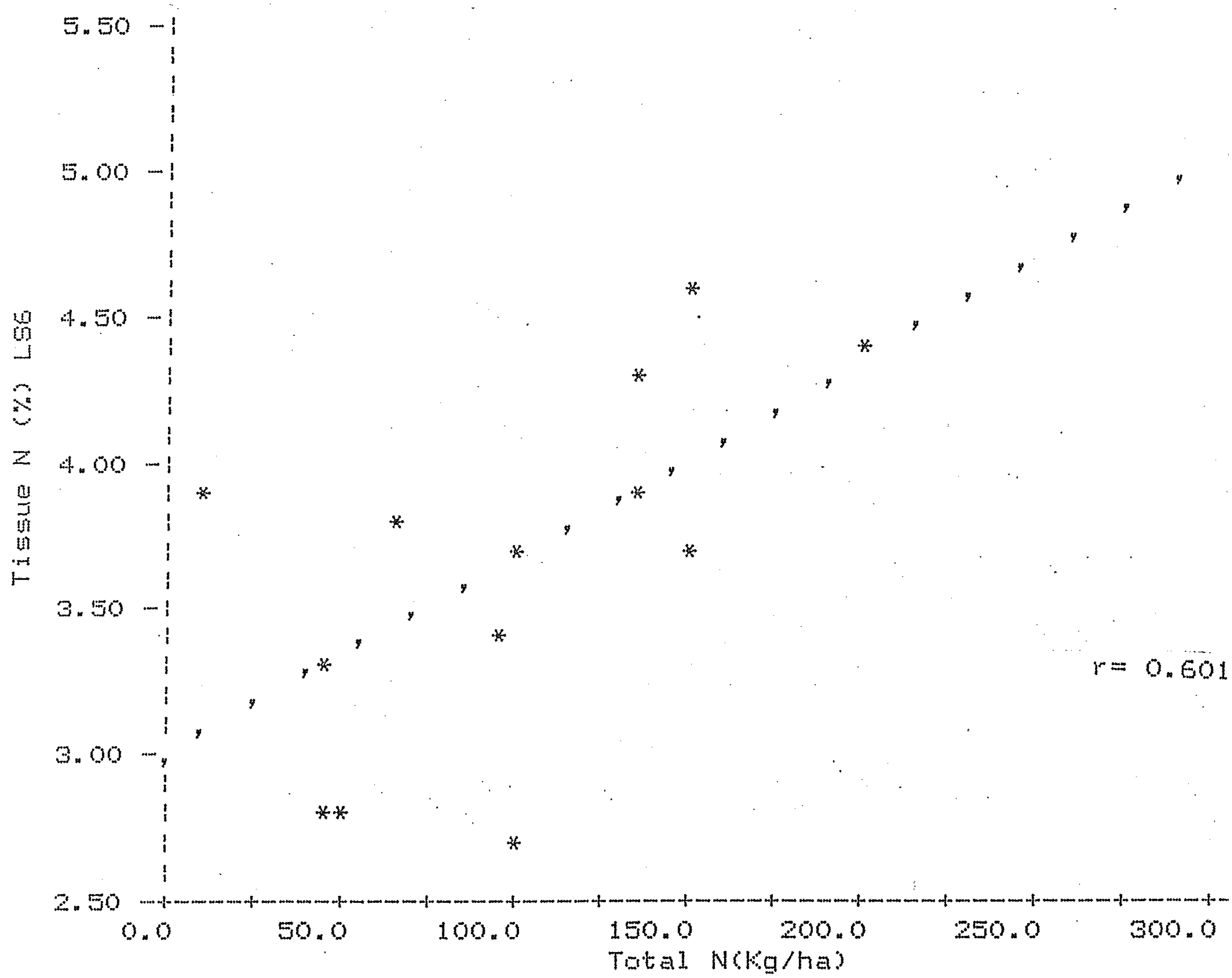
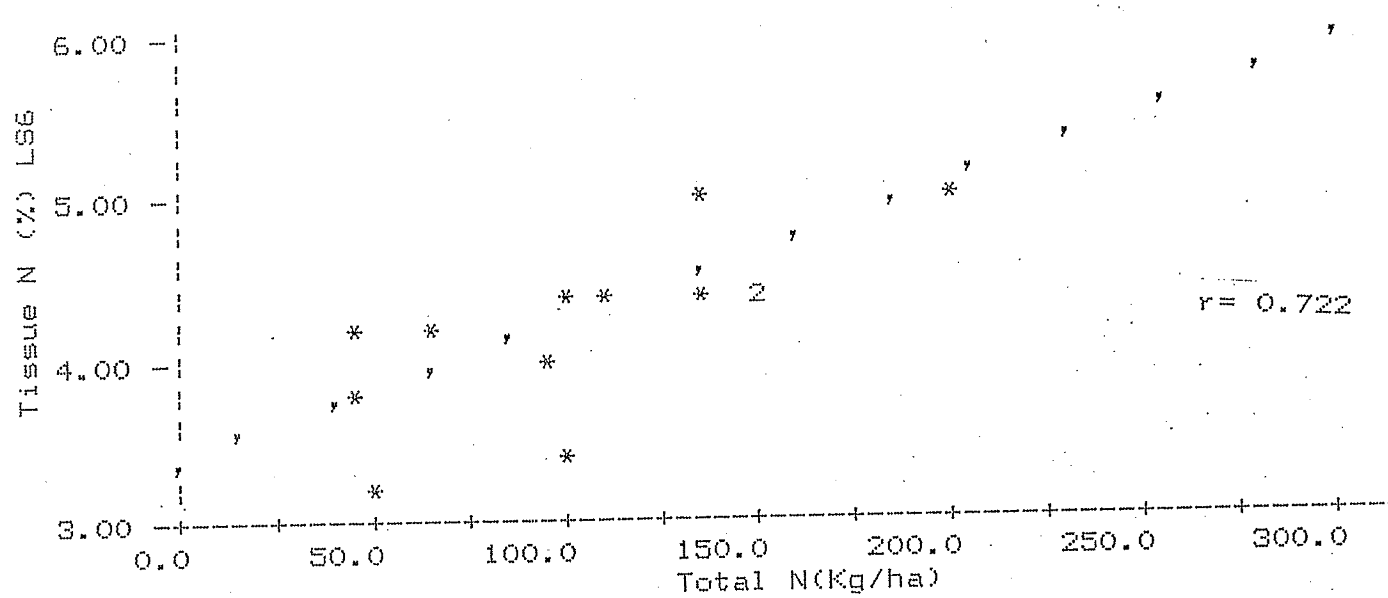


FIGURE 6. CORRELATION OF TOTAL N (SOIL N + APPLIED N) AND TISSUE N AT THE SIXTH LEAF STAGE HY320 MINTO 1989



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REFERENCE

Edwardson, S.E., E.H.Vasey and C.E. McDonald. 1989. Use of Near Infrared (NIR) Reflectance for Improving Nitrogen Management in Spring Wheat. In Proc. North Dakota Agricultural Association 1989 Crop Production Guide 223-233, NDSU, Fargo, North Dakota

SECTION G FLEXIBLE N MANAGEMENT

LIST OF FIGURES

LIST OF TABLES

FLEXIBLE N MANAGEMENT

DAVID R. S. ROURKE & MARGARET ADARAN*
AG-QUEST, INC., MINTO, MANITOBA

Maximum economic yields of wheat rely heavily on having an adequate supply of nitrogen. Though considerable effort, target yield fertilizer recommendations have been developed in Manitoba (Fehr, 1970, McGill, 1982). While these recommendations have served the farmers of Manitoba well (Ewanek, 1983). Josepheson & Zbeetnoff (1988) identified a number of areas which if addressed could have the potential to further improve the utility of the fertilizer recommendations. One of Josepheson's suggestions was to develop a data base which would permit better prediction of the likelihood of conditions which are highly correlated to yield response. Josepheson suggests a number of factors could be examined such as moisture prediction, soil physical factors, effect of management, timing of operations, seeding dates, etc.

One approach to addressing this suggestion is to develop a system which will predict the final yield prior to seeding. Bauder (1984) working in Montana developed a method of estimating small grain yield potential from stored soil moisture and rainfall probabilities. This compliments earlier work by Brown et al (1981) who developed a system of flexible cropping for dryland areas based on stored soil moisture and rainfall probability.

Earlier work by Black and Ford (1976) suggests as available water increases the need for N increases to achieve a higher yield. In their model, 2 pounds of nitrogen were needed for each bushel of wheat harvested. This relationship is different from the official North Dakota model (Dahnke 1989) or from the Manitoba Soil Testing Laboratory model (McGill 1982).

In the spring of 1988 the Canada Grains Council undertook a project entitled "Development of a Risk Management Guide for Wheat Producers". The objective of the project is to develop a risk management guide (RMG) which would enable wheat producers to evaluate the risk and probability of success associated with the use of inputs or other management practices throughout the growing season. The motivation for the project was a desire to fine tune wheat production practices for areas where wheat yields can be highly variable. On many Manitoba farms with an average wheat yield of 40 bushels/acre, it is not uncommon to experience a yield range of 10 to 60 bushels/acre. While many farmers adjust inputs intuitively to variations in yield, developing a RMG would help to ensure the best decision was made.

One of the areas involved in the RMG study is the development of a flexible nitrogen management strategy. The key components of the strategy are:

1) Target yield - establish initial yield goal or target yield on a field specific basis;
2) Base fertilizer application - Fertilize recommendations to achieve the target yield;

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*Presented on behalf of the Canada Grains Council, Winnipeg, Man.

3) Yield Tracking - determine yield potential at critical growth stages of the crop;
4) Supplementary Fertilizer Decision and Application - system to determine whether additional nitrogen is required.

The flexible nitrogen study was designed as a two tier study. The first tier studies were conducted at Minto, Manitoba on a Ryerson clay loam from 1988 to 1990. Studies were conducted using two types of wheat, Katepwa (HRS) and HY320 (CPS) under two different moisture regimes, normal rainfall (N) and high rainfall (I). The additional water on the high rainfall experiments was applied through sprinkler irrigation to raise the growing season precipitation to a level approximately 50% higher than the long term average season precipitation. In 1989, irrigation was also used prior to seeding to maximize stored soil water on the high rainfall plots. Only the data involving Katepwa wheat will be presented.

The second tier of studies involved cooperators from across Manitoba with some sites in Saskatchewan and Alberta. The cooperator studies were used primarily to expand the data base for correlating target yield and yield tracking to harvested yield. The cooperator program was established in 1989 and is scheduled to finish in 1991.

The primary flexible N management studies examined the yield response of Katepwa to topdressed nitrogen when various target yield/N levels were established at seeding. The treatments are shown in Table 1.

TABLE 1. TREATMENT LIST

TARGET YIELD (1) %	N AT SEEDING (2) % OF TARGET REQUIREMENT	N AT GS 31 (3) % OF TARGET REQUIREMENT	TOTAL N % OF TARGET
1. 50	50	0	50
2. 50/50	50	50	100
3. 75	75	0	75
4. 75/50	75	50	125
5. 100	100	0	100
6. 100/50	100	50	150
7. 125	125	0	125
8. 125/50	125	50	175
9. 150	150	0	150
10. 150/50	150	50	200

(1) Target Yield = (*Available soil water & average ppt for 90 day period after seeding) - 5 inches x 4 bu/inch

Fertilizer Nitrogen Requirement for Target Yield =
Target yield x 2 lbs N/bu - soil NO3 - N to 2 feet

(2) N at seeding applied in a band between every other row using 46-0-0

(3) N at GS 31 applied as a broadcast treatment using 34-0-0

The basic information for the trials can be found in Table 2. The trials were established on a Ryerson clay loam soil (27% sand, 48% silt and 25% clay, organic matter 4.7% and pH 7.5). Katepwa hard red spring wheat was seeded at a rate of 300 viable seeds/m2. P205 and K20 were placed with the seed at rates of 50 and 30 kg/ha respectively. The seed was treated with Vitavax; herbicides and fungicides were used as needed to control crop pests. Plots were harvested with a Wintersteiger plot combine taking a 1.25 x 6 m sample from the centre of each plot. The trials were conducted as 4 replicate RCBD, with plots sizes of 2 x 7.5 m. Results were analyzed at the 5% level and Duncan's Multiple Range Test used to separate means. Other flexible N management studies examined sources and methods of nitrogen application for topdressed N

The high correlation indicates there is a potential to use stored soil water and average precipitation data to form the basis for setting field specific yield goals (Target yield). Further refinement to the target yield calculation may involve adjusting the water use efficient factor to suit local conditions and varieties, using moisture deficit data rather than rainfall data or to use various rainfall probabilities in the target yield formula.

Since rainfall within a particular growing season is in itself very unpredictable, the ability to respond to changes in the growing season precipitation from the normal could be advantageous in terms of managing fertilizer input to achieve optimum economic yields. To this end a method was evaluated to estimate yield potential during the growing season.

YIELD TRACKING

The yield tracking formula used in this study was based on an arithmatic calculation of yield components.

Yield potential(bu/acre) =
(# of plants/m2 x tillers/plant x spikelet/head x .392) / 67.25

Zadoks growth stage 31 (5.5 leaf stage) is the earliest growth stage at which the head can be dissected from the stem and individual spikelets can be differentiated using the naked eye or a magnifying glass.

The results of the 1988-90 Growth Stage 31 Yield Tracking Correlations are summarized in Figure 2. There were 37 data points used in the correlations. The data collected for each data point (4 replicates) included plant counts from 1 square meter, tiller counts from 25 plants and spikelet counts from 10 plants which included the spikelet counts from the main stem as well as the tillers.

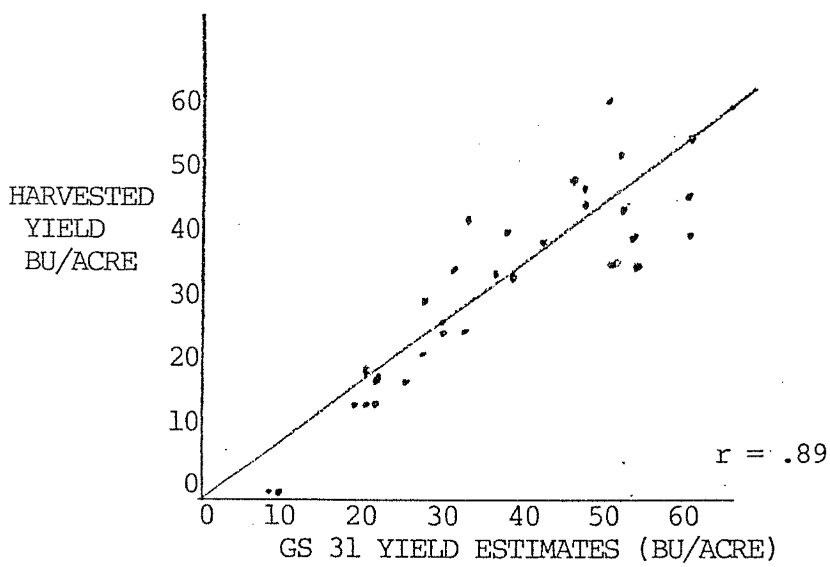


FIGURE 2. CORRELATION OF GS 31 YIELD ESTIMATES TO HARVESTED YIELD KATEPWA WHEAT, MINTO 1988-90

The high correlation indicates there is a potential to use yield tracking formula to predict final yields. Unfortunately yield tracking formula presented is variety specific. The reason for the variety specificity is primarily due to differences in floret number and kernel size which can differ greatly between varieties. For example, HY320 normally has a greater number of fertile florets and large kernel size Katepwa. It is also important to applications, timing of topdress N application, calibration of Brown soil probe, relationship of tissue N at 4, 5, 6 and 7 leaf stage with total N supply and final yield and effect of field variability on yield tracking. In the interest of brevity only the results of the studies conducted at Minto on Target Yield, Yield Tracking and topdressing will be presented.

TABLE 2. SITE INFORMATION - MINTO

YEAR	MOISTURE REGIME	TARGET YIELD BU/ACRE	AVAILABLE WATER (INCHES) SOIL AVAILABLE WATER(1)	RAINFALL 90 DAYS	ACTUAL RAINFALL (3)	NO3-N	P	K	S	SEED DATE
1988	Normal	40	7.0	8.0	7.0	30	18	702	149+	May11
1988	High	80	8.0	17.0	12.0	50	18	702	149+	May11
1989	Normal	40	6.6	8.4	5.2	44	19	824	149+	May13
1989	High	60	8.0	12.0	9.7	44	19	824	149+	May13
1990	Normal	34	5.6	8.0	12.0	49	10.4	396	126+	May19
1990	High	50	5.6	12.0	12.0	49	10.4	396	126+	May19

NO3-N, P, K, S: LBS/ACRE

(1) Available soil water at seeding based on system devised by Brown using depth of moist soil and soil texture (Brown et al 1981)
(2) Extra water was not applied to the high rainfall site in 1990 due to high natural rainfall.
(3) 100 year average rainfall for May, June and July is 7.8 inches.

RESULTS

TARGET YIELD

The results of the 1988-1990 target yield correlations are summarized in Figure 1. Target yield estimates were correlated to harvested yield from 13 experiments.

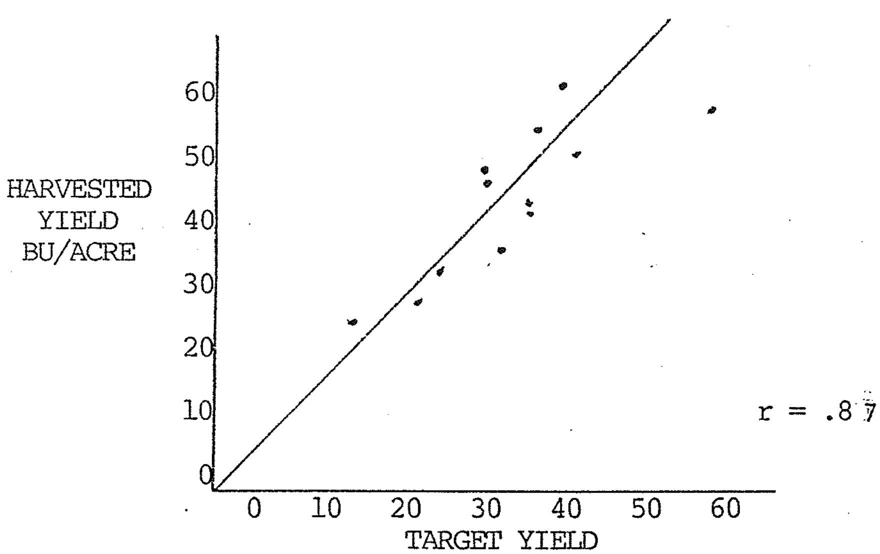


FIGURE 1. CORRELATION OF TARGET YIELD AND HARVESTED YIELD KATEPWA WHEAT, MINTO 1988-90

note that varieties which have larger floret number and kernel size often are more sensitive to late season drought than varieties like Katepwa. It follows that the correlation between yield tracking and final yield will tend to be more accurate for varieties which are less sensitive to conditions which occur after GS 31.

The importance of using a variety specific formula and using all available yield components to estimate yields can be shown by comparing the results of yield predictions from two different yield estimating formulas.

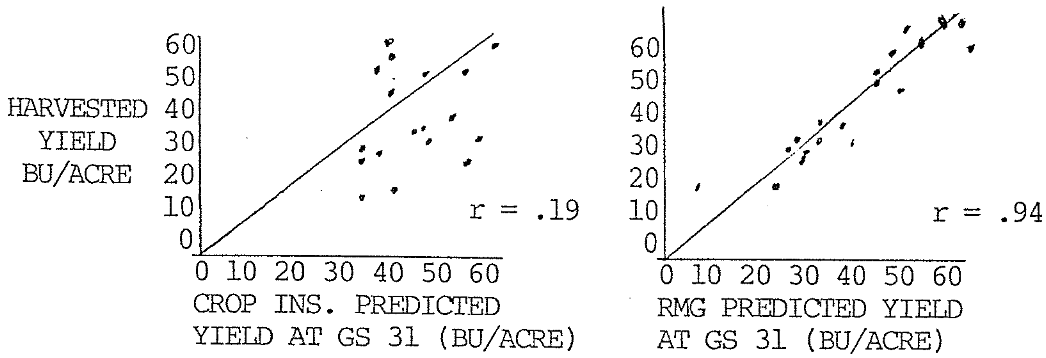


FIGURE 3. CORRELATIONS OF PREDICTED YIELDS AT GS 31 AND HARVESTED YIELDS, KATEPWA WHEAT, MINTO 1988-89

The 1988 and 1989 yield tracking data was used with the RMG formula (Figure 3A) and Manitoba Crop Insurance formula (Figure 3B). At Growth Stage 31, the Crop Insurance formula bases the yield prediction on plant counts only and constants are used for all other yield components.

SUPPLEMENTARY FERTILIZER DECISION AND RESPONSE

When conditions change, such as higher than expected rainfall, the wheat crop could have a yield potential higher than the original target yield. In these circumstances there is a need to have a guide to making a decision regarding a topdress application of nitrogen. A number of criteria could be used in the decision including critical tissue N and yield tracking. Alley et al (1987) have developed critical tissue N levels for use with wheat production in Virginia. On a cooperative study with Dr. Vasey at NDSU, Fargo plant samples were collected at the 4, 5, 6 and 7 leaf stage of the crop at various base N levels, topdressing and moisture conditions. The samples have been analyzed for tissue N using both the traditional Kjeldahl method as well as using near infrared technology. Edvardson et al (1989) in preliminary studies found a good correlation between the two methods. Further assessment of the utility of determing a critical tissue N level for specific growth stage is pending.

One possible method of using GS 31 yield estimates for determining topdressing requirements it so simply compare the target yield with GS 31 yield estimates. If the GS 31 yield estimates is greater, then topdressing should be considered. The rate of N required for the topdressing still needs to be calibrated. Table 3 contains an illustration of a situation where this simple method would help to increase yields in a year of higher than average rainfall.

The data presented in Table 3 is from a 1990 experiment conducted under natural rainfall conditions at Minto. Rainfall was approximately 50% higher than the long term average during the 1990 growing season.

TABLE 3. TOPDRESSED NITROGEN TRIAL, KATEPWA, MINTO 1990

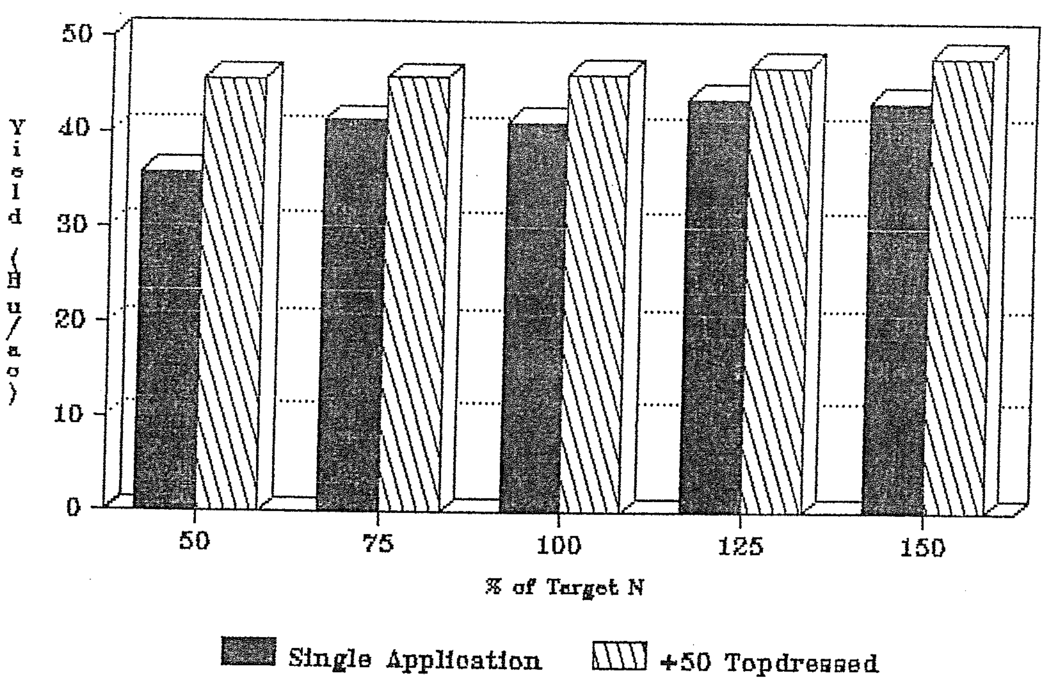
TREATMENT % OF TARGET N	TARGET YIELD(1)	GS 31 YIELD ESTIMATE (2)	DIFFERENCE (2)-(1)	HARVESTED YIELD
50	34	40	6	35
50/50	--	-	-	45

The yield advantage in this situation was 10 bushels/acre for an additional 34 lbs of nitrogen.

RESPONSES TO POST-EMERGENT N APPLICATIONS

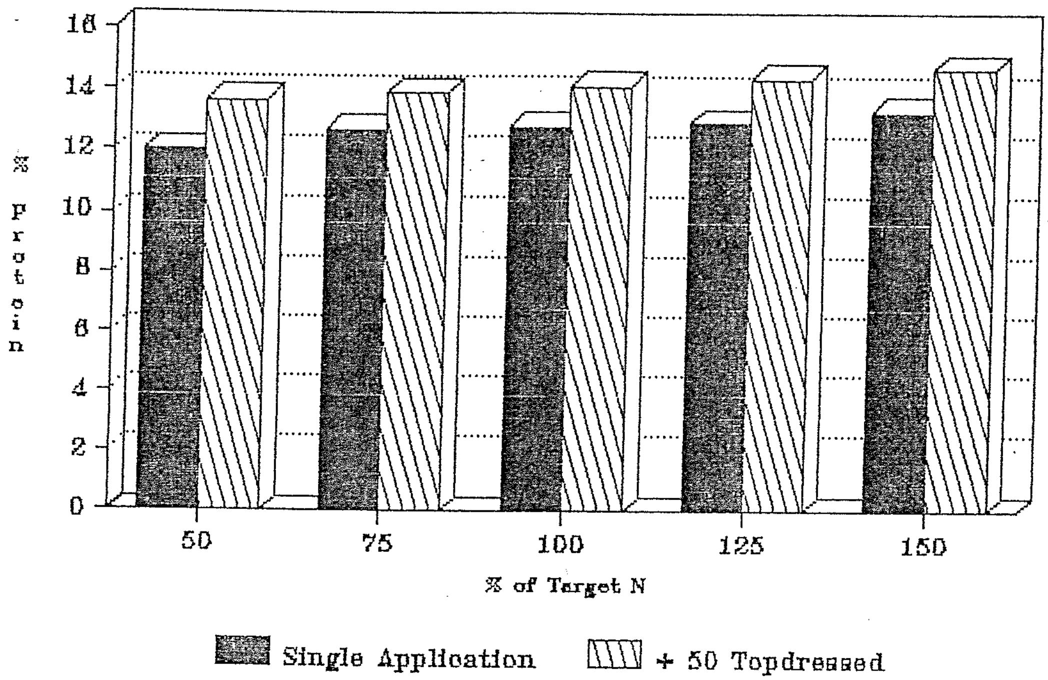
The yield and protein response of Katepwa wheat to topdressed N applications when various target yield/N levels were established at seeding is given in Figures 4 & 5 respectively. The figures represent data collected in 1988, 89 and 90 at two different moisture regimes, normal rainfall and high rainfall. Maximum yields from single N applications are achieved between the 100 and 125% of target N level.

Fig. 4 Response of Katepwa to
Single & Split N Application



High & Medium Moisture Minto 1988-90

Fig. 5 Response of % Protein in Katepwa
To Single & Split N Application



High & Medium Moisture Minto 1988-90

The topdressed N treatments were shown to significantly increase yield and protein levels compared to their respective base N level. The yield difference between the 50% treatment and the 50/50 treatment was 11.1 bu/acre. The protein difference was 1.7%. When treatments with equal total N levels are compared, the split N treatment continue to have an advantage. The yield difference between the 100 treatment and the 50/50 treatment was 4.9 bu/acre with a protein advantage of 9%. Alkier et al (1972) also found positive responses to topdressing at the 5th leaf stage, however the responses were smaller than those found in the current study.

The data supports the potential use of yield tracking and post emergent nitrogen application as a method of achieving more optimum yields especially in situations when GS 31 yield estimate is larger than the original yield goal.

CONCLUSIONS

Flexible N management for post emergent N applications which includes the use of target yields, base nitrogen application, yield tracking and supplementary nitrogen applications has been shown to have the potential to increase yields in years when growing conditions become more favourable than first expected. Further work in the development of flexible nitrogen management will need to assess the concepts on a broader base and factor in some of the missing components such as critical tissue N levels and economics. The system must also be examined to determine how it can compliment the present provincial target yield fertilizer recommendations.

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SECTION H FLEXIBLE N MANAGEMENT - HY320

LIST OF FIGURES

LIST OF TABLES

FLEXIBLE NITROGEN MANAGEMENT - HY320

Flexible N studies have been conducted at Minto during the last three years (1988-90) using low, medium and high moisture conditions each year. The studies mainly examined the yield and protein response to topdressed nitrogen. Target yield and nitrogen requirements were established at seeding time. The various treatments are indicated in Table 1.

TABLE 1. TREATMENT LIST

TARGET YIELD (1) %	N AT SEEDING (2) % OF TARGET REQUIREMENT	N AT GS 31 (3) % OF TARGET REQUIREMENT	TOTAL N % OF TARGET
1. 50	50	0	50
2. 50/50	50	50	100
3. 75	75	0	75
4. 75/50	75	50	125
5. 100	100	0	100
6. 100/50	100	50	150
7. 125	125	0	125
8. 125/50	125	50	175
9. 150	150	0	150
10. 150/50	150	50	200

(1) Target Yield = (*Available soil water & average ppt for 90 day period after seeding) - 5 inches x 5.2 bu/acre/inch

Fertilizer Nitrogen Requirement for Target Yield =
Target yield x 2 lbs N/bu* - soil N to a depth of 2 feet
*Assuming that HY320 requires 2 lbs of N per bushel of grain

(2) N at seeding applied in a band between every other row using 46-0-0

(3) N at GS 31 applied as a broadcast treatment using 34-0-0

The fundamental site information is summarized in Table 2. Randomized complete block trials with four replicates and 2 x 7.5 m plots were conducted on a Ryerson clay loam soil (27% sand, 48% silt and 25% clay). Organic matter was 4.7% and pH was 7.5.

TABLE 2. SITE INFORMATION - MINTO

YEAR	MOISTURE REGIME	TARGET YIELD BU/ACRE	AVAILABLE WATER (INCHES) SOIL AVAILABLE WATER(1)	RAINFALL 90 DAYS	ACTUAL RAINFALL (3)	NO3-N	P	K	S	SEED DATE
1988	Normal	52	7.0	8.0	7.0	30	18	702	149+	May11
1988	High	104	8.0	17.0	12.0	50	18	702	149+	May11
1989	Normal	57	6.6	8.4	5.2	44	19	824	149+	May15
1989	High	78	8.0	12.0	9.7	44	19	824	149+	May13
1990	Normal	45	5.6	8.0	12.0	49	10.4	396	126+	May11
1990	High	65	5.6	12.0	12.0	49	10.4	396	126+	May11

NO3-N, P, K, S in LBS/ACRE.

(1) Available soil water at seeding based on a system devised by Brown using depth of moist soil and soil texture (Brown et al 1981)
(2) Extra water was not applied to the high rainfall site in 1990 due to high natural rainfall.
(3) 100 year average rainfall for May, June and July is 7.8 inches.

Seeding rate was 300 viable seeds/m2 (111 kg/ha). P2O5 and K2O were placed with the seed at rates of 50 and 30 kg/ha respectively. Seed was treated with Vitavax; herbicides and fungicides were used when needed to control crop pests. Plots were harvested with a Wintersteiger plot combine taking a 1.25 x 6 m samples from the centre of each plot. The data was subjected to analysis of variance and means separated by Duncan's Multiple Range Test 5% level of significance.

RESULTS AND DISCUSSION

TARGET YIELD

Target yield estimates were correlated to harvested yield from 9 experiments conducted during 1988-90. A low correlation coefficient (r=.25) was obtained as shown in Figure 1. This correlation coefficient (r=.25) is much lower than that obtained for Katepwa for the same period (r=.87). This observation would seem to suggest that there is genotypic differences in response to the target yield formula. Further refinement to the target yield calculation to suit a particular variety is required. In refining the formula, factors including water use efficiency as well as nitrogen requirements may need to be adjusted. The suitability of moisture deficit data or various rainfall probabilities may be explored for use in the target yield formula.

Since rainfall within a particular growing season is in itself very unpredictable, the ability to respond to changes in the growing season precipitation from the normal could be advantageous in terms of managing fertilizer input to achieve optimum economic yields. To this end a method was evaluated to estimate yield potential during the growing season.

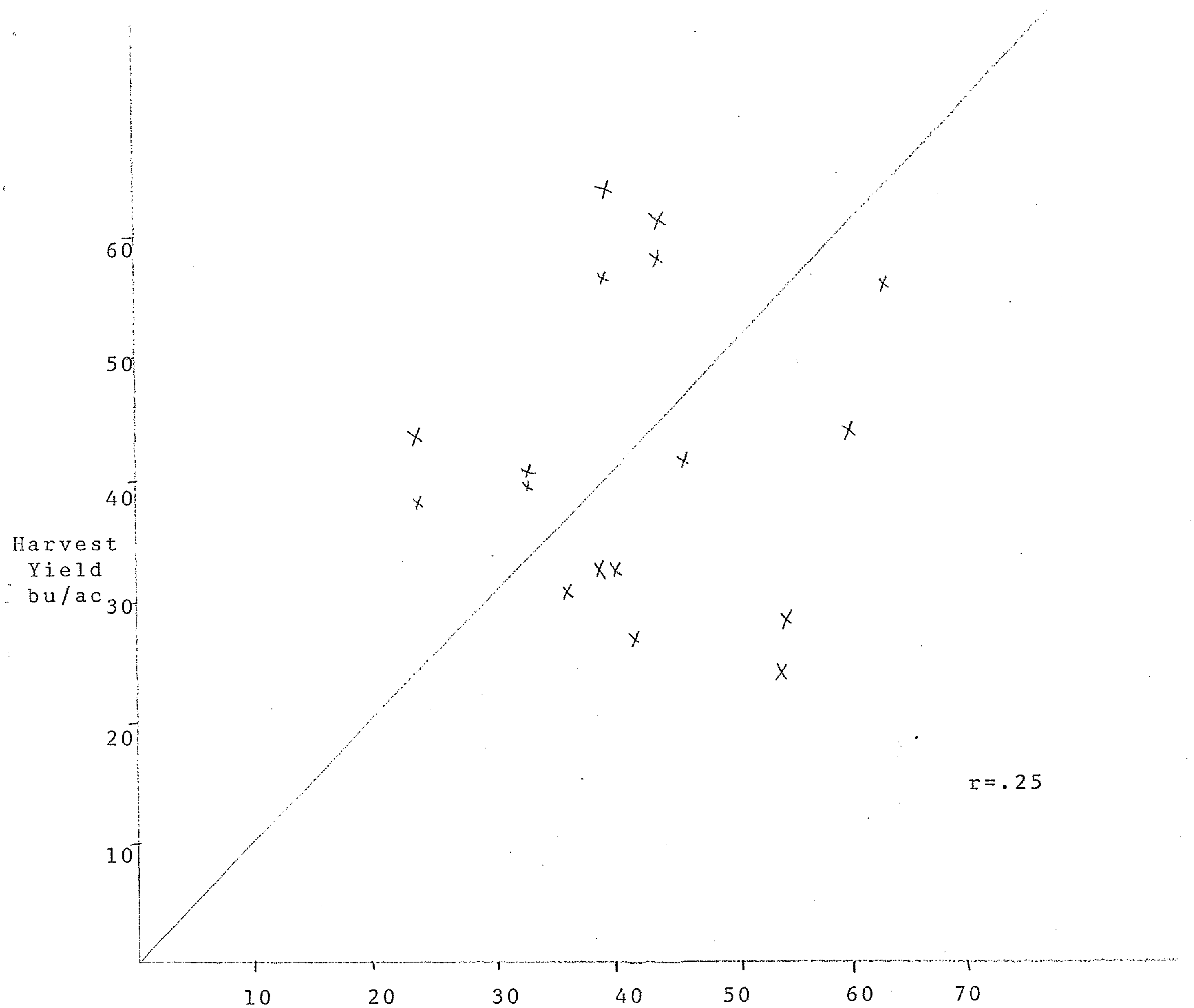


FIGURE 1. CORRELATION OF RMG TARGET YIELD AND HARVESTED YIELD
HY320 MINTO 1988-90

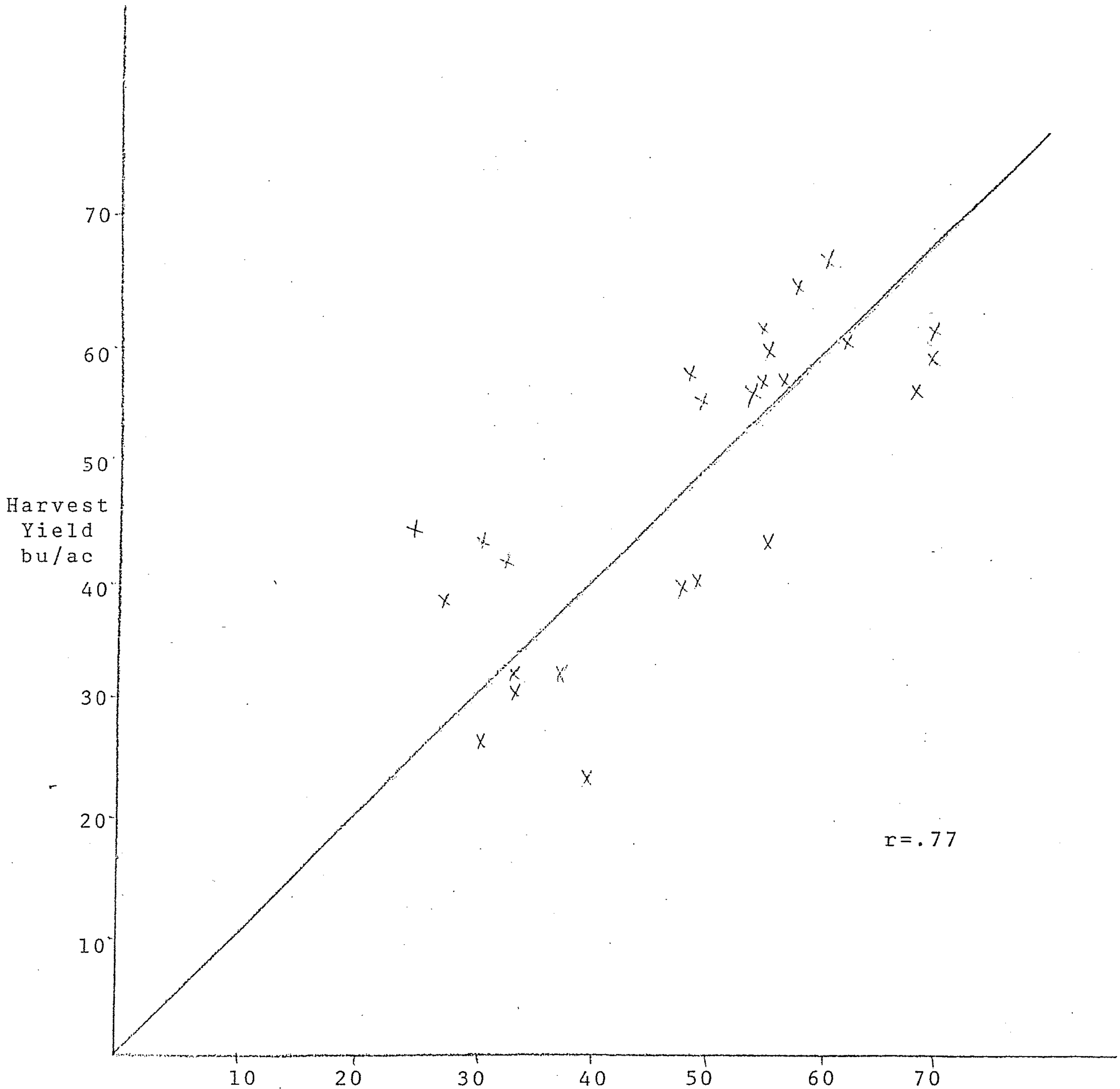


FIGURE 2. CORRELATION OF RMG ESTIMATED YIELD AT G.S.31 AND HARVESTED YIELD, HY320 MINTO 1988-90

YIELD TRACKING

The yield tracking formula used in this study was based on an arithmatic calculation of yield components.

Yield potential(bu/acre) =
(# of plants/m2 x tillers/plant x spikelet/head x .480) / 67.25

Zadoks growth stage 31 (5.5 leaf stage) is the earliest growth stage at which the head can be dissected from the stem and individual spikelets can be differentiated using the naked eye or a magnifying glass.

The results of the 1988-90 Growth Stage 31 Yield Tracking Correlations are summarized in Figure 2. There were 25 data points used in the correlations. The data collected for each data point (4 replicates) included plant counts from 1 square meter, tiller counts from 25 plants and spikelet counts from 10 plants which included the spikelet counts from the main stem as well as the tillers.

The correlation coefficient (r=.77) of estimated yield at G.S.31 and harvested yield obtained for HY320 is slightly lower than that obtained for Katepwa (r=.89). Nonetheless, the observation indicates that there is a potential to use yield tracking formulas to predict final yields. The yield tracking formula also seems to be variety specific and may still need to be improved, for example the multiplication factor (.480). The reason for the variety specificity as reported in the previous section (Flexible N Management, Katepwa) appears to be due to differences in floret number and kernel size. These traits can greatly differ between varieties. For instance, HY320 normally has a greater number of fertile florets and large kernel size than Katepwa. A point to note is that varieties which have larger floret numbers and kernel size often are more sensitive to late season drought than varieties like Katepwa. It therefore follows that the correlation between yield tracking and final yield would tend to be more accurate for varieties which are less senstiive to stress conditions occuring after G.S.31.

The importance of using a variety specific formula and using all available yield components to estimate yields can be shown by comparing the results of yield predictions from two different yield estimating formulas.

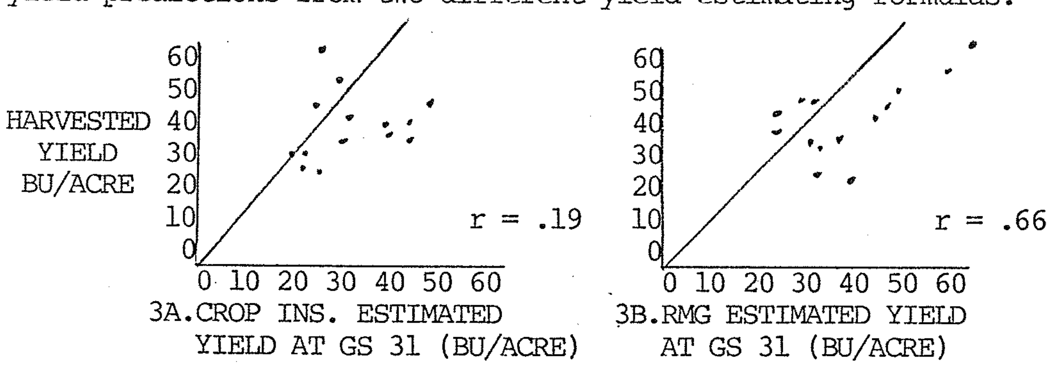


FIGURE 3. CORRELATIONS OF RMG ESTIMATED YIELDS AT GS 31 AND HARVESTED YIELDS, HY320, MINTO 1988-89

The 1988 and 1989 yield tracking data was used with the RMG formula (Figure 3A) and Manitoba Crop Insurance formula (Figure 3B). At Growth Stage 31, the Crop Insurance formula bases the yield prediction on plant counts only and constants are used for all other yield components.

SUPPLEMENTARY FERTILIZER DECISION AND RESPONSE

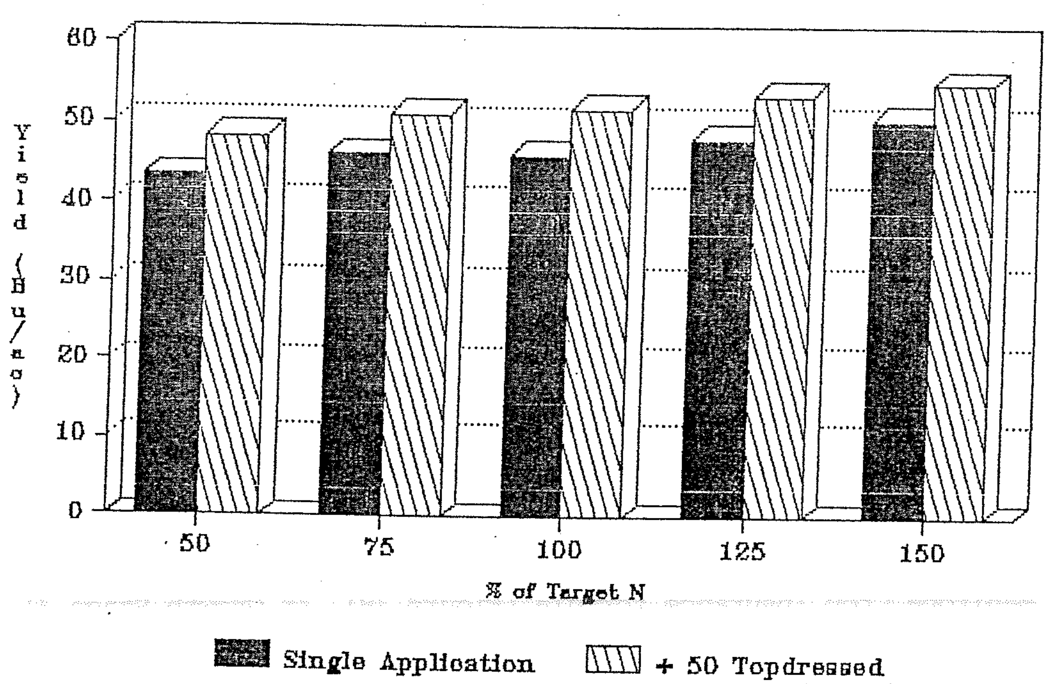
When conditions change, such as higher than expected rainfall, the wheat crop could have a yield potential higher than the original target yield. In these circumstances there is a need to have a guide to making a decision regarding a topdress application of nitrogen. A number of criteria could be used in the decision including critical tissue N and yield tracking. Alley et al (1987) have developed critical tissue N levels for use with wheat production in Virginia. On a cooperative study with Dr. Vasey at NDSU, Fargo plant samples were collected at the 4, 5, 6 and 7 leaf stage of the crop at various base N levels, topdressing and moisture conditions. The samples have been analyzed for tissue N using both the traditional Kjeldahl method as well as using near infrared technology. The results can be found in Section F of this report. Edwardson et al.,(1989) in preliminary studies found a good correlation between the two methods. Further assessment of the utility of determing a critical tissue N level for specific growth stage is pending.

One possible method of using GS 31 yield estimates for determining topdressing requirements is to simply compare the target yield with GS 31 yield estimates. If the GS 31 yield estimates is greater, then topdressing should be considered. The rate of N required for the topdressing still needs to be calibrated. For purposes of illustration see Table 3 in the Flexible N section for Katepwa.

RESPONSES TO POST-EMERGENT N APPLICATIONS

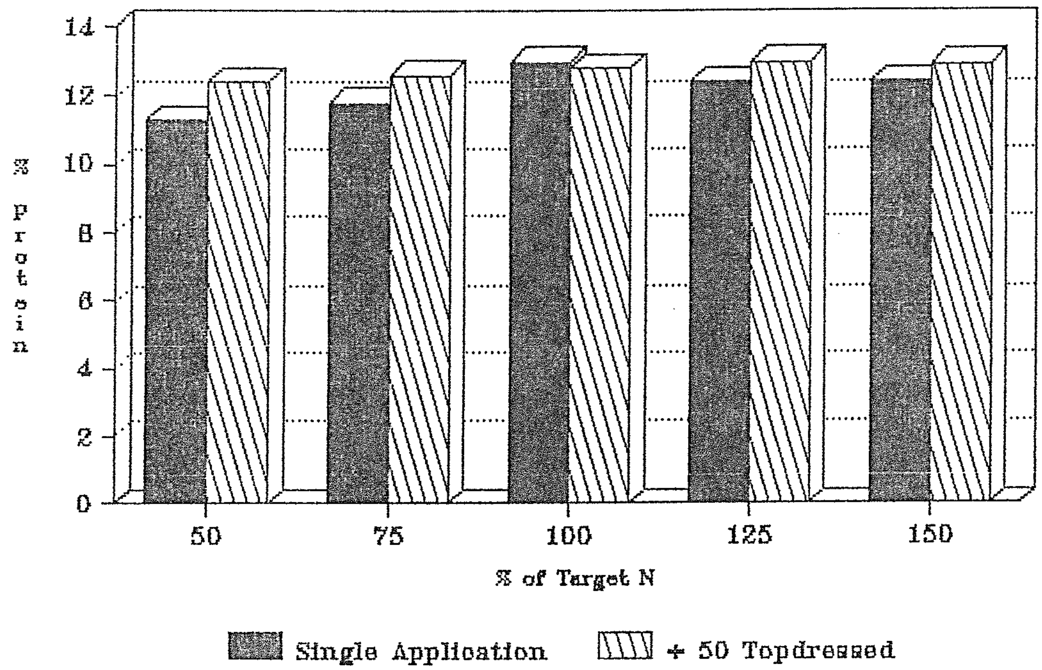
The yield and protein response of HY320 wheat to topdressed N applications when various target yield/N levels were established at seeding is given in Figures 4 & 5 respectively. The figures represent data collected in 1988, 89 and 90 at two different moisture regimes, normal rainfall and high rainfall. Maximum yields from single N applications are achieved between the 125 and 150% of target N level.

Fig. 4 Response of HY 320 to
Single & Split N Application



High & Medium Moisture Minto 1988-90

Fig. 5 Response of % Protein in HY 320
To Single & Split N Application



High & Medium Moisture Minto 1988-90

The topdressed N treatments were shown to significantly increase yield and protein levels compared to their respective base N level. The yield difference between the 50% treatment and the 50/50 treatment was 5 bu/acre. The protein difference was 1.1%. When treatments with equal total N levels are compared, the split N treatment continue to have an advantage. The yield difference between the 100 treatment and the 50/50 treatment was 2.3 bu/acre. The protein was slightly decreased. Alkier et al.,(1972) also found positive responses to topdressing at the 5th leaf stage.

The data supports the potential use of yield tracking and post emergent nitrogen application as a method of achieving more optimum yields especially in situations when GS 31 yield estimate is larger than the original yield goal.

CONCLUSIONS

1. Target Yield calculations prior to seeding using plant available water (Minto 1988-90) showed a poor correlation. More data needs to be gathered and a modification of the original formula derived.

2. Yield tracking at G.S.31 (Minto 1988-90) provides a good estimate of harvested yield and was much more accurate than the formula currently used by MCIC.

3. Split N applications are effective in supplementary initial N fertilizer application wen applied at G.S.31. The positive responses obtained from split N application make Flexible N Management a beneficial and viable option.

4. The role of yield tracking to predict the need for topdressing is looking good but is still under investigation. A combination of factors such as yield tracking, soil moisture at G.S.31, soil and critical plant N at G.S.31 should provide an accurate prediction for the need of supplemental N. This prediction shold in the end allow farmers to save more money by not applying N in unfavourable years and increase revenues by applying in responsive years.

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Edwardson, S.E., E.H.Vasey and C.E. McDonald. 1989 Use of Near Infrared (NIR) Reflectance for Improved Nitrogen Management in Spring Wheat. In Proc. North Dakota Agricultural Association 1989 Crop Production Guide p. 223-233 NDSU, Fargo, North Dakota.

APPENDIX A

1990 WEATHER DATA FOR MINTO, MANITOBA

PPT. 1990	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
MM	-	73.0	109.0	124.0	43.0	21.0
% OF AVERAGE	-	151.0	139.0	175.0	67.0	47.3
TEMPERATURE 1990						
MEAN	-	9.8	16.0	17.3	19.6	14.3
DIFFERENCE FROM NORMAL	-	-0.7	+0.7	-1.4	+2.3	+2.8

DAILY TEMPERATURE AND PRECIPITATION DATA, 1990

MAY	TEMPERATURE (C) MAX	MIN	PRECIPITATION (MM)
1	6	-6	
2	4	-4	4
3	8	-2	
4	14	-1	T
5	15	2	
6	25	7	
7	15	5	
8	9	-1	T
9	9	-2	
10	12	-2	
11	9	-2	
12	15	-4	
13	10	0	6
14	15	-2	
15	10	0	37
16	8	0	26
17	8	-2	
18	11	-2	T
19	13	4	
20	16	3	
21	19	8	
22	18	7	
23	19	3	
24	22	8	
25	20	6	
26	18	6	
27	23	5	
28	21	9	T
29	23	5	
30	25	9	
31	23	14	

TEMPERATURE		TOTAL PRECIPITATION	73.0MM
MEAN HIGH	17.25	100 YR.AV.	48.5
MEAN LOW	2.32	% OF AVERAGE	151
MEAN	9.8		
100 YR.AV.	10.5		
DIFFERENCE	-0.7		

JUNE	TEMPERATURE (C) MAX	MIN	PRECIPITATION (MM)
1	27	12	
2	11	2	8
3	14	1	
4	18	5	6
5	13	7	1
6	21	7	
7	24	9	
8	16	9	41
9	21	9	4
10	27	11	
11	24	16	1
12	22	8	
13	21	8	
14	13	6	
15	17	7	
16	21	9	
17	17	12	36
18	25	11	
19	22	12	4
20	20	12	
21	21	12	1
22	20	10	2
23	23	9	
24	27	13	
25	26	16	
26	26	16	
27	24	15	T
28	25	16	
29	27	15	
30	26	12	5

TEMPERATURE		TOTAL PRECIPITATION	109.0MM
MEAN HIGH	21.35	100 YR.AV.	78.6
MEAN LOW	10.6	% OF AVERAGE	139
MEAN	16.0		
100 YR.AV.	15.3		
DIFFERENCE	+0.73		

JULY	TEMPERATURE (C) MAX	MIN	PRECIPITATION (MM)
1	28	14	
2	27	16	2
3	21	13	82
4	16	10	
5	17	11	
6	22	12	8
7	22	14	14
8	21	13	
9	22	12	
10	20	12	
11	20	11	
12	23	10	
13	24	12	
14	24	13	
15	22	12	
16	26	12	
17	21	12	8
18	18	10	
19	19	11	
20	20	9	
21	19	9	
22	22	11	
23	27	16	
24	29	10	
25	26	12	
26	25	17	
27	27	17	10
28	22	13	
29	19	9	
30	22	9	
31	28	10	

TEMPERATURE		TOTAL PRECIPITATION	124.0MM
MEAN HIGH	22.55	100 YR.AV.	70.9
MEAN LOW	12.1	% OF AVERAGE	175
MEAN	17.3		
100 YR.AV.	18.7		
DIFFERENCE	-1.4		

AUGUST	TEMPERATURE (C) MAX	MIN	PRECIPITATION (MM)
1	30	19	
2	28	16	
3	24	12	
4	21	9	
5	27	9	
6	32	15	
7	32	18	
8	27	15	
9	23	11	
10	21	11	
11	15	11	7
12	22	11	
13	28	10	2
14	23	11	2
15	30	16	
16	27	15	
17	21	13	3
18	16	13	
19	23	13	
20	28	11	
21	27	13	T
22	26	18	20
23	26	16	
24	29	15	
25	18	16	8
26	20	14	1
27	23	12	
28	24	11	
29	22	13	
30	28	13	
31	30	14	

TEMPERATURE			
MEAN HIGH	24.95	TOTAL PRECIPITATION	43.0MM
MEAN LOW	13.4	100 YR.AV.	64.1
MEAN	19.6	% OF AVERAGE	67
100 YR.AV.	17.3		
DIFFERENCE	2.3		

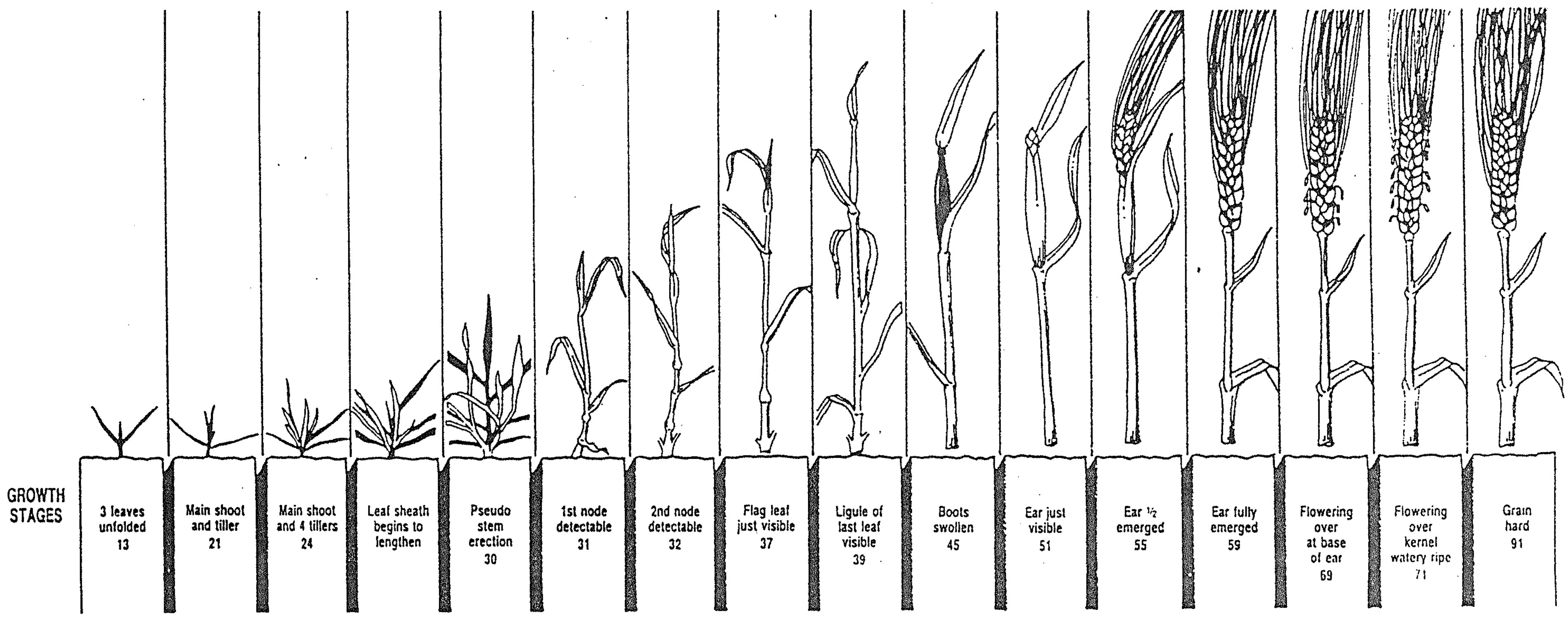
COMMON TERMS USED IN THIS REPORT

TERM	MEANING	INITIAL SOIL WATER (INCHES)	TOTAL PRECIP. (INCHES)	TOTAL AVAILABLE MOISTURE (INCHES)
I	irrigated or high rainfall	5.64	12.0	17.6
N	normal conditions	5.64	12.0	17.6
D	dry conditions	4.62	12.0	15.6

The levels of available moisture shown above are general for all trials in this report. An average value was obtained from all the trials. Data on individual trials can be found under each trial in the Methods and Materials section. Extra water was not applied to the high rainfall site in 1990 due to high natural rainfall. 100 year average rainfall for May, June and July is 7.8 inches.

TERM	MEANING
H	Hard Red Spring Wheat (Katepwa)
P	Canada Prairie Spring Wheat (HY320)

CEREAL GROWTH STAGES



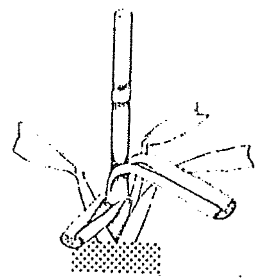
growth stage designations of the Zadoks-Chang-Konzak scale

2-Digit code	General description
	Germination
00	Dry seed
01	Start of imbibition
02	—
03	Imbibition complete
04	—
05	Radicle emerged from caryopsis
06	—
07	Coleoptile emerged from caryopsis
08	—
09	Leaf just at coleoptile tip
	Seedling growth
10	First leaf through coleoptile
11	First leaf unfolded
12	2 leaves unfolded
13	3 leaves unfolded
14	4 leaves unfolded
15	5 leaves unfolded
16	6 leaves unfolded
17	7 leaves unfolded
18	8 leaves unfolded
19	9 or more leaves unfolded
	Tillering
20	Main shoot only
21	Main shoot and 1 tiller
22	Main shoot and 2 tillers
23	Main shoot and 3 tillers
24	Main shoot and 4 tillers
25	Main shoot and 5 tillers
26	Main shoot and 6 tillers
27	Main shoot and 7 tillers
28	Main shoot and 8 tillers
29	Main shoot and 9 or more tillers
	Stem elongation
30	Pseudo stem erection
31	1st node detectable
32	2nd node detectable
33	3rd node detectable
34	4th node detectable
35	5th node detectable
36	6th node detectable
37	Flag leaf just visible
38	—
39	Flag leaf ligule/collar just visible
	Booting
40	—
41	Flag leaf sheath extending
42	—
43	Boots just visibly swollen
44	—
45	Boots swollen
46	—
47	Flag leaf sheath opening
48	—
49	First awns visible
	Inflorescence emergence
50	First spikelet of inflorescence just visib
51	
52	
53	¼ of inflorescence emerged
54	
55	½ of inflorescence emerged
56	
57	¾ of inflorescence emerged
58	Emergence of inflorescence completed
59	
	Anthesis
60	
61	Beginning of anthesis
62	—
63	—
64	
65	Anthesis half-way
66	—
67	—
68	
69	Anthesis complete
	Milk development
70	—
71	Caryopsis water ripe
72	—
73	Early milk
74	—
75	Medium milk
76	—
77	Late milk
78	—
79	—
	Dough development
80	—
81	—
82	—
83	Early dough
84	—
85	Soft dough
86	—
87	Hard dough
88	—
89	—
	Ripening
90	—
91	Caryopsis (kernel) hard (difficult to divide thumb-nail)
92	Caryopsis hard (can no longer be dented t thumb-nail)
93	Caryopsis loosening in daytime
94	Over-ripe, straw dead and collapsing
95	Seed dormant
96	Viable seed giving 50 percent germination
97	Seed not dormant
98	Secondary dormancy induced
99	Secondary dormancy lost

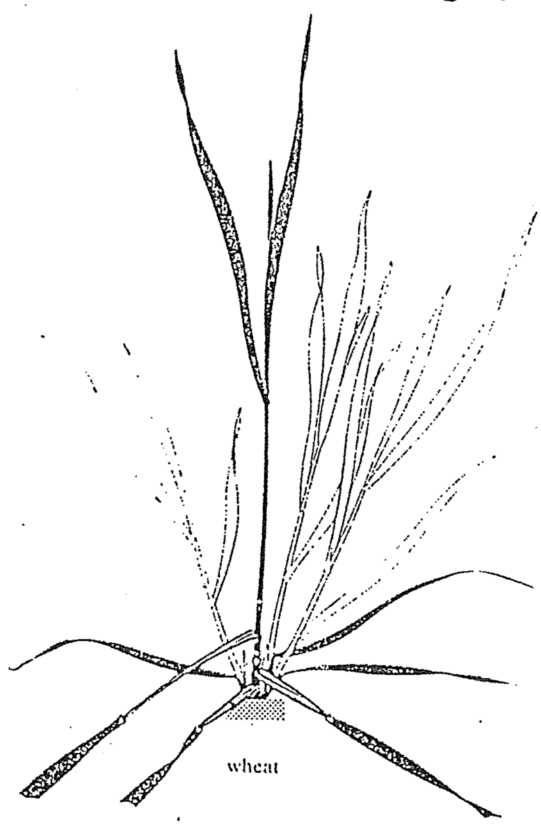
ZADOKS GROWTH STAGE DESCRIPTION

Not all the available Zadoks Growth Stages are used in spring wheat development and wheat can be at more than one stage at a time. For example, a plant with 5 leaves (G.S. 15) should also have 1 tiller (G.S.21). Use the main stem and most advanced stage when determining growth stage. Tillers will lag in development compared to the main stem.

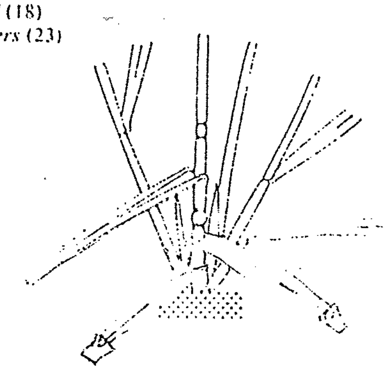
A normal sequence of growth stages for spring wheat would be 00 thru 09, jump to, 10 thru 13, jump to, 21 thru 23 or 24, jump to, 30 thru 32, jump to, 37 and 39, jump to 40 thru 99.
Growth stage 30 and 31 are hard for a novice to detect, therefore careful observation will be necessary. See the note below for additional information on growth stage 31.



First node detectable (31)



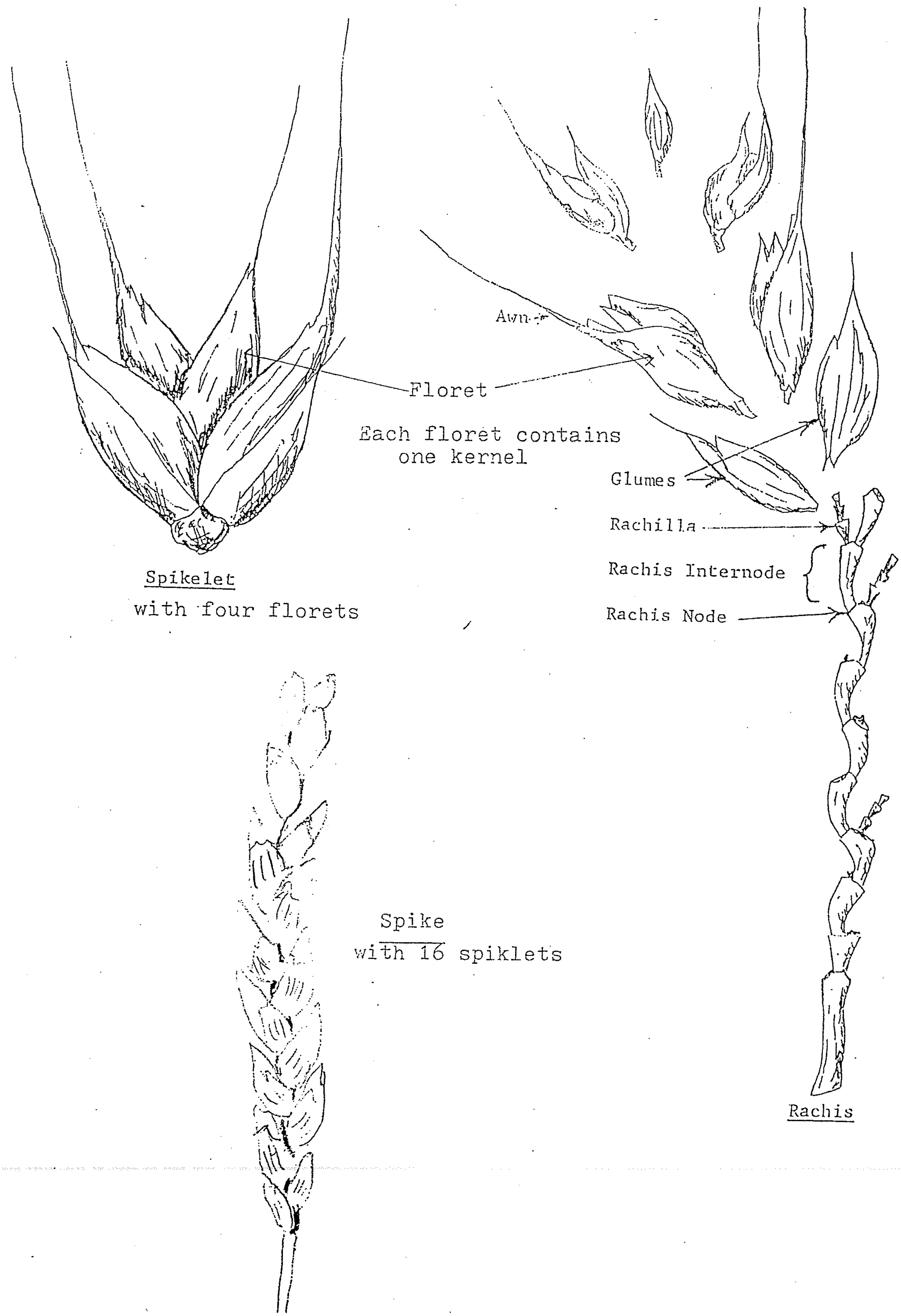
Second node detectable (32)
Eight leaves unfolded (18)
Main shoot and 3 tillers (23)



Second node detectable (32)

Counting nodes. Count the nodes on the main shoot above ground level that can be seen or felt, after peeling back the outer leaf sheaths. Splitting the shoot will confirm the extension of the true stem.

Structure of a Wheat Spike (Head)



1990 EXTENSION ACTIVITIES

FIELD DAYS

Canada Grains Council Risk Management Guide Tour, Minto July 12/9
Attendance: 40

Expert Committee on Weeds Tour, Minto July 13/9
Attendance: 12

Canada Grains Council Sponsor's Tour, Minto July 16/9
Attendance: 8

Simplot tour of Flexible N Management plots, Minto July 31/9
Attendance: 2

Western Cooperative Fertilizer tour of Flexible N Management plots, Minto Attendance: 1 Aug.24/90

MEETINGS AND PRESENTATIONS

Yield Tracking and Flexible Nitrogen Management, 12th Annual Manitoba-North Dakota Zero Tillage Workshop Bismarck, N.D., Attendance: 400+ Jan.17-19/

Risk Management for Wheat Production, Cargill Wheat Yield Club Elm Creek, Man., Attendance: 15 Feb.23/90

Annual Review, RMG, Canada Grains Council office, Winnipeg, Man. Attendance: 12 March 2,/9

Intensive Wheat Management, Sask. Irrigation Centre, Outlook, Sask., Attendance ~60 March 7/90

Risk Management Guide for Wheat Producers, Canada Grains Council Annual Meeting, Winnipeg, Man., Attendance: 200+ April 5/90

RMG Update, Manitoba Soil Science Spring Review Meeting U of M, Winnipeg, Manitoba Attendance: 15 April 18/90

Flexible N Management, Rourke & Adaran, in Proceedings Manitoba Soil Science Society Annual Meeting Winnipeg, Manitoba Attendance: 100+ Jan.7/91

Flexible N Management, Rourke & Adaran, Simplot Business Meeting, Sheraton Inn, Winnipeg, Man. Jan.27/91

Annual Review, RMG Canada Grains Council Office, Winnipeg, Manitoba March 7/91