RURAL CONSERVATION CLUBS PROGRAM

ONTARIO RIDGE TILL & STRIP CROPPING CLUB

“Comparison Of Strip Cropping With Field Cropping Management"
"Ridge Till & Strip Cropping Field Days"

FINAL REPORT

May 1997

Ontario Ridge Till and Strip Crop Club Research

1993-1996

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May 1997

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Project Summary

From 1993-1996, an on-farm participatory research project was conducted by the Ontario Ridge Till and Strip Crop Club in Southwestern and Eastern Ontario. The program assessed field versus strip crop management of corn and soybean systems and, in the final year of the project, corn and winter wheat systems. Strip cropping as practiced by the members of the Ontario Ridge Till and Strip Crop Club is a narrow strip intercropping system consisting of 3-6 corn rows with soybeans or winter wheat. The objective of these strip crop management systems is to increase crop productivity while at the same time conserving soil resources on the farm.

In corn-soybean strip cropping trials, increased light interception by outside rows of corn resulted in yield increases on 3 out of 4 sites. These yield increase were largely confined to the outside rows. Where individual outside row yields were measured, increases of approximately 30% over inner rows, or field managed rows were observed Soybean yields under strip management systems were reduced on 5 out of 7 sites. Both variety selection and row orientation appeared to be important factors for minimizing yield losses in soybeans. On all of the sites where yield losses were recorded, corn and soybeans were planted in a north-south direction in 6-row strips. The average yield loss for this system was 14.7%. Individual row samplings in these plots clearly indicated that the majority of the yield loss in soybeans was a result of shading in rows adjacent to corn rows. Losses of approximately 30% were recorded in the westernmost row which was also etiolated and delayed in maturity as a result of excessive shading. The shading effect was less significant on the eastern side where yield losses averaged 13% in the outside row. Overall, yield losses in soybeans planted with a north-south orientation, particularly those in the Eastern Ontario studies, appeared to be too large to be compensated for by any potential corn yield increases. Better results were obtained with an east-west orientation as the shading effect is less prevalent. Tall soybean varieties and varieties susceptible to white mold should be avoided when strip cropping in order to reduce the impacts of shading.

A strip management system for winter wheat and corn appears to be the most promising form of strip crop management evaluated during the four years of on-farm research. As in the case of corn, large increases in yield on the outside border rows (65% average increase) of winter wheat were responsible for increasing the wheat strip yield. The 3 row corn strip (with two out of three rows as border rows) was estimated to increase yields by 21% over field managed corn. When grown together in a strip cropping system, both crops appear to have the potential to reliably over yield which makes the system more attractive that the corn-soy system. From an agronomic and environmental standpoint, winter wheat appears to be an excellent strip crop companion for corn in that it completes its growth cycle well ahead of corn, is more compatible than soybeans with corn fertilizer and weed control programs, and is an extremely effective erosion control strategy. The benefits of this system are manifold, and further study into its effects could enable the widespread adoption of this conservation farming practice on farms.

Table of Contents

List of Tables

List of Figures

Acknowledgments

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Introduction

In 1993, The Ontario Ridge Tillage and Strip Crop Club was established in Ontario to further explore the potential of ridge tillage and strip cropping by conducting on-farm research and sharing information. The club is unincorporated and REAP-Canada, an on-farm research organization working in Ontario, was asked to act as the sponsoring organization for the club. Joe Omielan of the University of Guelph acted as the club's secretary manager and coordinated the research program in Southern Ontario. Jeff Quinn provided much of the field assistance for the Southwestern Ontario program. Roger Samson helped complete the project in Southwestern Ontario by providing additional field support and report writing services. In 1993 and 1994, Pierre Yves Gasser of Ag Knowledge coordinated the club activities in Eastern Ontario. In the last two years of the project, the Eastern Ontario activities were coordinated through a combined effort of Shawn McRae of McRae Farms Ltd. and Roger Samson of REAP-Canada. The farmer cooperators performed a great deal of the work involved in carrying out the experiments - from experimental planning to final harvest at both ends of the province.

The research was supported by the Canada-Ontario Green Plan's Conservation Club Program. The program was developed to encourage more environmentally friendly farming practices. Ridge tillage is now well recognized as a conservation farming practice that reduces soil erosion and herbicide use and is generally considered to be one of the most energy efficient cash crop farming systems. Strip cropping has been practiced in wide strips against the field slope as a means to reduce soil erosion. As practiced by the members of the Ontario Ridge Till and Strip Crop Club, strip cropping is a narrow strip intercropping management system that is designed to increase crop yield through more efficient sunlight interception by planting row crops in narrow strips thus giving more "border" rows. It provides not only the benefit of additional erosion control through the use of narrow strips, but also the potential for additional productivity and profitability which will encourage broader adoption of the technology by the farm community. The use of ridge tillage or no-tillage in combination with narrow strip cropping can be a very effective erosion control strategy, particularly if winter cereals are included in the strip cropping management system.

The strip cropping management system has been refined over the years by many of the Club members. One needs good management skills in planting, spraying, cultivating, and fertilizing to be able to take advantage of the narrow corn strips. The main benefit is the extra light available on the "border rows". However, if other factors are limiting there won't be any extra yield.

One needs to increase the population in the outside rows to achieve higher yields. However, the hybrid must be able to respond to the increased light and higher populations. One shouldn't increase the population too much as a drought may result in less yield than if one used the standard population.

There is quite a range of implementations of the strip management system across the province. People are using either two crop (corn and soybeans, corn and wheat) or three crop (corn, soybeans, winter wheat) systems. All crop strips may be the same width or the corn strips may be narrower than the other crop(s). There is considerable flexibility in the system and opportunities for further grower innovations.

Extension Activities

The club carried out both research and extension activities to promote ridge tillage, strip cropping and the combined use of ridge tillage and strip cropping. Approximately 50 farmers were involved in the club with the majority being located in Southwestern Ontario. The extension activities included field days and car tours both in Southwestern Ontario and Eastern Ontario as well as winter workshops. The major field day held in each of 1993, 1994 and 1995 in Southern Ontario created an opportunity to bring in speakers from further afield for an exchange of ideas. These speakers included Ernie Behn (Iowa), Rick Cruse (Iowa State University), Nate and Trish Andre (Ohio), Mike Reicherts (Iowa), and Alec Holzgang (Quebec). The Eastern Ontario group cooperated well with farmers in the Club Action Billon in Quebec. The groups participated in each other's winter meetings, workshops and farm tours and regularly exchanged information on ridge tillage and strip cropping successes and failures in the bioregion of the St. Lawrence Lowlands. This interaction was very important for the Eastern Ontario group as several of the Eastern Ontario farmers could speak very little English and several of the anglophone farmers in Quebec had some difficulties in French. The activities of the Quebec group were of significant interest to the Eastern Ontario group as there was quite a large group of farmers that had recently switched to ridge tilling and/or strip cropping in Quebec. Club Action Billon had several on-farm research projects on ridge-tillage and strip cropping as well as ecological/conservation farming advisors who worked with individual farmers belonging to the club, and who participated in our meetings.

Research Approach

The primary goal of the research project was to examine the dynamics of narrow strip intercropping and to provide information for further refinement of the management system. Some work was also performed in corn-wheat strip cropping systems to enable both crops to benefit from the strip cropping environment. The research was conducted with an on-farm participatory research approach. This type of approach benefits from the reciprocity that occurs through the continuous dialogue between the researcher and farmer cooperator. Most of the experiments designed for this project were based on innovative ideas that were originally developed by the farmer cooperators. The research was modified as deemed necessary through the four years of the program.

Most of the research trials were set up as side-by-side paired comparisons with machine harvesting. Some use of combine monitors formed part of the study as this technology became available for on-farm trials. The combine monitors appeared accurate on sites with even topography and homogenous soil types. On some farms, such as the McRae farm in Eastern Ontario, it proved less reliable than machine harvesting.

Hand sampling was performed on individual rows in corn, wheat and soybean strips in order to get a better idea of the dynamics of individual rows as they are affected by additional sunlight or shading in strip crop systems. In the case of soybeans, a plant growth analysis was also performed in order to assess changes in plant growth habits as a result of the shading that occurs in strip crop environments. A number of strategies were evaluated to increase corn yield, including the planting of dense populations of corn in very narrow rows (Jim House), double row planting on the ridge (Doug Smith), and identifying "leafy" corn hybrids which will respond to the extra light found in the outside

rows of a strip cropping environment (Jim House). As well, some efforts were made to evaluate soybean varieties for strip cropping (Jim House, Ron McRae)

Strip cropping was envisioned by the club as a management system rather than as an individual practice, as other variables such as plant population, row spacing etc. change in conjunction with the introduction of the stripping system. Hence, in many of the trials when strip management is compared to field management, the reader should understand that the strip management system being evaluated may have more than one changed variable compared to the field management system.

Locations of The Trials

Southern Ontario

Jim House, Port Stanley
Doug Smith, Thamesville
Harm and August Spangenberg, Fingal

Eastern Ontario

Ron McRae, Bainsville Michel Calande, Casselman
Jacques Grenier, St Isidore de Prescott

I: Strip Management vs. Field Management of Soybeans

The major challenge that needed to be met for the strip cropping of soybeans with corn was identifying the magnitude of the soybean yield reduction. Typically, soybeans grown in corn strips are subject to shading, particularly in the rows adjacent to the corn. This can result in reduced yields. Field observations and extensive field sampling were performed in both Eastern Ontario and Southwestern Ontario to determine where the yield reductions were occurring. Individual row sampling occurred at the sites in Eastern Ontario (McRae and Grenier Farms) while a plant growth analysis comparing interior rows to shaded border rows was performed in Southwestern Ontario (Smith and Spangenberg Farms) in 1993. In 1994 there were no soybean strip versus field management experiments conducted because the rotation cycle dictated that the experimental plots be planted to corn. In 1995, the experiments were again conducted at the Smith and McRae farms. Two new sites were established in Eastern Ontario in 1995 to broaden the field width so that a wider field strip system could be evaluated. This type of system would reduce any potential for windbreak effects from corn on the field strip yield. The experiment was also conducted in 1996 at the McRae farm because they wanted to get data on corn and soybean yields in the same year to make more effective comparisons on the system.

1993

Strip Management vs. Field Management of Soybeans in Eastern Ontario

Table 1: Materials and Methods for Soybean Strip Cropping Experiment in Eastern Ontario in 1993

variable	McRae Farm	Grenier Farm
location	Bainsville, Ontario	St. Isidore, Ontario
soybean planting	Pioneer 0877, May 22, 1993 in 30 inch rows	Maple Glen in 30 inch rows
treatments	soybeans planted in 15 foot strips with corn vs. soybeans in solid stand (45' strips)	soybeans planted in 15 foot strips with corn vs. soybeans in solid stand (45' strips)
orientation of strips	north-south	north-south
design	complete block design without randomization	complete block design without randomization
replications	6	6
pesticides	glyphosate, Primextra Light/Lorox(on corn), Pursuit/Lexone (on soybeans)	glyphosate, preemergent herbicide
cultivation	twice for weed control	twice for weed control
harvest method	1440 International combine, hand harvest	combine, hand harvest
weights	platform weigh scales	platform weigh scales*

* Machine harvest weights were obtained at Grenier farm but because the platform scales were malfunctioning the data is not presented.

Results

The results obtained from the machine harvested plots indicated that yield loss from the strip cropping system was 19.9% at the McRae farm (Table 2). A machine harvest weight was also taken at the Grenier farm but it was discovered during the weighing that the scales were malfunctioning. The extensive hand harvesting that was performed in individual rows showed an average yield reduction of 19.2% at the McRae farm and 12.1% at the Grenier farm (Tables 3 & 4).

Table 2: Machine Harvest Yield of Soybeans in Strip and Field Management at the McRae Farm in 1993

	Soybean Yield (bu/acre @14%)							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Mean	% yield
Strip Mgmt.	26.8	25.0	23.4	26.8	27.9	22.3	25.4	80.1
Field Mgmt.	33.0	29.4	31.1	33.4	34.0	29.1	31.7	100

The hand harvest yields for individual rows within a strip provided an interesting insight into the causes of the yield reduction in the narrow strip cropping system (Figure 1). In these experiments, where strips were planted in a north-south orientation, the yield of the rows nearest to the corn were significantly reduced. The extensive individual row sampling indicated that this was primarily a result of shading on rows bordering the corn with the situation being most problematic on the westernmost

row at both sites. Compared to the average yield of the four centre rows, yields in the west row were reduced by 27.2% and 33.5% at the McRae and Grenier farms respectively. Visual inspection of this row indicated that the crop had etiolated and was experiencing delayed maturity. This was also of some concern to the farmer cooperators as it takes several more days for this row to mature. Discussions with farmers and researchers within the club indicated that maturity within this row was delayed by 100-150 corn heat units compared to the centre rows. The row adjacent to the corn on the east side was less affected. It suffered yield reductions of 6.0% and 19.5% at the McRae and Grenier farms, respectively and was less etiolated. The impact of yield reductions in soybeans are of paramount concern to the farmers in the club. Since any soybean yield loss due to shading counteracts the positive response in the corn yield, the profitability of the strip cropping system and hence, the farmers interest in the system, are limited.

Table 3: Hand Harvest Yield of Soybeans In Strip and Field Management at the McRae Farm in 1993

Soybean Yield (bu/acre @ 14%)								
Treatment	Row *	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean****
Strip Management	A	30.4	30.9	30.7	29.8	36.4	22.8	**30.2 ab**
	B	30.5	31.3	32.5	32.1	41.6	32.0	**33.3 a**
	C	46.5	25.8	32.5	33.4	39.8	26.6	**34.1 a**
	D	31.0	32.8	30.9	32.0	32.3	29.9	**31.5 ab**
	E	30.0	36.4	33.4	30.3	18.9	28.1	**29.5 ab**
	F	20.9	26.3	25.4	19.8	22.4	25.3	**23.4 b**
	Mean	**31.55**	**30.58**	**30.90**	**29.57**	**31.90**	**27.45**	**30.3**
Field Management	A	39.6	35.6	26.0	46.0	51.5	31.7	**38.4a**
	C	38.6	33.9	29.2	47.0	45.2	29.5	**37.2a**
	F	39.4	29.5	35.7	39.7	45.3	31.9	**36.9a**
	Mean	**39.20**	**33.00**	**30.30**	**44.23**	**47.33**	**31.03**	**37.5**

* Row indicates the position of a row within a strip with A being on the east and F on the west.

** means followed by the same letter in each of the strip and sole culture sections are not significantly different at the 0.05 level using Tukeys HSD.

Table 4: Hand Harvest Yield of Soybeans ln Strip and Field Management at the Grenier Farm in 1993

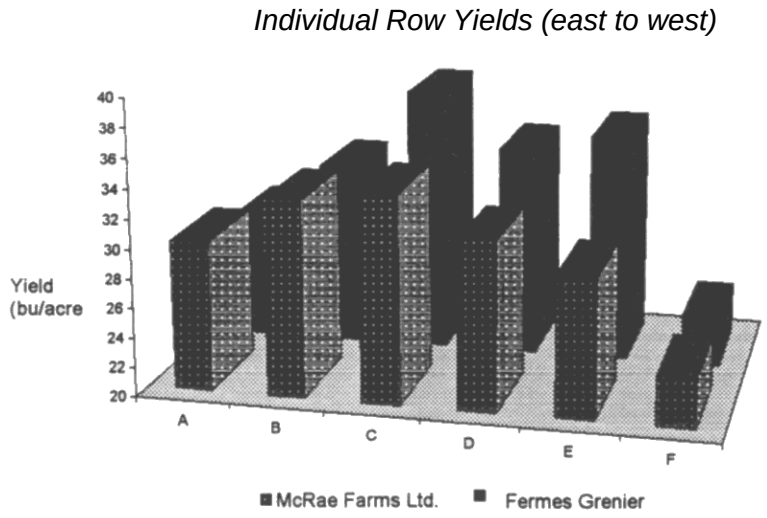
Soybean Yield (bu/acre @ 14%)								
	Row *	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**
Strip Management	A	33.8	25.6	30.3	23.1	31.9	27.2	**28.7 ac**
	B	30.6	33.0	34.8	29.4	33.8	33.8	**32.6 ab**
	C	39.3	40.0	45.9	37.0	32.3	34.1	**38.1 b**
	D	31.8	37.1	34.0	38.8	30.7	34.0	**34.4 ab**
	E	38.7	37.1	33.9	38.1	34.3	31.4	**35.6 ab**
	F	32.5	16.8	27.9	25.4	19.6	17.9	**23.4 c**
	Mean	**34.45**	**31.60**	**34.47**	**31.97**	**30.43**	**29.73**	**32.1**
Field Management	A	35.5	34.4	41.9	30.8	38.9	34.2	**36.0 a**
	F	35.3	36.3	37.3	37.2	31.2	44.6	**37.0 a**
	Mean	**35.40**	**35.35**	**39.60**	**34.00**	**35.05**	**39.40**	**36.5**

* Row # indicates the position of a row within a strip with A being on the east and F on the west.

** means followed by the same letter in each of the strip and sole culture sections are not significantly different at the 0.05 level using Tukeys HSD.

Our ability to draw significant conclusions from the data provided by the 1993 experiments at the McRae Farm and Grenier Farm is limited by several factors. The experimental design did not include the randomization necessary for statistical analysis between treatments although within the strip treatment there was clear indications of significant row by row yield differences. There was also some concern that the soybeans in the "field" management plot may have benefited from the windbreak effect of the corn as the field managed strips were only 18 rows wide. This may have enhanced its yields compared to a "real" field yield. It was decided to widen the soybean field management strips in subsequent years to reduce this potential effect.

Figure 1: Yield of Strip Cropped Soybeans in Eastern Ontario in 1993



Strip Management vs. Field Management of Soybeans in Southwestern Ontario in 1993

Experiments were established to compare the effects of strip cropping versus field management of soybeans in 1993. The farmers conducting the experiments were Doug Smith of Thamesville, Ontario and Harm and August Spangenberg of Fingal, Ontario. The strip cropping system at the field used on the Smith farm consisted of 6 rows corn and 6 rows soybeans with a ridge tillage system. The field on the Spangenberg farm tested the production of eight rows of soybeans and four rows of corn in their strip crop system using a conventional tillage system. This was chosen to maximize the relative number of "border" rows in the corn strips and because both crops could be planted in this arrangement with their 12 row planter.

Table 5: Materials and Methods for the Soybean Strip Cropping Experiment in South-western Ontario in 1993

Variable	Smith Farm	Spangenberg Farm
location	Thamesville, Ontario	Fingal, Ontario
orientation of strips design	north-south randomized complete block design	north-south randomized complete block design
replications	6	6
treatments	soybeans planted in 15 foot strips with corn vs. soybeans in 45 foot wide strips	soybeans planted in 20 foot strips with corn vs. soybeans in 50 foot strips
soybean variety	Great Lakes 2598 in 30 inch rows	NK 1990 in 30 inch rows
# of rows /strip	6 in narrow; 18 in wide	8 in narrow, 20 in wide
harvest method	6 row combine with yield monitor and weigh scales (as at elevator)	8 row combine harvest and weigh wagon

Results

Weather conditions were dry in the study area in 1993. Corn yields at both farms were below average because of the lack of precipitation. In addition, poor nitrogen uptake occurred in the corn at the Spangenberg farm as a result of the drought conditions that followed a sidedress nitrogen application using 28% UAN. At the Smith farm, soybean yields were reduced by 17% while at the Spangenberg farm no yield reduction occurred (Table 6). The lack of yield reduction at the Spangenberg farm was probably a result of the wider strips used (8 row), less competition from the adjacent short corn crop, and the soybean variety used.

At the Smith farm, soybean strips adjacent to the centre 6 rows used for the field managed section were also combined to determine yield effects. The 6 row strip to the east side of the corn strip yielded 46.6 bushels per acre on average while the 6 row strip to the west side yielded 41.3 bushel/ acre which was similar to the strip yield which also experienced significant shading. There was some concern that the centre section, representing a "field" management system, may have benefited from a windbreak effect provided by the soybeans. As a result, it was decided to only plant the corn strips part way down the field leaving one end of the field with an expanse of "uninterrupted" soybeans. Another factor to consider was that the centre 6 rows used for the field managed section were planted on land in soybeans the previous year while the 6 rows used for the strip managed section were planted on land in corn the previous year.

Table 6: Machine Harvest Yield of Strip and Field Management Soybeans in Southwestern Ontario in 1993

	Soybean Yield (bu/acre @14%)							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**	% yield
Smith Farm								
Narrow Strip	43.6	39.6	45.4	39.4	38.6	40.1	**41.1 b**	83.4
Wide Strip	51.3	48.7	52.5	45.3	45.7	52.5	**49.3 a**	100
Spangenberg Farm								
Narrow Strip	44.9	47.4	46.4	49.9	46.9	49.0	**47.4**	100
Wide Strip	*	45.6	48.2	50.3	45.6	47.0	**47.3**	100

* This was harvested by mistake the day before the day the weigh wagon arrived.
Means followed by the same letter are not significantly different at P=0.05 using Protected LSD

Extensive sampling of the shaded soybeans in outside rows was performed at each of the Southwestern Ontario sites in 1993. Plant heights, primary branches, pods, seeds and seed weight per plant were determined on an individual plant basis (Table 7). This data confirmed visual observations of the Eastern Ontario group in that rows adjacent to corn, particularly on the west side where shading late in the day was most pronounced, were etiolated and had fewer pods. At both sites, plant height was highest in the westernmost row of soybeans which suffered the most shading from the adjacent corn strip. The plants also had fewer pods, branches and seeds as well as a lower seed weight per plant. Even though the plants were taller they had fewer nodes and even though the pods and seeds per node were the same, the net effect was less seed yield per plant. The effect appeared to be most dramatic at the Smith farm where a taller soybean variety was used and the strip was 6 rows wide.

Table 7: Influence of Strip Cropping on Individual Soybean Plants in Shaded Outside Rows in Southwestern Ontario in 1993

	Height (cm)	# **of Primary Branches**	# **of Pods**	# **of Seeds**	**Seed Weight (g/plant)**
Smith Farm					
Field Row #1	81.2b	3.1a	28.5a	61.7a	9.5a
Field Row # 6	80.l b	2.9a	27.4a	58.0ab	8.8ab
Strip Row # 1	89.5b	2.3b	23.5b	50.9b	8.l b
Strip Row # 6	101.5a	1.7c	18.7c	39.3c	6.3c
Spangenberg Farm					
Field Row #1	52.0b	4.1	26.7	64.3	12.9
Field Row #6	53.3b	3.7	26.1	64.0	12.7
Strip Row # 1	55.4ab	3.7	22.9	54.9	10.6
Strip Row #8	60.2a	3.5	20.9	49.1	10.3

Row #1 is the eastern row while rows #6 and #8 are the western rows.
Means followed by the same letter are not significantly different at P=0.05 using Protected LSD

1995

Strip Management vs. Field Management of Soybeans in Eastern Ontario in 1995

Table: 8: Materials and Methods for the Soybean Strip Cropping Experiment in Eastern Ontario in 1995

variable	**McRae Farm**	**Calande Farm**
location	Bainsville, Ontario	Casselman, Ontario
soybean variety	Pride KG41, Pioneer 9071*	AC Bravor
planting density	150,000 seeds/acre - soybeans	172,000 seeds/acre - soybeans
planting dates	May 23, 1995	May 25, 1995
treatments	soybeans planted in 15 foot strips with corn vs. soybeans in solid stand (180 foot strips)	soybeans planted in 15 foot strips with corn vs. soybeans in solid stand (75 foot strips)
orientation of strips	north-south	east-west
design	randomized complete block design	randomized complete block design
replications	6	6
pesticides	glyphosate, pendimethalin/ atrazine (on corn), metolachlor/ metribuzin/linuron (on soybeans)	glyphosate/MCPA, Pursuit
cultivation	twice for weed control	twice for weed control
harvest date	October 17, 1995	October 30, 1995
harvest method	1440 International combine	combine equipped with an RDS Ceres II yield monitor
weights	platform weigh scales	RDS Ceres II yield monitor**

* In an attempt to test the hypothesis that a shorter season variety might perform differently under the shaded conditions next to the corn, the Pride variety KG41 (2650 CHU) was planted in the shaded rows while the four inside rows were planted to Pioneer 9071 (2725 CHU). The same combination was planted in the strip to be harvested within the solid stand treatment.

** The combine yield monitor was checked for accuracy during the fall harvest in 1995 using a weigh wagon on 9 separate weights. It overestimated yields on average by 4.6 % with results running between 3.4 and 7.8% higher.

Results

McRae Farms Ltd. again experienced a significant soybean yield loss in their strip cropping system compared to the sole culture system. On average, yields were reduced by 13.7% in the strips which were planted in a north-south direction (Table 9). At Ferme Michel Calande no significant yield reduction was experienced in the soybeans (Table 9). Row orientation may have played a significant factor in the different results obtained between the two farms. With a north-south orientation, such as at McRae's, early morning and evening shading can significantly decrease sunlight exposure for soybean rows contiguous to the corn strip. An east-west orientation, such as used at Calande's, would reduce shading for these rows. Michel Calande also believed that soybeans planted in an east-west orientation were less prone to white mold because of better sunlight penetration and wind movement to promote field drying and reduce white mold risks.

Table 9: Yield of Soybeans in Strip and Field Management in Eastern Ontario in 1995

	Soybean Yield (bu/acre @ 14%)							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Mean	% yield
McRae Farm								
Sole Culture	57.2	54.2	48.0	57.2	48.8	45.3	**51.8 a**	100
Strip	48.4	47.6	39.2	50.5	43.7	41.5	**45.2 b**	87.3
Calande Farm								
Sole Culture	57.1	54.1	53.0	54.9	56.7	54.2	**55.0 a**	100
Strip	53.1	53.8	55.4	54.6	54.2	54.4	**54.3 a**	98.7

** means followed by the same letter at the same farm are not significantly different at the 0.05 level using Tukeys HSD.

Strip Management vs. Field Management of Soybeans in Southwestern Ontario in 1995

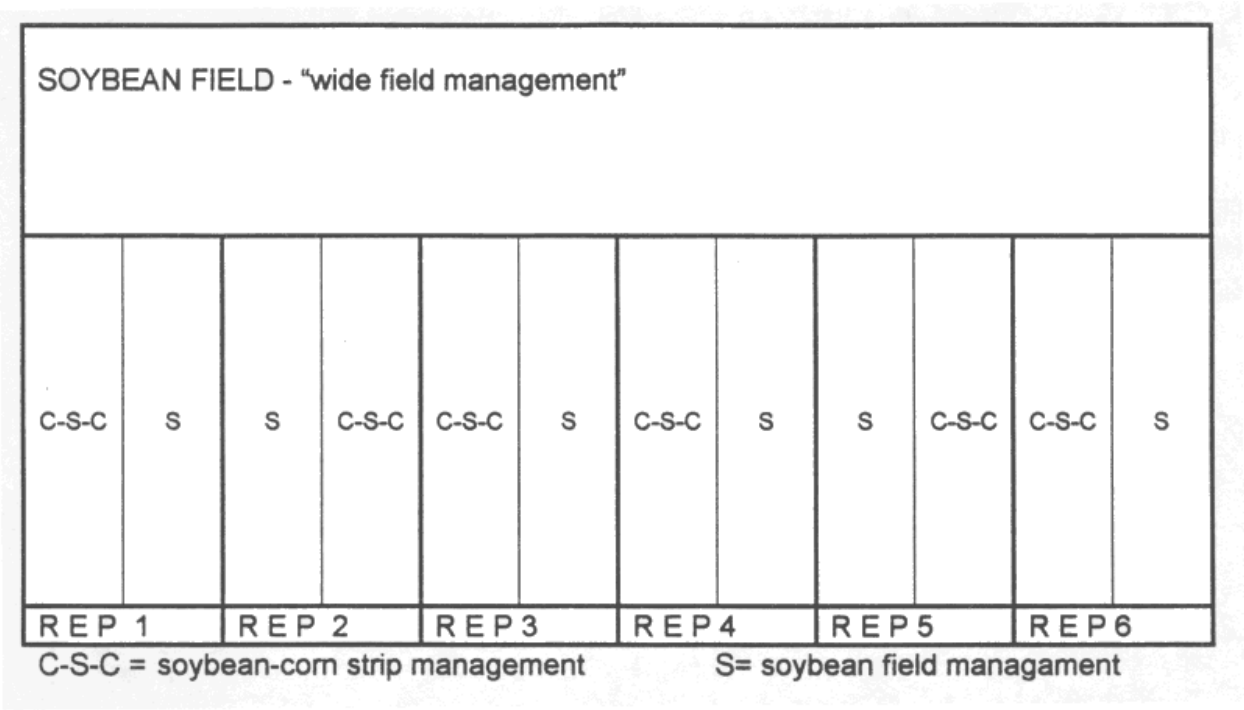
Table 10: Materials and Methods for the Soybean Strip Cropping Experiment in Southwestern Ontario in 1995

Variable	**Smith Farm**
location	Thamesville, Ontario
variety	Great Lakes 2415
orientation of strips	north-south
design	randomized complete block design
replications	6
treatments	strip cropping management versus field management
# of rows /strip	6 rows in narrow; 18 rows in wide; corn strips not planted all the way down the field
cultivation	inter-row cultivation (2X)
Harvest	Machine harvest with combine monitor and weigh scale

Results and Discussion

Because of a plugged herbicide nozzle at planting that resulted in a weedy soybean row adjacent to the corn in the strip managed soybeans, the yields of the strip and field managed soybeans cannot be compared. However, the corn strips were not planted the full length of the field while all the soybean strips were. Soybeans were planted where the corn strips would have been establishing a full wind-exposed soybean field situation (Figure 2).

Figure 2. Diagram of field layout indicating soybean-corn strips from randomized experiment running into a real field of soybeans



Comparing the strip management yields with the corresponding field management yields gives the estimate of the yield reduction due to the shading from the corn strips, since both these sets of yields had the weedy row. Results indicated that the yield from strip cropping of soybeans was reduced by 5% (Table 11). Comparing the strip management yields (centre six rows of eighteen) with the corresponding field management yields gives the estimate of the yield advantage from the windbreak effect of the corn strips. The yields were within 2% which indicated that the soybeans under field management were not experiencing a significant windbreak yield advantage from the corn in this year.

Table 11: Soybean Response to Narrow Strip Intercropping at the Smith Farm in 1995

Rep.	Field Mgmt.* (bu/ac)	Strip Mgmt.* (bu/ac)	Field Mgmt. (bu/ac)	Wide Field Mgmt. (bu/ac)
1	41.7	41.5	58.4	59.6
2	44.6	43.2	49.2	51.6
3	50.7	48.5	51.2	50.1
4	48.7	48.2	52.1	57.2
5	52.9	46.5	60.8	58.1
6	48.3	45.3	59.0	59.4
Mean	**47.8**	**45.5**	**55.1**	**56.0**
% of Field		**95%**		**102%**

* Nozzle plugged at planting. One weedy row next to corn on every strip.

1996

Strip Management vs. Field Management of Soybeans in Eastern Ontario in 1996

Table 12: Materials and Methods for Soybean Strip Cropping Experiment in Eastern Ontario in 1996

Variable	McRae Farm
location	Bainsville, Ontario
soybean variety	Pioneer 9071
planting dates	June 2, 1996 - soybeans
planting density	175,000 seeds/acre
treatments	soybeans planted in 15 foot strips with corn vs. soybeans in solid stand (180 foot strips)
orientation of strips	north-south
design	randomized complete block design
replications	6
pesticides	flumetsulam / clopyralid / metolachlor (on corn), flumetsulam / metolachlor (on soybeans)
corn fertilizers	125 lb N/acre in the form of UAN
cultivation	twice for weed control
harvest date	October 16 & 17, 1996
harvest method	1440 International combine
weights	platform weigh scales*

Results

Yield results obtained on the soybeans at the McRae Farm in 1996 were similar to results obtained in the previous years. Soybean yields were reduced by 12.7% in 1996 as compared to 19.1% in 1993 and 12.7% in 1995. Clearly, at the McRae farm, soybean yield reductions can be expected from strip cropping with corn in a north-south direction and that these yield reductions would be similar to any potential gains in corn yield experienced at the farm.

Table 13: Yield of Soybeans In Strip and Field Management in Eastern Ontario in 1996 at the McRae Farm

Soybean Yields (bu/acre @ 14%)								
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**	% Yield
Field Management	29.5	32.6	36.8	37.1	39.6	32.2	34.6 a	100
Strip Management	26.2	33.1	32.2	31.2	30.0	28.6	30.2 b	87

** means followed by the same letter are not significantly different at the 0.05 level using Tukeys HSD.

Management Changes as Result of Trials and Discussions

Because this was a participatory research project there were many discussions among cooperators, Club members, and researchers about the trials. Many of the Club members made modifications in their strip cropping management systems as a result of these discussions. Some members switched to growing 6 rows of corn and 12 rows of soybeans to reduce the relative reduction in soybean yields. Some members also started to plant a shorter season soybean (100 to 150 heat units shorter) variety in the rows next to the corn strips so all the bean rows would be ready to combine at the same time. There continues to be a lively exchange of ideas and research questions about soybeans in strip cropping.

II: Strip Management vs. Field Management of Corn

The main rationale for strip cropping management is the improvement in corn yields that can occur from the additional sunlight that is received by the outside corn rows. Experiments were established in Eastern Ontario at the McRae Farm to test this system in 1994 and 1996. In Southwestern Ontario experiments were established at the Smith farm in 1994 and 1996. Row sampling was conducted at the Smith Farm in 1994 and 1996 to determine which rows were most responsible for the increase in yield that is generally occurring in a corn-strip cropping system with soybeans.

1994

Strip Management vs. Field Management of Corn in Eastern Ontario in 1994

Table 14: Materials and Methods for Corn Strip Cropping in Eastern Ontario in 1994

Variable	McRae Farm
location	Bainsville , Ontario
corn variety	Northrup King 2409
planting date	May 26, 1994
treatments	corn planted in 15 foot strips with soybeans vs. corn in solid stand
orientation of strips	north-south
design	complete block without randomization
replications	6
pesticides	glyphosate, Dual/Marksman (on corn), Pursuit/Sencor (on soybeans)
corn fertilizers	115 lb/acre UAN
cultivation	twice for weed control
harvest	1440 International combine equipped with an RDS Ceres II yield monitor

Results

During the harvesting of the plots, complete reliance upon the new combine yield monitor caused problems. It was discovered that when low volumes of grain are put through the combine after it has been calibrated for "normal conditions, it exaggerates the yields quite dramatically. Since single rows were harvested with the combine, monitor readings proved inaccurate. Subsequently, however, we harvested more single rows and after comparing these readings with accurate weigh scale readings, a mathematical model to adjust the inaccurate readings was generated to see if the data could be corrected:

Real Yield (tons) = {[Monitor Reading (tons) / Acres - 0.6] * 1.20482}

The subsequent adjustment indicated that there was no yield increase from strip cropping compared to sole cropping and that individual rows within the strip performed similarly. We believe, however, that the corrected data is to be viewed with skepticism since it is simply not accurate enough for the purposes of the experiment. No further use of the combine yield monitor was made in the experiments for individual row harvesting.

Table 15: Corn Strip Yields Obtained With an RDS Ceres II

Combine Yield Monitor Corrected for Monitor Error at the McRae Farm in 1994

Corrected Monitor Yield (bu/acre @15.5%)								
	Row *	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**
Strip	A	50.7	78.6	87.0	86.6	76.6	76.1	**76.0**
	B - E	66.5	90.9	87.9	78.5	74.8	72.8	**78.6**
	F	41.6	74.6	86.3	88.0	84.4	75.6	**75.1**
	MEAN	52.92	81.35	87.07	84.38	78.63	74.86	**76.5**
Sole Culture	A - F	69.2	82.3	82.2	82.1	68.8	75.7	**76.7**

* Row # indicates the position of a row within a strip with A being on the east and F on the west.

Strip Management vs. Field Management of Corn in Southwestern Ontario in 1994

Table 16: Materials and Methods for Corn Strip Cropping Experiment at the Smith Farm in 1994

Variable	**Smith Farm**
location	Thamesville, Ontario
orientation of strips	North - South
design	RCBD
replications	6
treatments	Strip-crop managed corn (with higher populations in outside rows) vs. Field managed corn (in centre 6 rows of 18 rows)
previous crop	soybeans
corn varieties	Pioneer 3515 in outside rows of strip-cropped corn and Pioneer 3525 in inside rows of strip-cropped corn and in all rows of field managed corn
row spacing	30 inches
# of rows /strip	6 in strip-crop and 18 in field managed corn
harvest method	Row by row segments hand harvested; Machine harvest with yield monitor and weigh scales

Results and Discussion

Both machine and hand harvested corn yields indicated that strip field management system increased corn productivity compared to the field management system (Tables 17 & 18). Machine harvested yields of 187 bu/acre represented a yield increase of 13.3% for the strip cropped system. The outside rows of the strip cropped corn out yielded centre rows significantly in the strip crop system (Figure 3) The two outside rows averaged 240 bushel/acre versus 202 bu/acre for the centre two rows or a 19% increase. In addition, rows two and five showed somewhat higher yields than the two centre rows (rows three and four) which indicates that the yield response from stripping may not be confined to just the outside rows.

Table 17: Machine Harvested Yields for Strip and Field Management in Southwestern Ontario at the Smith Farm in 1994

	Corn Yield machine harvested (bu/acre @ 15.5%)							
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**	**% Yield**
Field Management	166	160	166	165	154	180	**165.2 a**	**100**
Strip Management	170	188	193	189	190	193	**187.2 b**	**113**

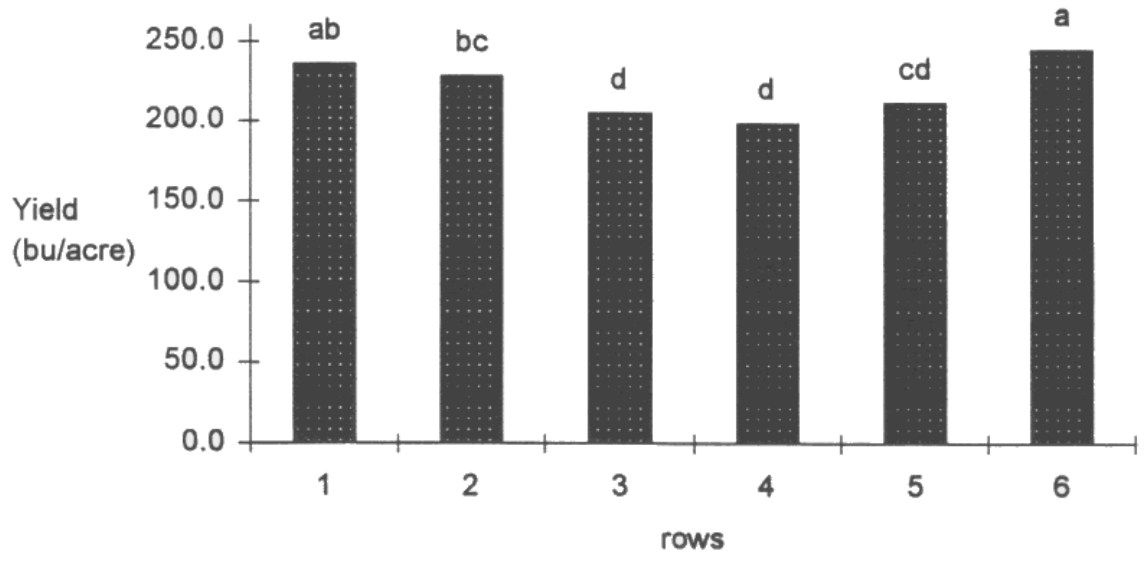
Means followed by the same letter are not different at P=0.05 using Protected LSD.

Table 18: Row Yields for Strip and Sole Culture Corn at Smith Farm in 1994, from East to West

	Corn Yield (bu/acre @ 15.5%)							
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	**Mean**	**% yield**
Field Management	186.6 [3525]	180.3 [3525]	180.1 [3525]	179.9 [3525]	189.1 [3525]	182.8 [3525]	**183.1**	**100**
Strip Management	235.4 ab [3515]	227.6 bc [3525]	204.2 d [3525]	197.7 d [3525]	211.0 cd [3525]	244.5 a [3515]	**220**	**120**

The corn hybrid for each row is indicated by the number in the square brackets.
Means followed by the same letter within management system are not different at P=0.05 using Protected LSD.

Figure 3: Hand Harvest Yield, from East to West, of Strip Managed Corn in at the Smith Farm in 1994



1996

Strip Management vs. Field Management of Corn in Eastern Ontario in 1996

Table 19: Materials and Methods for the Corn Strip Cropping Experiments in Eastern Ontario

variable	**McRae** Farm	**Calande Farm**
location	Bainsville, Ontario	Casselman, Ontario
corn variety	Pioneer 3893	Pioneer 3921
planting dates	May 18 and 21, 1996	May 7, 1996
treatments	corn planted in 15 foot strips with soybeans vs. corn in solid stand	corn planted in 15 foot strips with soybeans vs. corn in solid stand
orientation of strips	north-south	east-west
design	randomized complete block design	randomized complete block design
replications	6	6
pesticides	glyphosate, flumetsulam/ metolachlor (on corn and soy)	glyphosate, flumetsulam/ metolachlor
corn fertilizers	125 lb/acre in the form of UAN	110-48-31; 32 lb S; 1.6 lb Zn; 16 lb Mg/acre
cultivation	twice for weed control	twice for weed control
harvest dates	November 12 & 13, 1996	October 28, 1996
harvest method	1440 International combine	combine equipped with an RDS Ceres II yield monitor
weights	platform weigh scales	RDS Ceres II yield monitor' and weigh wagon

* The combine yield monitor was checked for accuracy during the fall corn harvest. On average it overestimated yields by 2.0%, with results running from -.9% to 6% above those of the weigh wagon.

Results

At the McRae farm no significant differences were obtained between the two treatments. There appeared to be much variability in the results as yields between replications and treatments varied considerably (Table 20). At the Calande farm a significant but small increase in yield was recorded in 1996. Overall, there appeared to be little advantage to strip cropping corn on these sites in 1996. Typically, the farmers said they expect to experience a 10-15% yield increase in corn in an average year using the strip cropping system.

Table 20: Yield of Corn In Strip and Field Management in Eastern Ontario in 1996

Corn Yields @ 15.5%)								
	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**	I% Yield
McRae Farm								
Field	105.7	95.7	102.7	122.9	112.8	110.9	108.5 a	100
Strip	91.5	100.2	90.6	121.3	95.1	120.7	103.2 a	95.1
Calande Farm								
Field	124.4	129.4	129.3	128.7	129.5	126.6	128.0 a	100
Strip	126.5	130.1	130.7	131.3	129.9	131.2	130.0 b	101.5

* means followed by the same letter at each farm are not significantly different at the 0.05 level using Tukeys HSD.

Strip Management vs. Field Management of Corn in Southwestern Ontario in 1996

Table 21: Materials and Methods for the Corn Strip Cropping Experiment in Southwestern Ontario in 1996

Variable	Smith Farm
location	Thamesville, Ontario
orientation of strips	north-south
design	randomized complete block design
replications	6
treatments	strip cropping management versus field management
corn variety	Pioneer 3769
row spacing	Strip cropped corn was planted in twin rows for rows 1,2,5 and 6. Rows 3, and 4 were single rows as were all rows in field managed corn. Higher corn populations were planted in rows 1 and 6 of the strip cropped corn.
# of rows /strip	6
cultivation	one interrow cultivation (twin rows made it too tight after corn plants were larger)
harvest method	machine harvest with combine monitor and hand harvest of 17.5 foot row sections

Results

The weather conditions in 1996 were cooler than normal, this, combined with the late spring experienced in 1996, resulted in corn yields slightly below normal. Overall, yields increased from 138 bushel per acre in the field management system to 159 bushel per acre in the strip crop system or approximately 15.3% (Table 22). As a further innovation Doug Smith planted twin rows in the outer rows of the strip crop system. This was done to obtain more even plant spacing at the higher plant populations used in the outer rows of the strip crop managed corn. Almost all of the yield increase occurred in the outside rows (rows 1 and 6) in the strip crop system. Yields in the centre four rows averaged 134 bushel per acre while yields in the east row adjacent to the soybeans yielded 179 bushel per acre and the west side row yielded 202 bushel/acre. This represents an increase of 33.4% and 50.6% for the east and west side rows respectively (Table 23).

Table 22: Machine Harvested Yield for the Corn Strip Cropping Experiment in Southwestern Ontario in 1996

	Corn Yield (bu/acre @ 15.5%)							
System	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	**Mean**	**% Yield**
Field	127.5	127.5	134.0	136.0	143.0	162.0	**138.3 b**	100
Strip	135.0	149.5	165.0	161.0	162.0	184.0	**159.4 a**	115.3

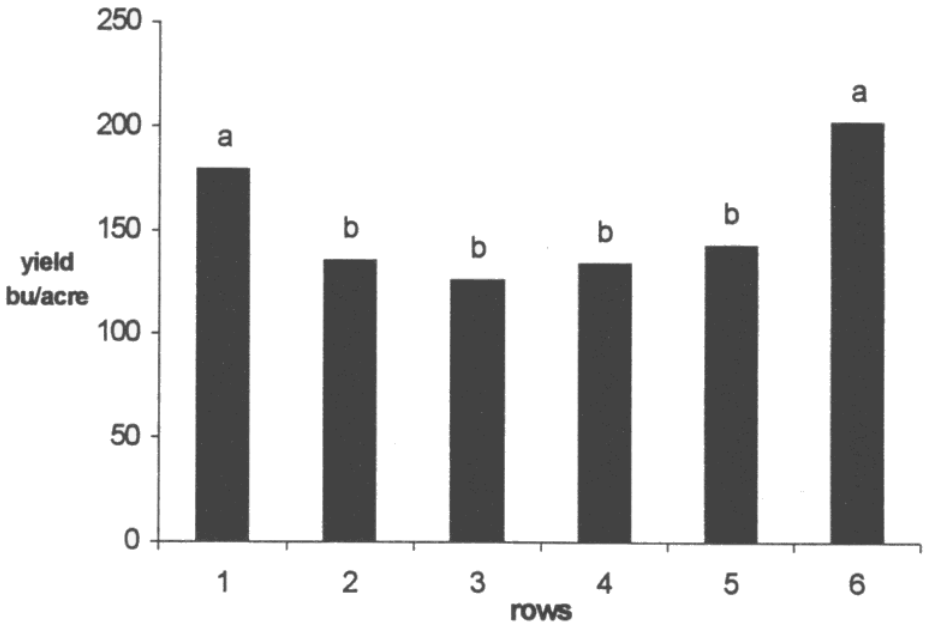
Means followed by the same letter are not significantly different at P=0.05 using Protected LSD

Table 23: Hand Harvest Yields of Individual Corn Rows under Strip and Field Management in South Western Ontario at the Smith Farm in 1996

	Corn Yield (bu/acre @ 15.5%)							
System	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	**Mean**	**% Yield**
Field	120.0	123.3	126.6	128.7	130.4	125.9	**125.8**	**100**
Strip	178.8 a	134.8 b	125.4 b	133.5 b	142.4 b	201.8 a	**152.8**	**118.6**

Row means within management system followed by the same letter are not significantly different at P=0.05 using protected LSD.

Figure 4: Hand Harvest Yields of Strip Managed Corn Rows at the Smith Farm in 1996



Brief Summary of Corn and Soybean Data

Information gleaned over the past four growing seasons from experiments executed at McRae Farms Ltd., Ferme Grenier, and Ferme Michel Calande in Eastern Ontario, and the Smith farm in Southwestern Ontario is valuable to farmers and researchers interested in narrow strip cropping.

In reviewing the soybean data outlined in Table 24, soybean yield appears to suffer due to narrow strip cropping with corn, though the yield loss is not consistent. The average yield loss of the five sites planted in a 6 row corn-soybean strip in a north-south direction is 14.6%. Individual soybean row samplings taken at the sites in 1993 (Figure 1) provided an interesting insight into this phenomenon with the biggest yield loss coming from outside rows on the west side which were etiolated in appearance and slightly later maturing. Soybeans were planted in an east -west orientation on only one site and showed no significant yield reduction on this site.

Table 24: Summary of Soybean Yields ln Strip and Field Management From 1993 To 1996

Year	Site	Row Orientation	Soybean Yields (bu/acre @ 14%)			
			Field	Strip	% Yield of Field	# of soy rows
1993*	McRae	North-South	37.5	30.3	80.8	6
	Grenier	North-South	36.5	32.1	87.9	6
	Smith	North-South	49.3	41.1	83.4	6
	Spangenberg	North-South	47.3	47.4	100.0	8
1995	McRae	North-South	51.8	45.2	87.3	6
	Calande	East-West	55.0	54.3	98.7	6
1996	McRae	North-South	34.6	30.2	87.3	6

* hand harvested yields presented

The corn strip cropping data obtained at the Smith Farm in 1994 and 1996 indicates that corn yield increased by approximately 13-15 percent. This is what most farmers state they expect. However, the two Eastern Ontario sites in 1996 (Table 25), indicate that yield increases cannot be expected from the strip cropping system every year, as had been formerly surmised. No yield differences were detected at the McRae farm and a very small yield increase was obtained at the Calande farm. This makes prediction of the profitability of narrow strip cropping even more difficult than we had previously anticipated. However, the strip cropping management system extensively studied in these trials is not the only system being practiced by growers.

Table 25: Summary of Corn Yields ln Strip and Field Management 1994 and 1996

Year	Site	Row Orientation	Corn Yields (bu/acre @ 15.5%)		
			Field	Strip	% Yield of Field
1994	Smith	North-South	165.2	187.2	113.3
1996	McRae	North-South	108.4	103.3	95.2
	Calande	East-West	128.0	129.9	101.5
	Smith	North-South	138.3	159.4	115.3

A noteworthy lesson which has been gleaned from our strip cropping research is that differences in yield between crops grown in narrow strips and those grown under field management may be either significant or insignificant, depending upon climatic conditions which can differ dramatically between years. The interaction among crops in individual years may also differ. Farmers who are contemplating strip cropping must be aware that corn yields are not guaranteed to increase under strip cropping conditions, though the odds are favourable. Soybean yields have been proven to be lower when grown between strips of corn when planted in a north-south direction. Further work is required to understand if east-west planting can minimize this yield loss. Generally, however, it cannot be expected that soybeans in strips yield as under field management. The objective of any strip cropping program should be to minimize soybean yield loss due to shading and optimize the increase in corn yield. The results obtained from this Eastern Ontario study indicate that soybean yield losses

in a north-south orientation are significant enough to make it doubtful that corn yield increases can be expected to compensate for this loss.

Though the information which we have been able to collect over the past four growing seasons has proved to be quite valuable to us, the data has been variable enough that predictions of profitability are, at this point, impossible to determine accurately. There is ongoing innovation in strip cropping management systems among Club members and researchers. Narrow strip cropping of corn and soybeans remains a fascinating concept, but one which requires further research in order to ensure its profitable implementation.

III: Strip Cropped Corn and Winter Wheat at the House Farm in 1996

Introduction

In the final year of the research project, at the House farm of Port Stanley, Ontario, corn and winter wheat were assessed as a strip cropping system. The farmer cooperator, Jim House, felt there were several drawbacks associated with using soybeans as an adjacent crop to corn, the primary one being that soybean yields were reduced by the shading effects of the corn. In addition, strip cropping soybeans and corn in the same field complicated herbicide programs and did little to reduce erosion risks as both were row crops and they shared the same growth cycle. For these reasons, he believed that winter wheat represented a better alternative. The winter wheat growth cycle is largely completed by the first week of July and hence there should be minimal competition with the corn crop for solar radiation and nutrient requirements. He hypothesized that the winter wheat crop might actually over yield due to the additional sunlight it receives on the edges of the rows early in the season. Since corn and wheat herbicides are generally similar, the production system should be easier to operate and less risky in terms of spray drift.

Materials & Methods

Corn was planted no-till in narrow strips (3 rows- 21 inches apart) at two sites consisting of sand texture and clay texture soils, respectively, with winter wheat as a strip crop. At the sand site, Jim House had an adjacent section planted to soybean as a strip crop for corn and it was sampled for comparison purposes. At the clay site, corn strips were planted with winter wheat on both sides. The corn was planted at 48,000 plants per acre in the outside two rows and 42,700 plants per acre in the centre row. The Direct 73 seed corn was planted on May 27-28, 1996. Fertilization consisted of 10 lbs per acre of 11-52-0 on seed, 250 lbs 12-32-16 dry fertilizer placed 2" off the seed, and 180 lbs actual nitrogen applied at the time of sidedressing. The Harus winter wheat was planted at 135 lbs per acre on October 10, 1995 in 15' strips (24 runs spaced at 7.5") with gaps for the corn to be planted into in the spring. The fertilization of the winter wheat included 7 US gallons of 10-34-0 at planting on the seed and dry fertilizer broadcast in early May at a rate of 90 lb. nitrogen (applied as urea) and 60 lbs of potassium per acre. Where corn was growing between winter wheat strips, the anhydrous rate was cut to 90 lbs per acre as a result of the nitrogen fertilizer which was applied over both the corn and winter wheat in the spring. The distance between the outside wheat and corn rows averaged 28.5". On the sand site, strips ran east - west and at the clay site they ran north- south. The Northrup King soybeans were no-till planted in 17" rows at 210,000 seeds per acre on June 6, 1996.

Corn sampling was performed by hand harvesting two- 5 metre sections of corn in each of the three rows Nov. 12, 1996. This was performed in four consecutive strips. This section of corn was also machine harvested in order to determine a combine yield for the four 3-row strips. The winter wheat and corn strips were, on average, 28.5 inches apart between outside rows. In the winter wheat, sampling also occurred in three 5-metre sections, in four consecutive strips. However, because there were 24 wheat rows, individual wheat row sampling was confined to individual rows for the three outside rows on each side to determine the extent of the yield increase in outside rows. The middle 15 rows of the strip were sampled in 5 -three row groupings. Thus row 1, 2, 3, 22, 23 and 24 were sampled individually and groupings of rows 4-5-6, 7-8-9, 10-11-12, 13-14-15, 16-17-18, 19-20-21 were collected to determine centre row yields. Winter wheat harvesting was performed by cutting with

a hand sickle the 5-metre sections and placing the material in burlap bags the week of August 5-9, 1996. As a result of a suggestion made by Jim House, head counts were also taken for the winter wheat crop in outside rows and selected inner rows. The crop suffered from significant levels of fusarium and he was concerned that yield results might not adequately reflect growth differences due to the presence of many empty heads. No hand harvesting of soybeans was performed, but a machine yield was collected. The winter wheat samples were threshed using a Hege plot combine. The corn samples were processed at the Agriculture Canada's Delhi research station in early November.

Results

Winter Wheat

Hand harvest yields and head counts of individual rows of winter wheat indicate that the outermost rows experienced increased productivity (figures 2 and 3). Head counts in outside rows were approximately 70% higher on the clay site and 50% higher on the sand site than inner rows that were sampled (rows 2,11,12,23). On the sand site it appeared that the yield increase had also occurred in the rows next to the edge (rows 2 and 23) although the response was greatly reduced. Overall, wheat yields increased in outside rows by 61% and 68% on the sand and clay sites respectively, compared to yields in the centre 20 rows. The overall effect of the stripping system was to increase yields from 61.0 bu/acre (average of centre 20 rows) to 64.4 bu/acre (average of 24 rows) on the clay site or 5.6% and from 64.0 bu/acre (centre 20 rows) to 68.0 bu/acre (24 rows) or 6.2% on the sand site. If the wheat strip could be narrowed to 10' or 12', the result would be a higher yield for the wheat crop (approximately 7 and 9% with 10' and 12' spacing respectively, compared to only a 6% increase with 15' spacing).

Table 26: Hand Harvest Yields of Winter Wheat from the House farm in 1996

	yield (bu/acre)	
row	**clay site**	**sand site**
1	103.8 a	111.6 a
2	62.0 b	76.6 c
3	59.0 b	59.4 d
4-6	59.5 b	64.7 cd
7-9	59.1 b	61.7 cd
10-12	61.5 b	68.0 cd
13-15	64.5 b	69.9 cd
16-18	61.8 b	59.0 d
19-21	60.7 b	63.6 cd
22	59.1 b	60.2 d
23	58.9 b	67.8 cd
24	100.8 a	94.9 b

Table 27: Wheat Head Count from the House farm in 1996

	row #	**1**	**2**	**11**	**12**	**23**	**24**
Wheat	**clay site**	332 a	184 b	199 b	197 b	190 b	327 a
Heads/m^2	**sand site**	313 a	226 b	193 b	204 b	205 b	303 a

Figure 5: Hand Harvested Winter Wheat Strip Yields

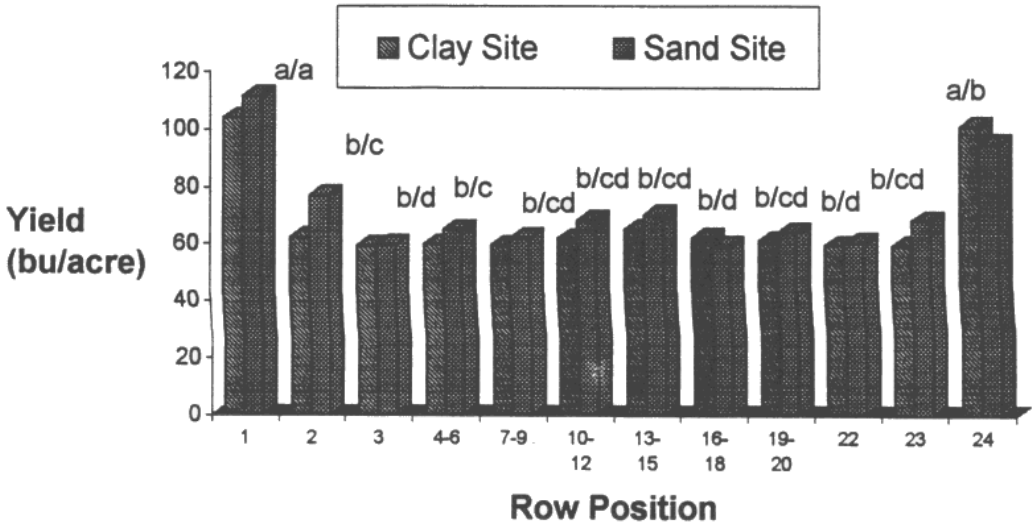
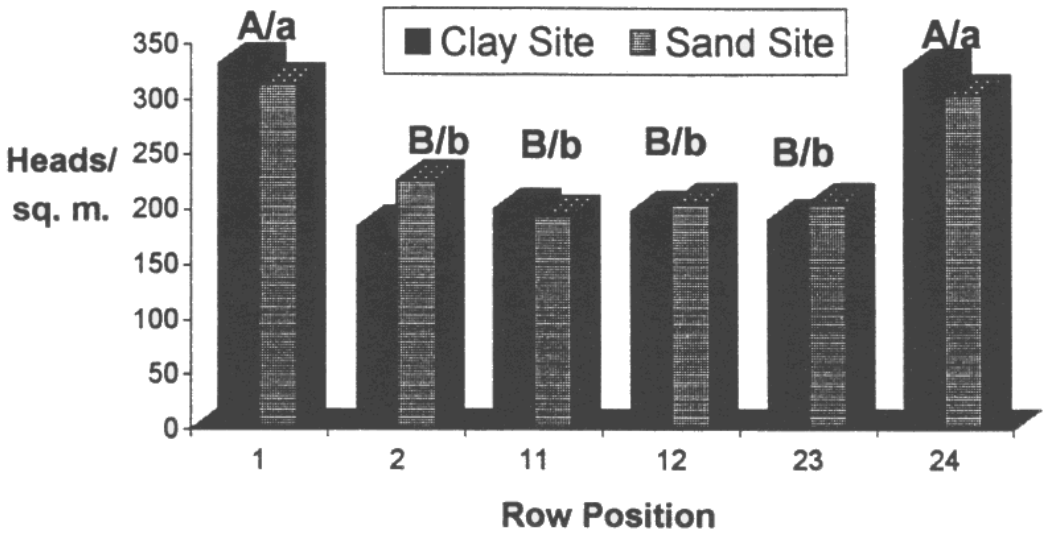


Figure 6: Head Counts Of Individual Wheat Rows

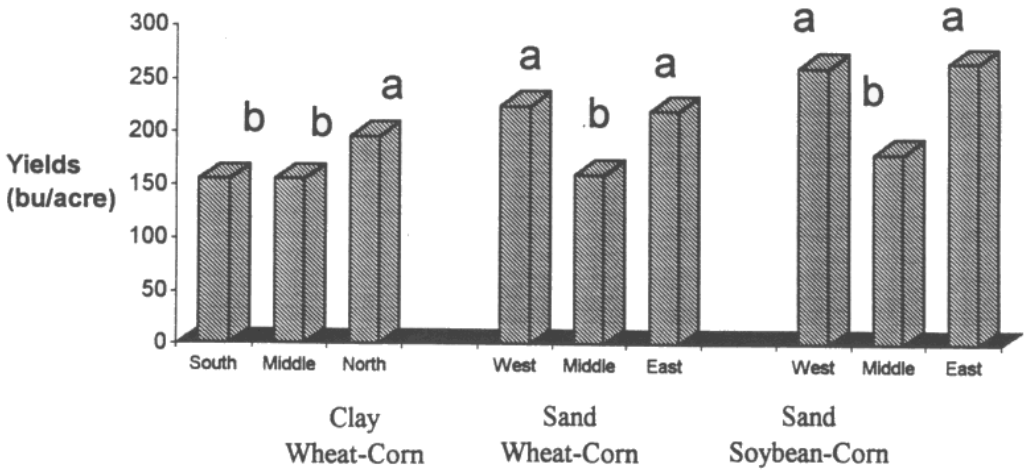


Corn

Corn productivity was relatively high considering the dry growing season. Centre row yields averaged 166 bushel/acre over the three sites (Figure 7). The average strip yield for the three sites was 202 bushel/acre or a 21.6% yield increase over the yield obtained in the centre row. The centre row may have over yielded compared to a conventional field management system, but no control plot was available for making this comparison. Within the corn strip, the outside rows were significantly higher yielding than the inner row which was planted at an 11 % lower population. Over the three sites, the outside rows yielded 31.8% higher on average than the centre row. This was similar to the average outside row yield response of 30% obtained at the Smith Farm for the 6 row corn strip crops that was previously discussed (Fig 3 and 4) . An exception to this was the south facing row on the clay site which had a yield equivalent to that of the centre row. The south facing row has been observed to be vulnerable to low crop yields in dry summers at other sites so this is not unexpected.

In most years, the water competition overlap of winter wheat and corn would not be expected to be a serious problem, however, the House farm was very dry in the summer of 1996. There was not enough rainfall in the summer to replenish the soil moisture used by the wheat crop earlier in the season. The soybeans appeared to be less competitive with corn as an adjacent crop in this drought year, despite the fact that the soybeans were relatively productive, yielding 50 bushels/acre. Overall, the three narrow row corn system appears to be an excellent system to take advantage of the additional sunlight available to corn. It has the potential to provide much higher increases in yield than the 6 row corn stripping system as 2 out of 3 rows are border rows as compared to one out of three in the 6 row system.

Figure 7: Hand Harvested Corn Strip Yields



Conclusion and Discussion

The result of the sampling performed at the House farm indicates that winter wheat yield is increased in outside rows where it is strip cropped with corn. This result is interesting in that both crops growing in the same field have the potential to out yield monocultures of either crop in the same field. However the 14.25" spacing between the wheat and the corn needs to be accounted for in assessing yield increases. In the wheat yield assessments, 3.75" of the wheat row is accounted for, and 10.5" off the corn is accounted for in the corn yield assessments. This area could be better accounted for by the corn crop yield as it is primarily a result of space requirements for field operations in the corn crop.

Too often, the result of strip-cropping corn with soybeans is that increases in corn yield do not compensate for decreases in soybean yield. This does not appear to be the case, however, with corn and winter wheat strip cropping systems as both crops consistently over yield. It would be interesting to evaluate how narrow a winter wheat and corn strip-cropping system could be practically implemented. Jim House has proven the yield potential of his narrow strip cropping corn system. However, if this system could be implemented in conjunction with an over yielding winter wheat production system, interest in strip cropping may increase. The corn appears to be the more yield responsive crop of the two in the strip cropping system, as 2 out the 3 rows are border rows, as opposed to only 2 of the 24 rows in the winter wheat. System development towards narrower wheat rows could further increase the yield response of the wheat. A significant economic response would result, as not only will the wheat yield increase somewhat, but more corn will be grown in the field. An economic analysis of strip management systems could optimize strip widths, given existing machinery availability.