Agriculture Canada

Research Branch
Direction générale de la recherche

Technical Bulletin 1987-15E

Issues and problems in northern wheat development

Canada

Issues and problems in northern wheat development

Proceedings of the Early Maturing Wheat Workshop

Held in Edmonton, Alberta, Canada February 19, 1987

PHILIP CLARKE
Research Station
Agriculture Canada
Beaverlodge, Alberta

Technical Bulletin 1987-15E

Research Branch
Agriculture Canada
1987

Copies of this publication are available from

P. Clarke
Research Station
Research Branch, Agriculture Canada
P.O. Box 29
Beaverlodge, Alberta
T0H 0C0

Produced by Research Program Service

Cat. No.: A54-8/1987-15E
ISBN: 0-662-15672-2

cover

The dots on the map represent Agriculture Canada research establishments.

SUMMARY

The Early Maturing Wheat Workshop was held in response to concerns expressed by northern wheat producers and wheat research workers. At the center of the issue was the downgrading of the variety Garnet to a Canada Feed status. Garnet was both the long-term and the only truly short-season wheat variety eligible for the Canada Western Red Spring class. Its absence emphasizes the need for increased research involvement for a region that represents about thirty per cent of total western Canadian wheat production.

RESUME

La tenue de l'atelier sur les variétés précoces de blé faisait suite aux préoccupations exprimées par les producteurs de blé du Nord et les chercheurs. Le principal sujet abordé a été le déclassement de la variété Garnet au rang de Canada Fourrager. Cette variété était la seule variété bien établie à cycle vraiment court qui pouvait être classée dans la catégorie de blé de printemps roux de l'ouest du Canada. Cette situation met en évidence la nécessité d'intensifier les efforts de recherches dans une région qui produit environ 30 % du blé canadien de l'Ouest.

TABLE OF CONTENTS

Economics of Wheat in the Parkland[1]

L.P. Apedaile, D.R. Oke and L.E. Ruud[2]

I. Introduction

The ability of the prairie parkland to compete with the rest of the world depends on steady advances in productivity, economic efficiency and support by the public treasury. This paper examines the issues behind the performance of wheat in the parkland. Trends in yields for the parkland relative to southern Alberta, the United States and France are compared. A comparison of costs of production and gross margins is also made taking into account subsidies where possible. Gross margins are a useful measure of performance of the wheat system. Finally, we attempt to point out research which is required to enhance the wheat system for the parkland and northern edges of the prairies.

The methods of analysis are crude and results are preliminary based on systems analysis and partial budgeting. Interactions between wheat and other crop systems in the cropping pattern are not taken into account. Fixed costs of farming are not apportioned to wheat, but are presumed to be a primary claimant against gross margin.

The northern prairies are represented by the Peace region of Alberta using data from Census Division (CD) 15. The parkland is represented by CD 10. The southern prairies, as a basis for comparison, are represented by CD 5 in Alberta.

II. Area seeded to wheat

Wheat area is a fairly steady proportion of area seeded to the three major crops in the parkland year after year, seemingly irrespective of its price relative to other crops (Table 1, Figures 1, 2 and 3). By contrast, barley and canola trade off one against the other reflecting their relative prices, delivery opportunities and relationships in rotations. The main difference between the parkland and southern Alberta is the predominance of wheat in the south, occupying 60-70 percent of the arable

---

[1]Paper presented at the Agriculture Canada Workshop on *Early Maturing Wheat*, at Edmonton, Alberta: February 19, 1987.

[2]L.P. Apedaile is Professor; D.R. Oke and L.E. Ruud are Graduate Students, Department of Rural Economy, University of Alberta, Edmonton, Alberta.

area.

In the Peace country (CD 15), area seeded to wheat increased to almost 1,000,000 acres in 1985 from under 200,000 acres in 1974 (Figure 4). However, the cropping patterns have been evolving to less and less wheat proportionately in the past decade (Figure 3). The highest proportion of area seeded to wheat relative to the three crops was in 1979 at 53 percent which dropped to a low of 22 percent by 1982. In 1986 the proportion was 31 percent. The barley/canola pattern in CD 15 mimics that of the rest of the province.

III. Wheat revenue

Revenue from wheat has fluctuated considerably with price and yields (Figure 5), hitting a peak in 1981 in both the parkland and the south. The peak in the Peace exceeded slightly the parkland peak and came two years later, riding on record yields and $165/t wheat. The peak revenue in the parkland in 1981 was attributed to the record price of $184/t that year (Table 2 and Figure 6) and greater than average seeded area. The revenue to farmers from wheat in 1984 in CD 10 and CD 15 of Alberta combined was $222.7 million.

IV. Wheat yields

In general, yields are unstable year to year (Figure 7 and Table 3). In particular, frost damage in 1974 and 1982 shows up in distinctly lower yields in those years. The coefficient of variation for yield is highest for the Peace at 19.3 percent compared to 16.0 percent and 15.4 percent for CD 5 and CD 10 respectively (Table 4). These statistics suggest a need for more reliable varieties in the parkland and north, and cast doubt on the sure crop image of the parkland. Further analysis of annual and seasonal soil moisture and precipitation patterns would likely reveal a need for drought resistant characteristics in parkland and northern wheats.

Comparisons of yield with France (Ile de France) and the United States (Kansas) are revealing (Figure 8). Yield trends over the last 22 years show significant improvement in France, the USA and CD 10 (Table 5). Yields for southern Alberta have not improved in 22 years while there is significant but unremarkable improvement in the Peace. Yields in Kansas show no strong upward trend (Figure 8).

The remarkable part of the yield comparison is the performance of wheat yields in France. The 1967 kilogram per acre difference in average yields between France and the parkland of Alberta no doubt reflects varietal and climatic differences and higher input intensities. However, a complete transformation of agriculture over the last 22 years in France, including farm consolidation, agronomic practices and varietal improvements account for their high rate of improvement in yields. Furthermore, the institutional environment of the French wheat system seems to have played a major role. Price incentives and an absence of restrictions on type of wheat sown have stimulated initiative and behavioural change among French farmers ensuring rapid uptake of technological opportunity and broad-based adoption of new technology. These factors, present in France, are absent in Alberta, pointing at the need to think beyond varietal changes.

V. Grade, price and average revenue per acre

Weighted average prices were compared for the north, parkland and southern Alberta (Table 2 and Figure 6). Generally the price in the south was $10.00 above the price in the parkland, due to grade alone. Based on 1984 production, this price difference for CD 10 is equivalent to $7,605,000. Similarly the parkland price was always above the northern price by several dollars. These comparisons exclude the freight effect which would widen the Peace/parkland spread by about $0.40 basis Vancouver and $3.00 basis Thunder Bay. These spreads became apparent only in 1973 when the price of wheat moved up sharply. When price, grade and yield are combined as average revenue from wheat per acre, the parkland exceeded the south only 5 years out of the last 22 years examined (Figure 9). This lower performance underscores the 42 kg/acre lower yields in the parkland over the last 22 years (Table 4) and lower grades in the north.

In summary, there are three factors contributing to lower per acre revenue as one moves north in the province. Grade, yield and price combine to reduce average revenue per acre by $9.00 from the south to the parkland and by another $10.00 from the parkland to the north for a total north/south difference of $19.00. Research on the north/south differences in the structure of cereal agriculture produced similar results (Apedaile and Packer, 1986). The problems with wheat performance as one moves north appear to be part of a more general pattern on the prairies. Resolution of the problems inherent in northern wheat production probably extend well beyond varietal questions.

VI. Wheat performance compared to that for other international players

The concept of gross margin is widely used in Europe as the means of comparison of alternative farm enterprises. Gross margin (GM) is convenient because the same number may be interpreted according to fixed cost obligations, level of liability, standard of living, and values patterns for individual producers. Assumptions by economists about widely differing circumstances are left out of the analysis.

GM is the amount of money left over after operating or variable cash costs have been met. The GM is what is available to pay fixed cash costs (e.g., taxes and mortgage interest), meet family living requirements, pay off liabilities, replace obsolete and worn out equipment, invest in new equipment, buildings and technology and invest in more land. Higher GM's lead to bidding up the prices of land and equipment and to an appreciation of equity in farm assets and vice versa. Appreciation leads to accumulation of wealth which is thought to be the major economic motive in Canada.

The economic performance of wheat in the parkland measured in terms of gross margin compares well with the performance in the United States, but is far below that of France. Table 6 contains comparable data on gross margins with and without subsidization. Subsidies are explained in the footnotes to the Table. The GM for wheat in the Peace is the lowest of those compared, at $67.15 per acre with subsidies included. For the parkland, the GM is $103.41 compared to $91.03 for the United States and $528.29 for France. Subsidies are greatest for France at twice the $61.73 level for the United States. The evidence confirms the relatively low level of subsidization, even in 1983, in Alberta.

The before-subsidy GM's indicate how far parkland wheat system performance has to go to catch up to that of France. However, CD 10's performance exceeds that of the United States by a factor of 2.5 suggesting that the parkland still retains a competitive edge over Canada's major competitor in international markets.

VII. Introduction to the wheat system

Wheat is simply another option for farmers. If it doesn't perform well economically, farmers should reduce their wheat acreage. Let market forces work, so the argument goes, and let producers with differing skills and with the luck of the draw on soil and climate respond to the market. Using this logic, some may suggest that northern and parkland farmers should leave the production of wheat up to southern growers. So why are so many parkland and northern people especially interested in wheat?

The reason for their interest appears to lie in the way they view wheat as a natural and traditional staple commodity valued for reasons beyond economics yet tied up with historic profitability. Wheat is seen as holding great potential. That same kind of potential has been unlocked for barley and canola, but remains beyond their grasp for wheat. Many publicly enacted policies and regulations including price pooling, quotas, distance related rates, car allocations, grades, research emphasis and central desk marketing, all taken together, seem to be holding back the economic potential of wheat in the parkland. Chief among these institutional factors are grades tied to red colour and protein. It all seems very unfair and inequitable to parkland and northern producers.

Parkland and Peace country wheat producers cannot meet the grading standards for wheat. The publicly funded and directed research establishment has taken the grading standards as given and has sought to maximize yield and pest resistance subject to these constraints. However, as Figure 7 shows, there has been little or no statistically significant achievement in yields in Alberta with this constrained optimization approach.

A popular view of a solution to these problems imposed by the institutional environment is to revise the standards, permitting white wheats with less protein and higher yields. Veeman reports that one percent protein trades off for about 15 percent yield (Veeman, 1987). She also reports that one percent protein is worth about $5.00 per tonne. Fifteen percent of $150.00 wheat is $22.50. Technological advances with enzyme enhancers in leavening processes enable the use of lower protein (gluten) flours without violating consumer preferences. Even these preferences are subject to adjustment over time. Therefore, it is logical to conclude that the wheat grading standards can be changed.

Probably, changes to standards are required. However, there are other issues which emerge from an analysis of parkland wheat production. The overall wheat system consists of a production system and a post-production system (Figure 10). These two systems contain many human activities which are an expression of technology. The activities take place in an environment of the natural ecosystem, the solar system, many institutional systems and, of course, many non-agricultural human activities.

VIII. Model of the parkland wheat system

A. Environment

Performance of the wheat system is driven by the technology embodied within its various activities. However, the system is always under the influence of its environment. The notion of environment extends beyond the ecosystem/ecology concepts to include social, political and economic systems, both domestic and international.

The various environments to the parkland wheat system are labelled in Figure 10. All are important. The social and cultural environment determines a major part of tastes and preferences for wheat based foods. The solar system fuels photosynthesis. Solar energy is under one percent efficient in crop production. The atmosphere and hydrosphere contribute uncertainty and risk through yield variability.

Climatologists are confident in their projections that the parkland area of the prairies is getting warmer and that within 30 to 50 years, a one to three degree average annual temperature change may be realized. Short season wheat varieties would then be unnecessary. In the meantime, however, climate limits the economic performance of wheat in the parkland prairies principally with a short frost-free period, droughtiness and fall rains. Farmers respond with early seeding, oversized harvest equipment and grain drying. A major focus for biotechnological change at the present time is the accommodation of the wheat system to these uncontrollable features of the ecosystem.

Similarly, other environments constrain or shock the wheat system. Consequently, the wheat system seeks to close its boundaries with the environments or to embrace parts of the environment within its boundaries. For example, the institutional environment is partly within the prairie wheat system in the form of producer-run pools, and advisory committees. For the parkland wheat system, however, the institutional environment is completely outside the system. Furthermore, the system is wide open to shocks from that environment at its boundaries.

B. The model

Figure 11 illustrates a model of the production and on-farm post-production systems for wheat. A change in technology for any one activity or a rearrangement of activities changes the whole system. Failure of the whole system to change often jeopardizes the performance of the new technology. An example is no-till technology. It is not useable for reasons beyond the mechanical and draught power design problems. Weed control, capital cost and the distribution of factor returns are some of the related systems issues unresolved.

Winter wheat is a technology that rearranges the timing sequences of system activities. Thus, a winter wheat system is different to a spring wheat system. The lack of success of winter wheat in the parkland appears to be due in part to incompatability of the rearrangement with the ecosystem of the parkland. That is, the issues for winter wheat are at the boundary of the wheat system with the ecosystem in terms of rainfall patterns and soil moisture in August, snow cover and spring thaw patterns.

The post-production system for wheat is divided into on-farm and off-farm subsystems. The off-farm subsystem is part of the environment to the on-farm subsystem. It includes transportation, elevation, storage, ocean freight, foreign and domestic milling, baking, processing, wholesaling, retailing and home preparation of wheat foods. An example of a new shock to the on-farm PPS subsystem from the off-farm PPS subsystem is the demand for lower moisture tolerances in tropical and subtropical markets. The on-farm PPS subsystem is going to have to respond. The response has implications for the production system and for varietal development.

C. Early maturity

It would seem that the problem of satisfying grade standards lies at the boundary or interface of the production system and the on-farm post-production subsystem. The conventional thinking lies in shifting this interface to the left along a calendar axis with early maturing varieties. The preoccupation with earliness and the loss of yield associated with later seeding through May in the parkland severely limits achievement of economies of size for farmers. Economies of size are the main basis for total gross margin as average GM's shrink over time. Earlier maturing varieties would help even more if they were spring frost resistant or could be sown in late fall without sprouting.

The systems model of Figure 11 also points to an approach other than earlier maturing varieties to resolve grade and harvest problems. The on-farm PPS activities might be rearranged to control drying without weathering. It is common in many other wheat PPS's to store the grain on the head under cover prior to threshing. Relief from the pressure to thresh within the limited harvest season could enable larger size wheat operations. The focus of research in this case would be on engineering, economics and entomology for the PPS and on storage and curing attributes for varietal development.

IX. Discussion of some insights from the model

The systems analysis of wheat performance in its most rudimentary form points at many gaps in technology (know-how) in the parkland. The problems seem to lie where the activities of the production and post-production systems come together (interface). The production activities on the one hand are governed by individual initiative relatively free of institutional constraint. The post-production system, on the other hand, is almost completely regulated. Individual initiatives are confined to on-farm activities of cutting, drying, threshing, farm transport and storage. The pricing of the wheat other than for local feed is done through several intermediaries acting between producers and consumers operating under government regulations.

Where and how the production system activities meet the post-production system activities is a good place to look for system improvements. Most attention so far has been placed on moving those interfaces to earlier dates on the calendar to prevent early frost damage, spread the harvest work load and avoid fall rains and early snows. Winter wheat achieves these objectives and therefore is being tried. Other less obvious enhancements to production activities include; land improvements, fall seeding, improved solar energy capture, spring frost resistance, growth stimulation, drought resistance, field water management and pest control. The problems with many of these suggestions are the economic claims against wheat revenue from growing numbers of off-farm stakeholders such as chemicals and equipment suppliers and lenders, and the bias of new technology in favour of large farms.

The post-production system appears to have the most trouble with the squeeze between atmospheric constraints and institutional constraints. The quality of wheat standing in the field when the post-production system takes over in the parkland is generally seen as potentially CWRS1.[3] The problems arise in the degree of maturity at cutting, frost before or after cutting, dryness at threshing and weathering. Current mechanical technology has addressed these problems with high capacity equipment to handle the crop quickly when it is in optimum condition. This approach is capital intensive resulting in high unit fixed costs and thus is an important claimant on the gross margin. The technology is also heavily reliant on solar energy for drying at a time of year with rapidly shortening days and high relative humidity.

There are two focuses for improvement of the parkland wheat system. The first is the technologies within the activities themselves such as tillage, weed control, varieties, cutting, threshing, drying and storage. Activities could be added, subtracted, divided or combined. Most improvement may lie in the ways activities relate to each other. An example of rearrangement of post-production activities is to combine cutting and threshing, replacing drying in the swath by drying with auxilliary energy during storage or handling.

Systems theory suggests that any new activity or rearrangement of activities creates a new system with a need for rearrangements and changes throughout the system. The case of the parkland wheat system is probably not unique in this regard. Research must address the whole system if appropriate results in terms of economic performance are to emerge. A single-minded approach based

[3]This perception may be incorrect under some growing conditions.

on early maturity or fighting the CWRS standard is only a part of what has to be done within the whole farming system of the parkland let alone the wheat system on the prairies.

Table 1: Total acreage planted in wheat ('000) for CD's 5, 10 and 15 of Alberta, 1964-85.

Year	CD 5	CD 10	CD 15
1964	-	-	-
1965	-	-	-
1966	-	-	-
1967	-	-	-
1968	1,011	903	654
1969	769	772	454
1970	324	397	191
1971	516	472	300
1972	718	578	380
1973	901	638	359
1974	867	470	185
1975	874	537	218
1976	974	715	377
1977	802	590	277
1978	864	610	338
1979	949	609	318
1980	940	753	643
1981	1,050	812	709
1982	1,075	803	770
1983	1,198	921	921
1984	1,131	845	843
1985	1,138	857	964

Source: *Agriculture Statistics Yearbook*, Government of Alberta, various years.

Table 2: **Wheat price weighted by grade for CD's 5, 10 and 15 of Alberta, 1964-85.**

Year	CD 5	CD 10	CD 15
1964	55.55	53.95	53.70
1965	57.99	58.35	58.10
1966	63.20	62.07	61.09
1967	57.93	57.59	57.13
1968	49.25	44.76	44.87
1969	45.30	43.15	42.47
1970	48.64	46.59	48.36
1971	57.35	55.71	53.16
1972	70.49	66.65	66.26
1973	157.95	153.92	144.97
1974	146.90	133.87	135.16
1975	129.94	124.15	123.76
1976	105.26	99.24	95.26
1977	103.33	92.82	91.14
1978	140.62	126.74	124.35
1979	184.43	173.32	167.33
1980	198.33	180.45	183.25
1981	186.31	184.34	184.26
1982	173.75	161.09	154.42
1983	179.28	166.75	163.04
1984	168.70	156.82	147.82

Source: *Agriculture Statistics Yearbook*, Government of Alberta, various years.

Table 3: Wheat yield in kilograms per acre for CD's 5, 10 and 15 of Alberta, 1964-85.

Year	CD 5	CD 10	CD 15
1964	751	555	621
1965	816	648	479
1966	996	672	596
1967	667	683	482
1968	904	544	694
1969	893	699	523
1970	849	830	623
1971	806	844	754
1972	860	759	721
1973	852	833	661
1974	797	683	621
1975	887	797	789
1976	852	961	898
1977	610	900	750
1978	900	770	750
1979	735	900	910
1980	940	975	855
1981	1,115	820	780
1982	965	935	625
1983	900	825	955
1984	580	900	830
1985	600	815	590

Source: *Agriculture Statistics Yearbook*, Government of Alberta, various years.

Table 4: **Summary of wheat yields for CD's 15, 10 and 5 of Alberta, Canada, Kansas, United States and France, 1964-85.**

	N	Mean yield (kgs/acre)	Standard deviation	Minimum	Maximum	Coefficient of variation (%)
Alberta, CD 15	22	704.83	135.94	478.99	955.00	19.3
Alberta, CD 10	22	788.59	121.85	544.31	975.00	15.4
Alberta, CD 5	22	830.67	132.97	580.00	1,1155.00	16.0
Canada	22	708.10	90.30	533.28	856.48	12.8
Kansas[a]	22	833.18	166.61	530.71	1,129.50	20.0
United States	22	860.34	109.04	698.92	1,070.60	12.7
France	22	1,755.60	376.49	1,143.30	2,605.08	21.4

[a]Most wheat grown in Kansas is winter wheat.

Table 5: **Trends in wheat yields estimated for CD's 15, 10 and 5 in Alberta, United States (Kansas), Canada and France over the period 1964-1985.**

Location	Trend in kgs/acre per year	Degrees of freedom	Student t statistic	R^2
Alberta, CD 15	12.8	20	3.45*	0.37
Alberta, CD 10	13.9	20	4.90*	0.55
Alberta, CD 5	-1.7	20	-0.38	0.01
Canada	6.9	20	2.58	0.25
United States (Kansas)	18.8	20	4.84*	0.54
France	52.6	20	9.61*	0.82

*Statistically significant with 99% confidence.
Source: OLS estimates using data from Table 3.

Table 6: Gross margins and costs (in Canadian current dollars per acre) of producing wheat in France (Ile de France), United States, and CD's 10 and 15 of Alberta, 1983.[1]

Item	France	United States	Alberta	
			CD 15	CD 10
Yield (tonnes)	2.59	1.00	0.81	0.99
Farm price[2]	255.85	156.90	163.04	166.75
Total revenue[3]	662.62	156.90	132.71	164.58
Variable costs[4]	134.33	65.87	65.56	61.17
Gross margin[5]	528.29	91.03	67.15	103.41
Subsidies ($/ac)[6]	120.05	61.73	23.15	28.08
Unsubsidized Gross Margin[7]	408.25	29.30	44.00	75.33

[1]Exchange rates are 1983; $1.00 Cdn = $0.77 U.S.; $0.1624 Cdn = 1 FF.
[2]Includes subsidies.
[3]Excludes byproducts such as the value of crop residues; includes insurance receipts.
[4]Includes hired labour, crop insurance, seed, fertilizer, pesticides, fuel and lubrication and repairs.
[5]Available to reward operator labour, capital, land and management from which are paid taxes, interest on liability, depreciation, capital maintenance, and loan principle.
[6](a) Alberta subsidy level is $28.45 per tonne. Subsidies included were Western Grain Stabilization Act, Alberta Farm Fuel Distribution Allowance and the Crow Benefit.
[6](b) U.S. federal support to wheat production for 1983 was $61.73 Cdn/tonne.
[6](c) Wheat subsidies in France are based on the difference between the price of an equivalent Canadian grade, c.i.f. Rotterdam and the farm price received by French producers.
[7]Problems of low protein in the Peace River Region in 1983 are reflected through yield and price in the low gross margin.

FIGURE 1

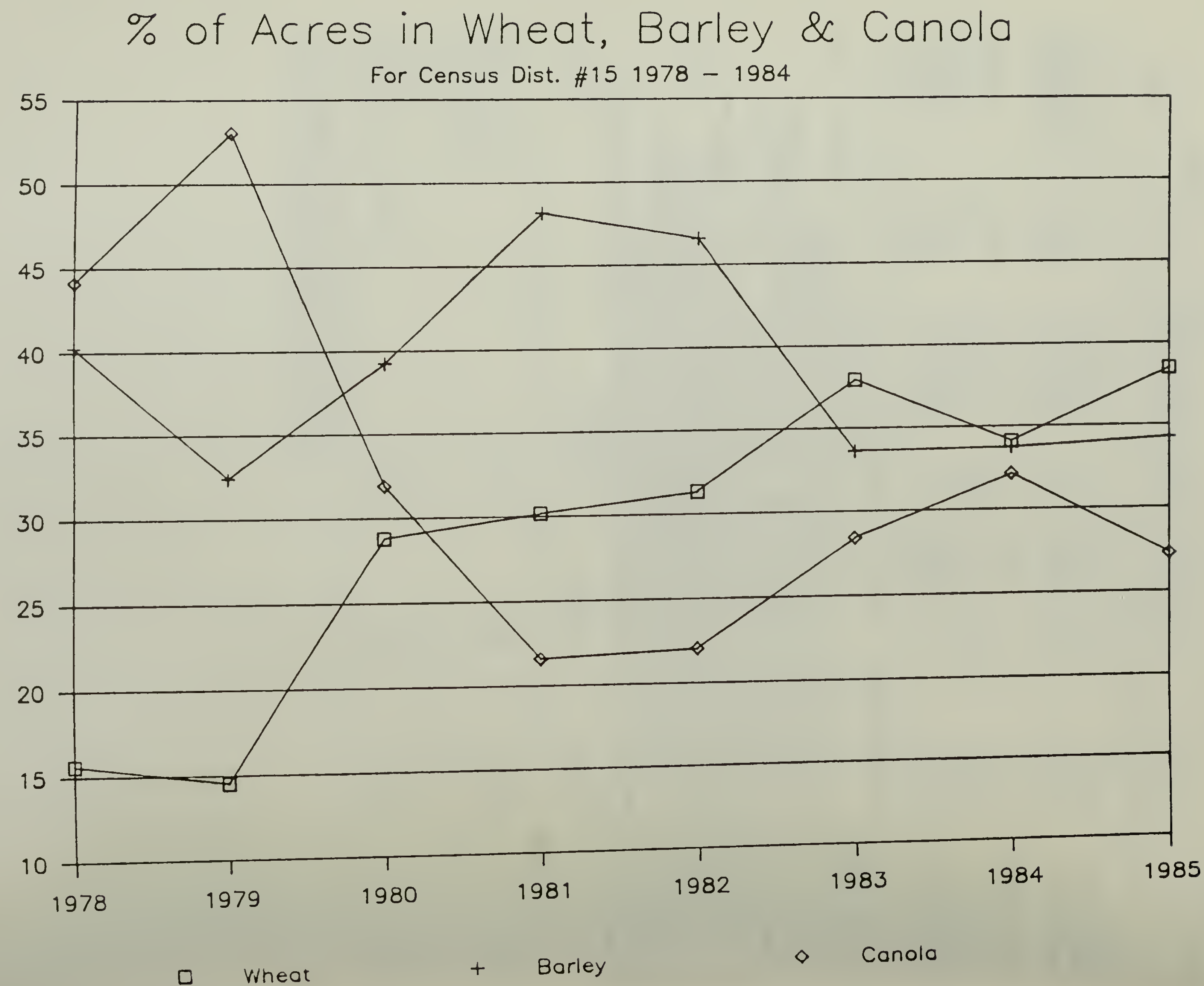

% of Acres in Wheat, Barley & Canola
For Census Dist. #15 1978 - 1984
55
50
45
40
35
30
25
20
15
10
1978
1979
1980
1981
1982
1983
1984
1985
Wheat
Barley
Canola

FIGURE 2

% of Acres in Wheat, Barley & Canola

For Census Dist. #10 1978 – 1984

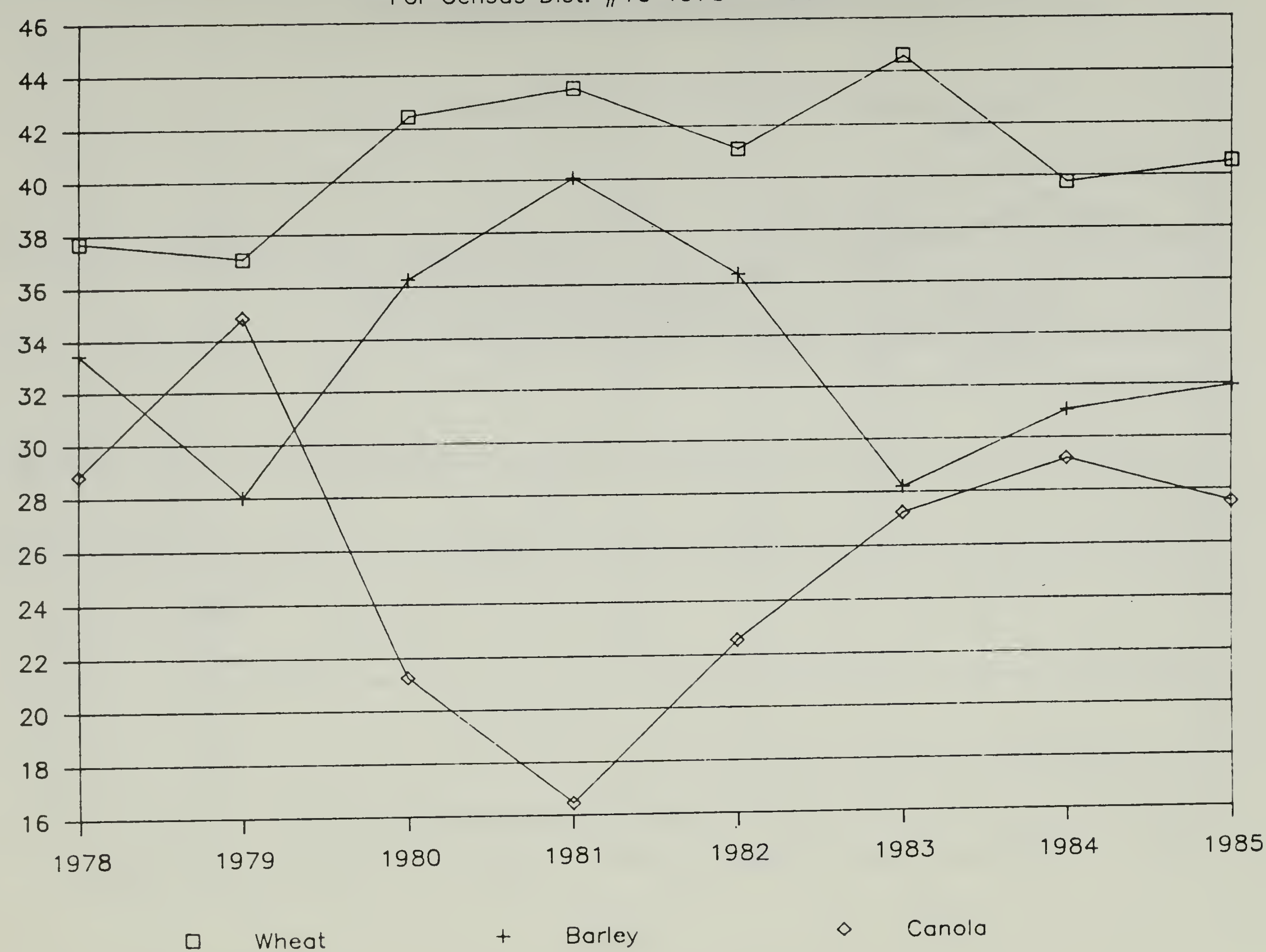


FIGURE 3

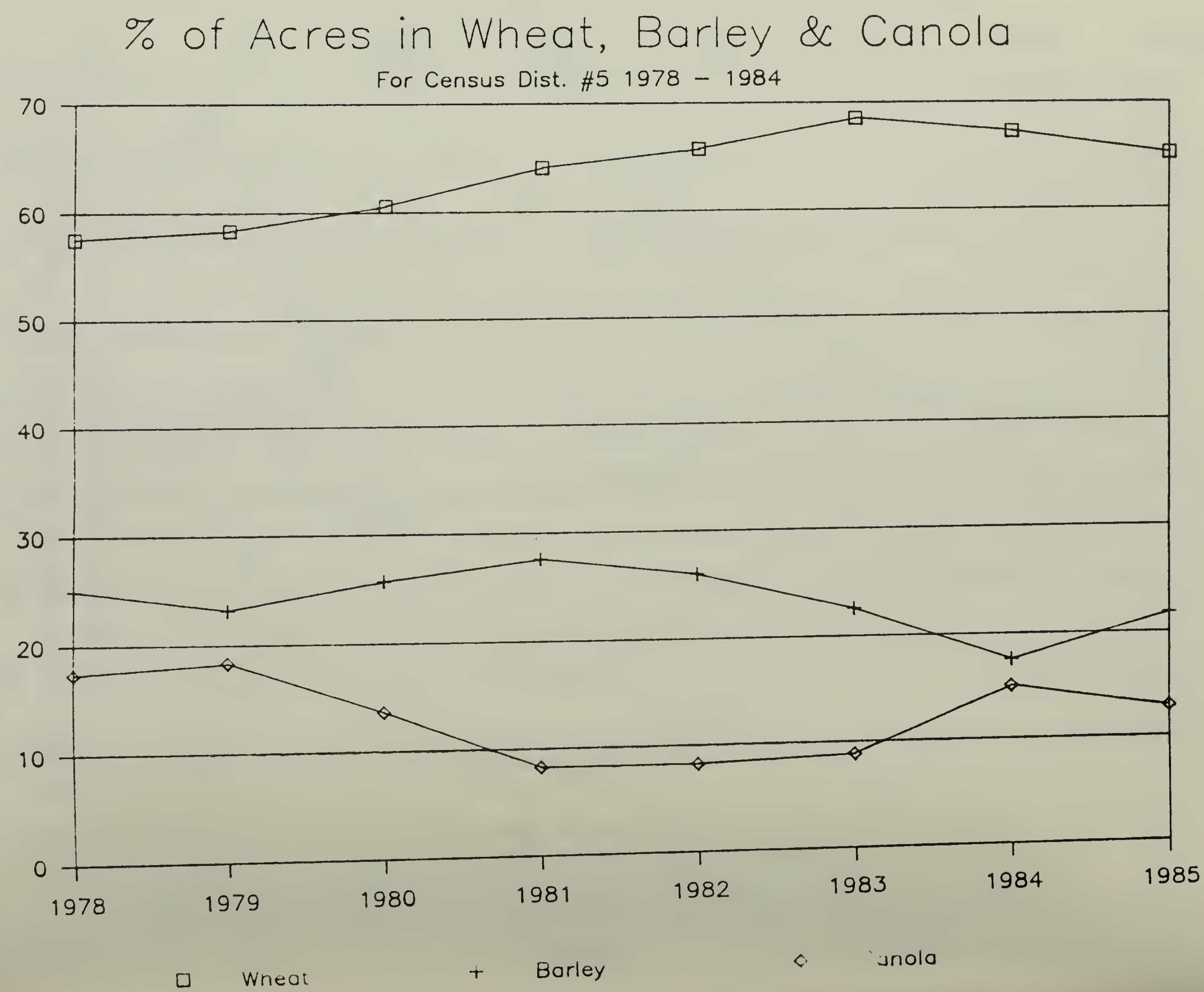

% of Acres in Wheat, Barley & Canola
For Census Dist. #5 1978 – 1984
70
60
50
40
30
20
10
0
1978
1979
1980
1981
1982
1983
1984
1985
Wheat
Barley
unola

FIGURE 4

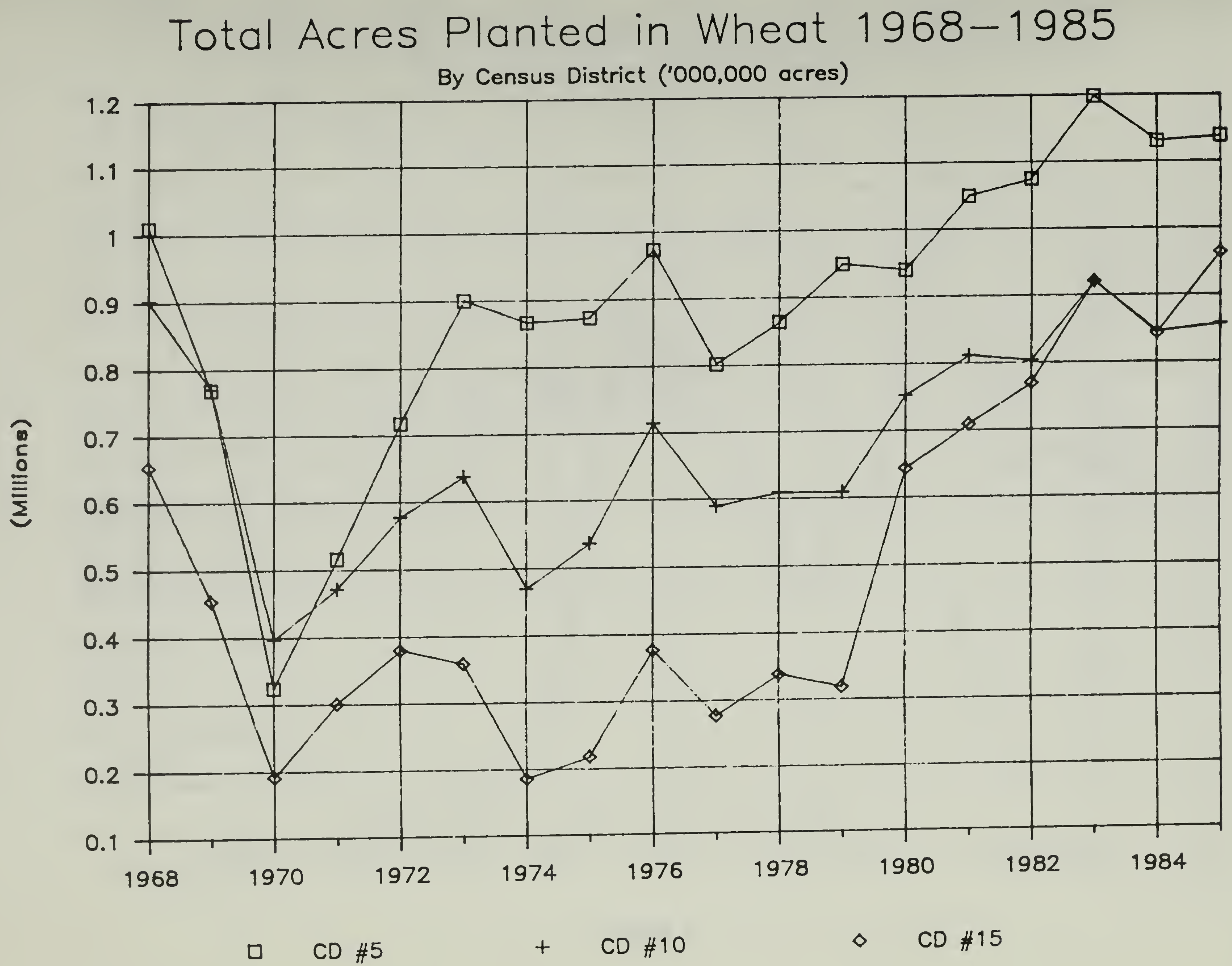

Total Acres Planted in Wheat 1968–1985
By Census District ('000,000 acres)
(Millions)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1968
1970
1972
1974
1976
1978
1980
1982
1984
□ CD #5
+ CD #10
◇ CD #15

FIGURE 5

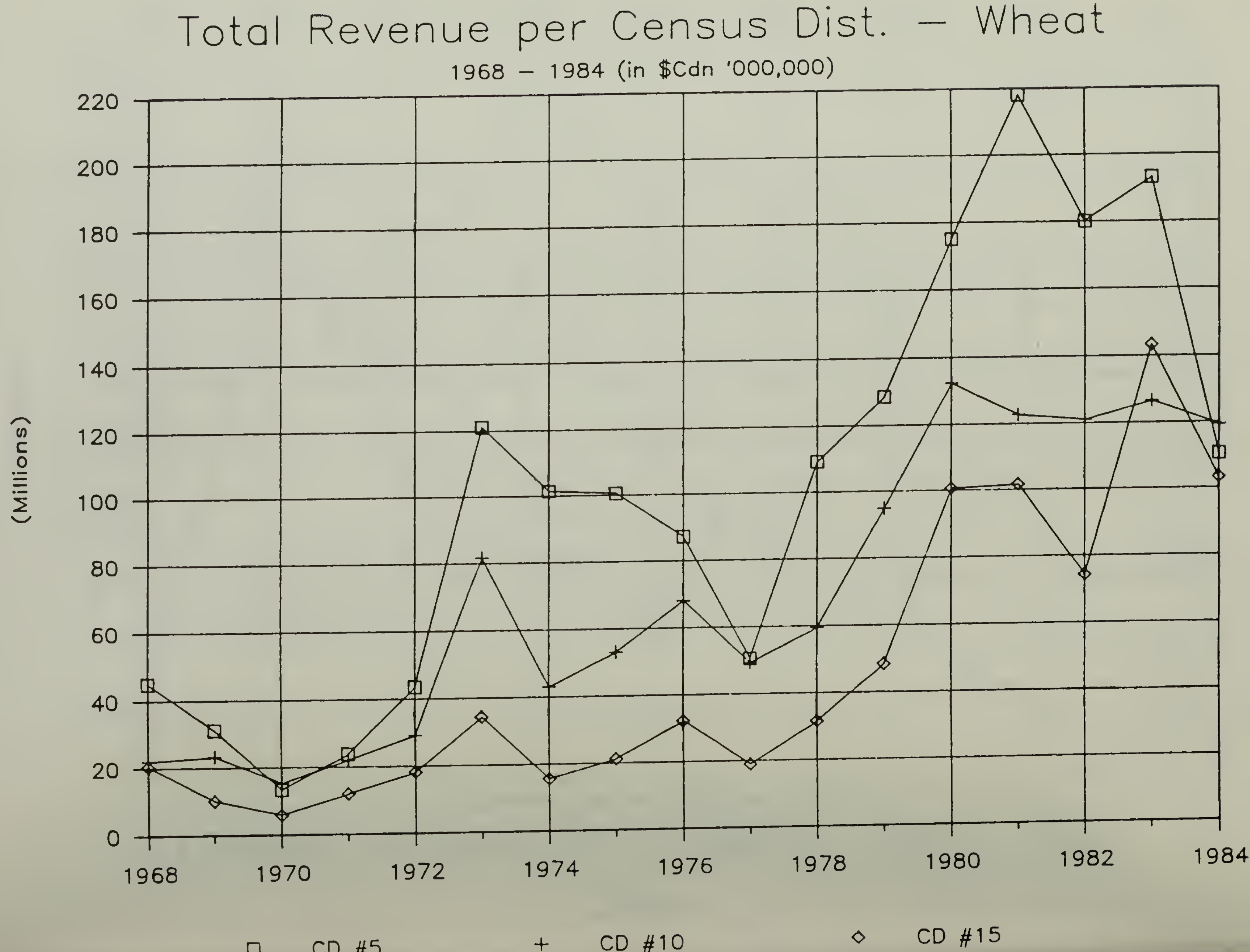

Total Revenue per Census Dist. — Wheat
1968 — 1984 (in $Cdn '000,000)
(Millions)
220
200
180
160
140
120
100
80
60
40
20
0
1968
1970
1972
1974
1976
1978
1980
1982
1984
□ CD #5
+ CD #10
◇ CD #15

FIGURE 6

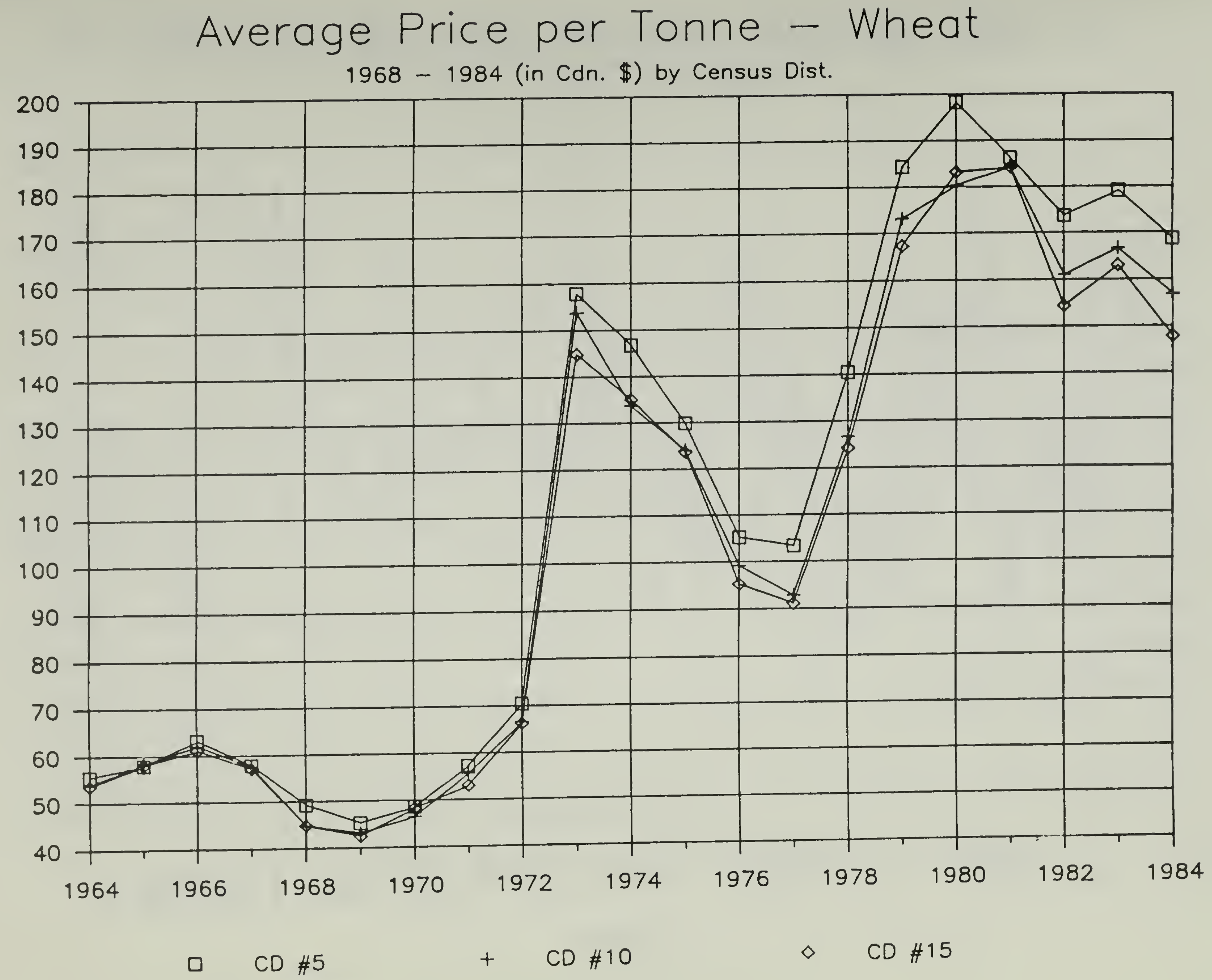
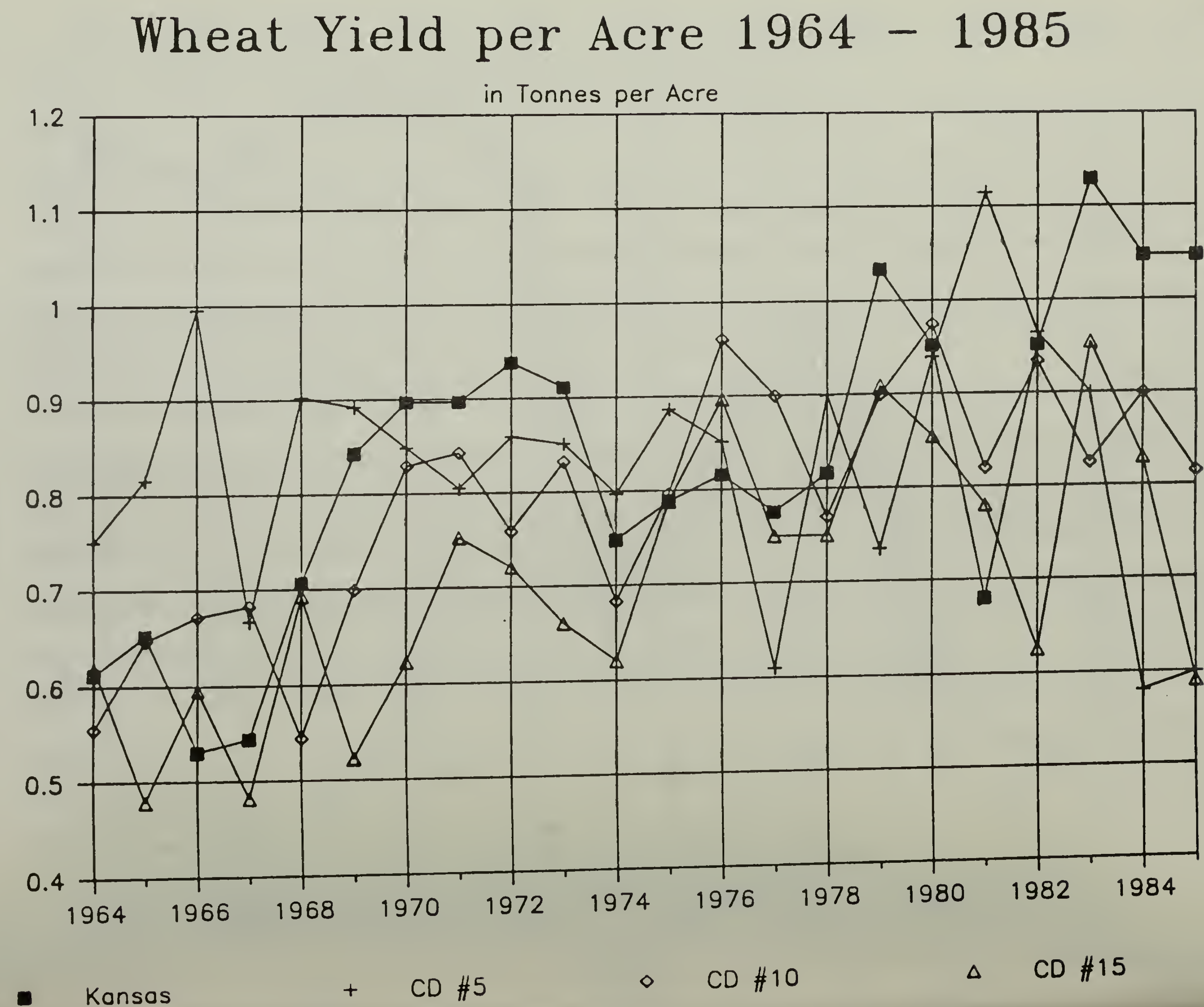

Average Price per Tonne – Wheat
1968 – 1984 (in Cdn. $) by Census Dist.
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
□ CD #5
+ CD #10
◇ CD #15

FIGURE 7



Wheat Yield per Acre 1964 – 1985
in Tonnes per Acre
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
Kansas
CD #5
CD #10
CD #15

FIGURE 9

Average Revenue/Acre by Census Dist.

1964 – 1984 (in Cdn. Dollars)

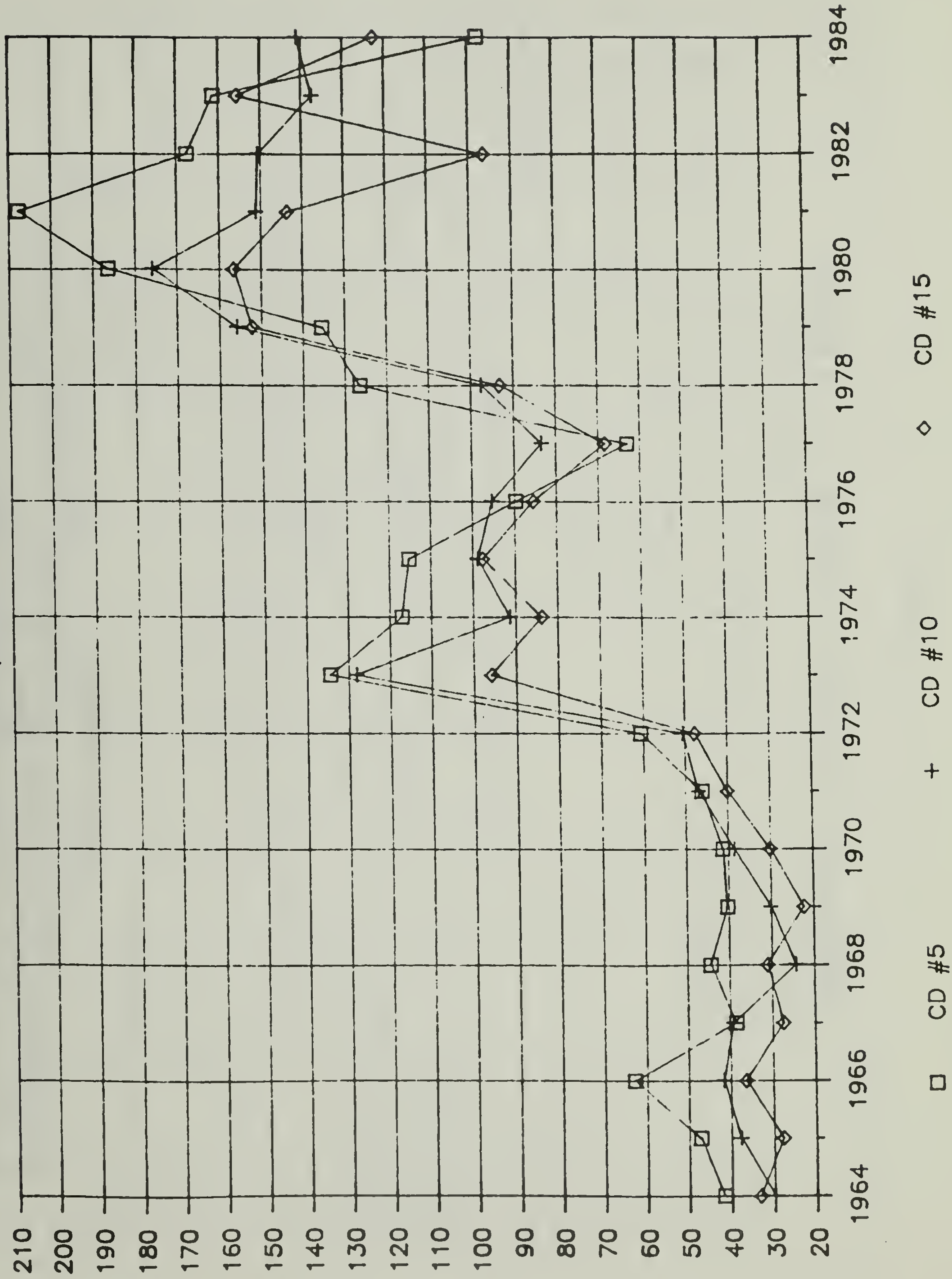


FIGURE 8

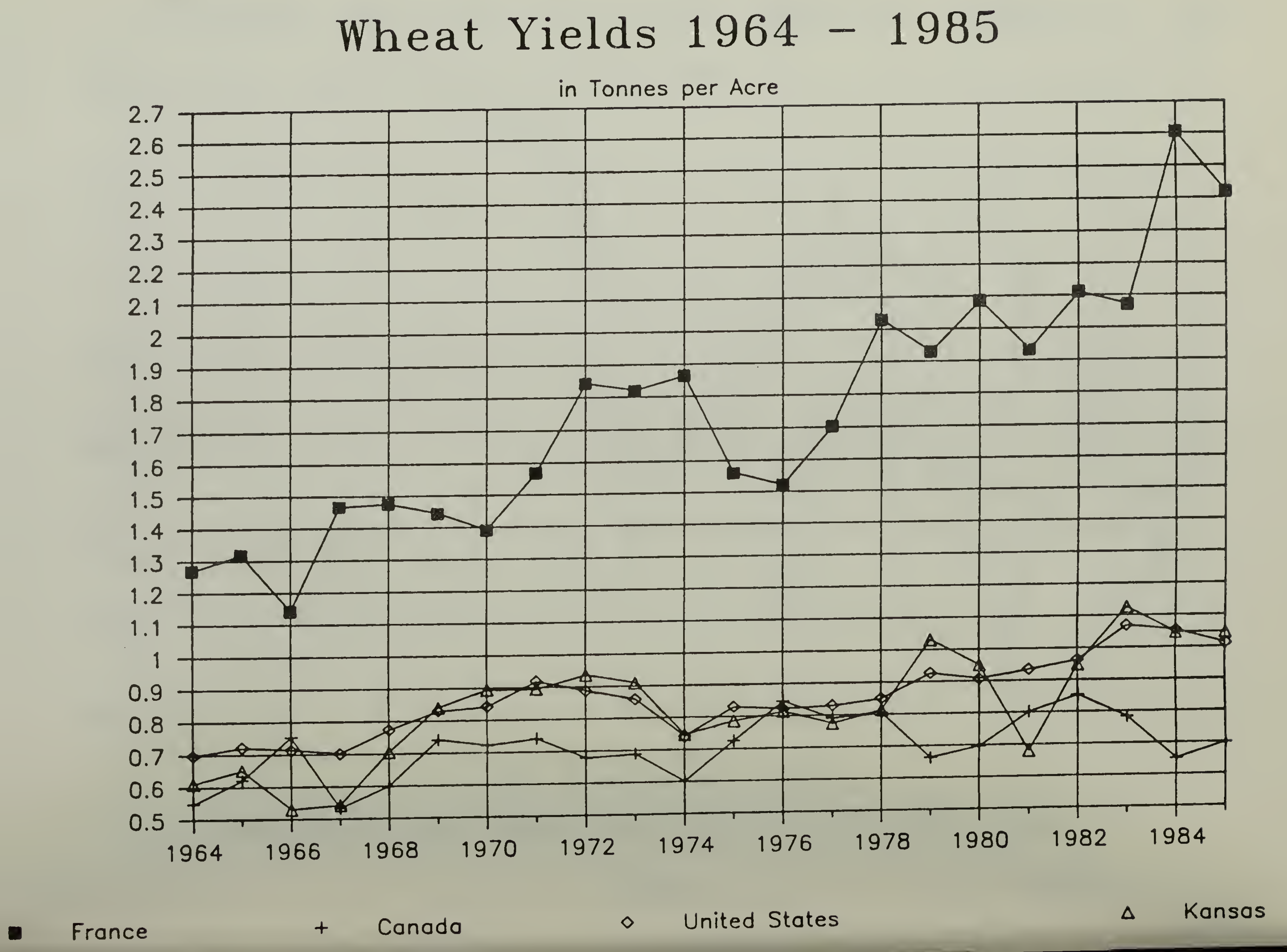

Wheat Yields 1964 - 1985
in Tonnes per Acre
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
France
Canada
United States
Kansas

FIGURE 10

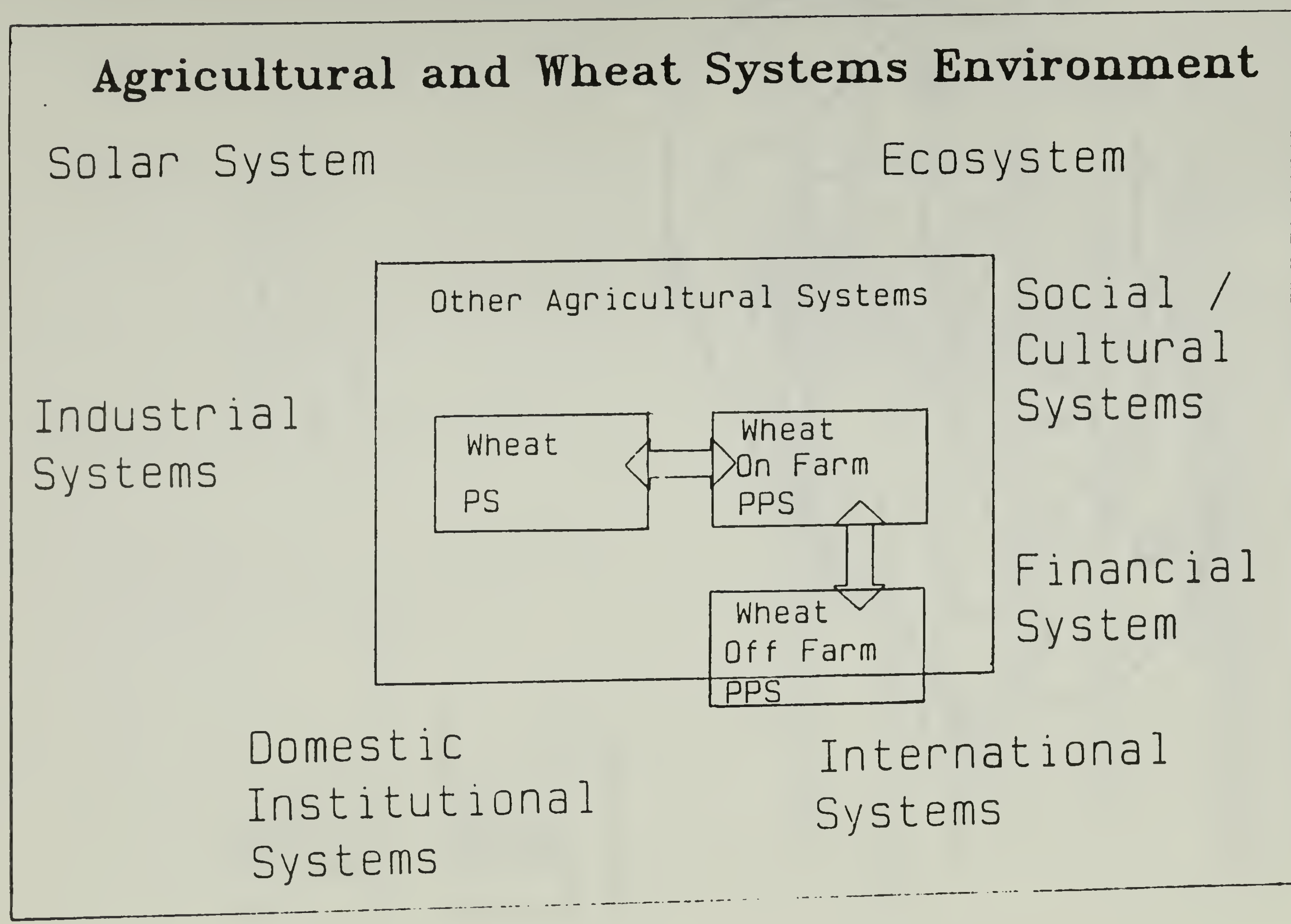
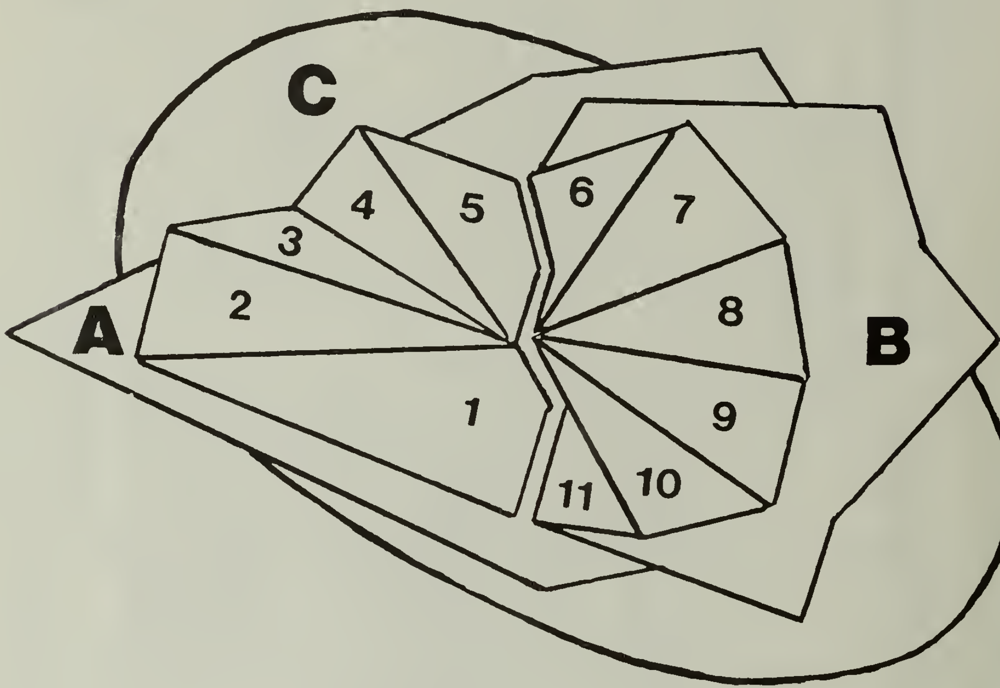

Agricultural and Wheat Systems Environment
Solar System
Ecosystem
Other Agricultural Systems
Social / Cultural Systems
Industrial Systems
Wheat PS
Wheat On Farm PPS
Wheat Off Farm PPS
Financial System
Domestic Institutional Systems
International Systems

Figure 11: **Wheat production and post-production systems showing the ecosystem and institutional environments impinging on the performance of the wheat system.**



Legend of activities

Production system (PS)
1. tillage
2. fertilization
3. seeding
4. harrowing
5. pest management

Post-production system (PPS)
6. cutting
7. drying/curing
8. threshing
9. handling
10. storage
11. delivery

A = Ecosystem

B = Off-farm post-production system

C = Institutional environment

References

1. Andruchow, Lloyd J., *The Alberta Farm Enterprise Research Project 1983 Vermilion Region,* Alberta Agriculture, Edmonton, Alberta: 1985.

2. Apedaile, L.P. and K.J. Packer, "North South Issues for Western Canadian Cereal Agriculture: The Case of Alberta." Paper presented at the annual meetings of the Canadian Association for Rural Studies at the Learned Societies Meeting at Winnipeg, June 6, 1986.

3. Bank of Canada, *Bank of Canada Review,* January 1984.

4. Canada Grains Council, *Canadian Grains Industry Statistical Handbook 1984,* Winnipeg, Manitoba: 1984.

5. Canada Grains Council, *Government Policies Supporting Grain Production and Marketing,* Winnipeg, Manitoba: 1986.

6. Stanton, B.F., *Production Costs for Cereals in the European Community,* Cornell University, Ithaca, New York: 1986.

7. United States Department of Agriculture, *Agricultural Statistics 1984,* United States Government Printing Office, Washington, D.C.: 1984.

8. Veeman, M.M., "A Hedonic Price Function for Wheat in the World Market." Unpublished paper, Department of Rural Economy, University of Alberta, Edmonton, Alberta: 1987.

MANAGEMENT PRACTICES AFFECTING MATURITY OF WHEAT

K.E. Bowren, Agronomist

Agriculture Canada Research Station, Melfort, Saskatchewan

The number of days to mature a crop depends on many factors. The climatic conditions, type of land and soil texture and type are important. In addition the crop variety, rate, depth, and date of seeding, seedbed preparation, fertilizer used, weed control and harvesting methods affect when a crop is ready to cut.

In the north the long summer days have been known to mature crops quicker than in southern areas where the days are shorter. Tobacco has been grown at Isle-LaCrosse in northern Saskatchewan and corn grows at Fort Vermilion in northern Alberta.

Light textured soils around Nipawin and Prince Albert mature crops faster than heavy textured clay soils in these areas. Briggs and Aytenfisu (3) at the University of Alberta found that sowing dates, cultivars, and seed rates significantly affected growth period, yield and protein content of the grain. Most of the interaction of the production parameters also had a significant effect. They suggested that new wheat cultivars should be checked for response to variable seeding and management at different sites.

In eastern Canada, Nass et al (14), reported that when seeding was delayed beyond May 27 and May 2 in 1972 and 73 respectively, large reductions in yield were evident in wheat. Decreased yields usually involved decreased hectolitre weight, 1000 seed weight, grain protein yield, increased disease and delayed maturity.

At Melfort zero till seeding, where heavy trash remained on the soil surface, reduced the soil temperature by as much as 3° for several weeks after seeding over a prepared seedbed. In critical years this delayed the emergence and the maturity of the crop by several days. At Minnesota a study with corn showed that the soil temperature difference between zero till and till planted corn was about 3° for 6 weeks after seeding in favor of the latter. This temperature difference increased emergence of corn from 16 to 95 percent twenty days after planting.

Austenson (2) reported that delays in seeding at Saskatoon resulted in later maturity. This data show that the time required for maturity averaged 110 days when seeded as early as possible and 91 days from seedings made June 15 nearly 2 months later. Average date of maturity was delayed from August 6 to September 14 by this seeding delay.

Date of Seeding Hard Red Spring Wheat, Saskatoon 1929-49

Seeding Date	Yield bu/ac	Date ripe	Weight lb/bu
Early as possible[1]	25.9	August 6	61.6
May 1	27.8	August 10	62.1
May 15	28.6	August 20	62.1
June 1	27.8	September 1	61.3
June 15	23.0	September 14	58.5

[1] April 6 to May 4 average April 18

Austenson 1973. Principles of Agro. 631.5 A934, P:100

Seeding Rate

At Melfort in a 5 year study with wheat 168 kg/ha seeding rate outyielded a 67 kg/ha seeding rate and hastened maturity by 2-3 days. In these studies fertilizer 11-48-0 at 40 lb/ac improved maturity by 1 to 2 days with each rate of seeding. Austenson reported that at Saskatoon and Tisdale barley was sown at 1.0, 1.5 and 2.5 bu/ac for 3 years. At Saskatoon yields were similar but at Tisdale the increase in seeding rate progressively increased yields. At both locations the heaviest seeding rate resulted in 3 day earlier maturity compared to the lightest seeding rate.

Depth of Seeding

Austenson (2) reported that in a 3 year study at Saskatoon and Tisdale when barely was planted 3.5" deep the maturity was delayed by as much as 5 days over similar plantings of 1.5 inches deep and yields were increased or maintained by the shallower seeding.

At Swift Current it was found in a 3 year study of wheat seeded at 2,3 and 4 inches that yields were highest at the 2 inch seeding depth and maturity was delayed with deeper seeding.

In a greenhouse study at Melfort the effect of seeding at four different depths was determined. The data showed that seeding depths of more than 8 cm increased the days to heading and maturity and reduced the yield of both varieties.

Fertilizer

Lacombe reported that phosphate fertilizer hastened maturity by 3 to 4 days. Other researchers have reported similar results.

Effect of Depth of Seeding Wheat - Greenhouse - Melfort

Neepawa

Depth of Seeding cm	Days to Emerge	Plants Emerging	Days to Tillering	Days to Heading	Yield gm/pot
		(no/22 cm)			
4	5.0	3.8	22	48	27.0
8	7.0	3.3	24	46	27.5
12	8.5	3.0	25	50	16.5
15	55.5	.7	63	75	5.9
L.S.D.		1.6			11.2

Glenlea

Depth of Seeding cm	Days to Emerge	Plants Emerging	Days to Tillering	Days to Heading	Yield gm/pot
		(no/22 cm)			
4	5.0	5.5	23	42	18.1
8	7.3	4.8	26	46	14.7
12	7.8	3.5	25	46	11.7
15	9.8	2.3	27	49	9.0
L.S.D.		1.6			6.5

A field study which was conducted for 7 years showed similar results.

Harvesting

Harvesting methods can also enhance the maturity of a crop. Many studies (7, 8, 9, 10, 11, 12, 13) have shown that most crops can be swathed prior to full maturity. Studies as early as 1930 at Swift Current indicated that spring wheat could be harvested at an early stage of maturity without loss in yield or quality. In 1957 Dodds (7) confirmed this and reported that hard red spring wheat could be windrowed at a kernel moisture content of 35% (wet weight basis) without loss of bushel weight or yield. He reported that if grain was windrowed at this stage it was ready for combining some 3-5 days before the standing grain. In addition he reported that early windrowing reduced the natural and mechanical losses which occur at harvest time. In 1966 Dobbs and Warder (5) found that protein content was maximized when wheat was windrowed at a kernel moisture content of about 35%. In subsequent studies they showed that other quality factors, such as 1000 kernel weight, total phosphorus and germination were not reduced by early windrowing.

Most of the early studies on harvesting were done in the brown soil zone of southwestern Saskatchewan but in 1972 because harvesting varies with the climate and crop area a wheat harvesting system program for western Canada was initiated. Time of swathing studies were set out at Research Stations at Melfort and Swift Current in Saskatchewan and at Beaverlodge and Lacombe in Alberta. Hard red spring wheat, cultivar Neepawa, considered to be the most suitable for all locations at the time, was used as the test crop. The crop was seeded on well prepared summerfallow at each location, the local weed control, fertilizer and cultural practices with field machinery were followed. The experimental design was a randomized complete block with four replications. Plot size varied between locations but was approximately 4 m x 30 m. Kernel moisture content (KMC), wet basis, was used as a measure of maturity, and was measured daily by collecting 50 g samples at about 0900 h local time, from each swath and the standing crop at each location. Swathing was started when the grain had matured to about 50% KMC and continued on a daily basis until it reached 14.5% or less. The number of swaths cut varied with the season and location. The swaths at Melfort were combined with a field combine equipped with a special weighing device when the grain had dried to 14.5% KMC. Samples were taken from the grain from each swath for analysis. The measurements were compared graphically to the KMC of each swath at cutting. Harvesting losses were measured in each plot.

The researchers concluded that wheat can be windrowed at an early stage of maturity (30-35% KMC) at all locations without serious loss in yield or quality. Even windrowing earlier than this could have advantages in expediting harvesting, more important than the losses in short growing seasons or if large acreages had to be harvested with limited equipment. No loss in quality was noted when windrowing was done as early as 40% KMC at Lacombe.

At Beaverlodge in northern Alberta, Christensen and Legge (4) reported windrowing wheat at less than 35% KMC in warm, dry conditions had little effect on test weight, falling numbers and grade under wet conditions windrowing above 20% KMC resulted in lower falling numbers and a loss in grade. Direct combining and artificial drying above 20% KMC lowered test weight, falling numbers and grade.

In 1985 a study was started at Melfort to compare the effect of swathing hard red spring wheat (Katepwa) and semi-hard spring wheat (HY320) at different stages of maturity. Ten different stages of physiological maturity, ranging from 55% KMC to 14% KMC of each crop were swathed and evaluated for yield and quality factors. The test was set out in a split plot randomized block design with four replications. The two wheat cultivars were the main plots and swathing dates were the subplots.

In 1985 the yield of both cultivars was highest when swathed at 14.5% KMC about 150 days after seeding. Swathing at Cut 7, about 30% KMC, about 130 days after seeding produced the second highest yield. In 1986 HY320 yields were maximized at 20 to 25% KMC, while Katepwa yields were maximized at 15 to 20% KMC. The weather during both harvest seasons was somewhat abnormal, but in general this data indicate that harvesting these two cultivars at similar stages of maturity of between 20 and 30% KMC will give similar yields and quality results, and will advance the harvest by several days over leaving them stand to full maturity.

In many of the studies on management practices done in western Canada little information was recorded on the affect of the treatments on crop maturity. This may be due to the fact that there is a fairly wide range of physiological maturity at which wheat and other crops can be cut without loss in yield or quality. Taking advantage of this aspect and cutting wheat when the grain reaches the firm dough stage (30 to 35% KMC) combined with other good management is a way of shortening the growing season under many conditions.

References

Anonymous. 1965. Principles and practices of Commercial Farming.

Austenson, H.M. 1973. Principles of Agronomy.

Briggs, K.G. and Aytenfisu, A. 1979. The effect of seeding rate, seeding date, and location on grain yield, maturity, protein percentage and protein yield of some spring wheats in central Alberta. Can. J. Plant Sci. 59(4): 1139-1145.

Christensen, J.C., Legge, W.G. 1984. Effect of harvest time and drying method on the yield quality and grade of hard red spring wheat in northwest Alberta. Can. J. Plant Sic. 64(3): 617-623.

Delong, G.E. et al. 1952. Progress Report 1947-52. Dom. Exp. Farm, Lacombe, Alberta.

Hayes, W.A. 1982. Minimum Tillage Farming.

Dodds, M.E. 1957. The effect of windrowing at different stages of maturity on the bushel weight and yield of wheat. Can. J. Plant Sci. 37: 149-156.

Dodds, M.E. 1966. Grain losses in the field when windrowing and combining wheat. Can. Agric. Eng. 8: 31-32.

Dodds, M.E. and Pelton, W.L. 1967. Effect of weather factors on the kernel moisture of a standing crop of wheat. Agron. J. 59: 181-184.

Dodds, M.E. and Pelton, W.L. 1969. Weather factors affecting the change of kernel moisture in windrowed wheat. Agron. J. 61: 91-101.

Dodds, M.E. and Warder, F.G. 1966. The effect of early windrowing on the protein content of spring wheat. Can. J. Plant Sci. 46: 687-689.

Dodds, M.E. and Warder, F.G. 1970. The combining and drying of high moisture spring wheat. Can. J. Plant Sci. 50: 67-70.

Dodds, M.E., Bowren, K.E., Dew, D.A. and Faris, D.G. 1979. The effect of windrowing hard red spring at different stages of maturity at four locations in western Canada. Can. J. Plant Sci. 59: 321-328.

Nass, H.G., Johnston, H.W., Macleod, J.A., Sterling, J.D.E. 1975. Effect of seeding date, seed treatment and foliar sprays on yield and other agronomic characteristics of wheat oats and barley. Can. J. Plant Sci. 55(1): 41-47.

WHEAT QUALITY IN NORTHERN REGIONS

K.H. Tipples, Director

Grain Research Laboratory, Canadian Grain Commission, Winnipeg, Manitoba

The effect of geographical location on wheat quality may be considered under four headings related to variation in:

1. Protein content
2. Intrinsic quality characteristics
3. Moisture content
4. Deleterious effect of adverse growing and harvesting conditions on quality/grade.

Protein

Variation in protein content and effect of location on grade are fairly well understood. A hard red spring wheat variety such as Neepawa may vary widely in protein content (e.g. 8-20%) depending on location, soil type, soil fertility, growing conditions etc.

The southern Prairies have historically produced wheat of higher protein content than the north. The examples in Table 1 are taken from the Canadian Grain Commission's 1984 red spring wheat new crop protein survey, which comprised 9445 samples from 989 stations located in 39 crop districts in the three Prairie provinces.

Average protein content of western Canadian wheat varies from year to year around a long term average of 13.6% (e.g. 12.8% to 14.9% since 1964). Because of the protein segregation system used to market No. 1 and 2 CW Red Spring wheat at guaranteed protein levels, fluctuations in protein content

Table 1

Province	Crop District	No. of Samples	Protein Content, %*		
			Mean	Min.	Max.
a) North					
Alberta	7	197	11.3	8.5	15.7
Saskatchewan	9A	437	13.8	9.3	19.2
Manitoba	5	211	12.7	8.1	18.2
b) South					
Alberta	2	515	14.8	9.9	18.8
Saskatchewan	3AS	246	15.2	11.1	19.1
Manitoba	1	200	15.0	10.6	19.0
c) All					
Alberta	all	2122	13.9	8.1	19.1
Saskatchewan	all	5049	14.5	8.6	19.7
Manitoba	all	2274	14.6	8.9	20.0
Prairie Provinces	all	9445	14.3	8.1	20.0

* N x 5.7 13.5% moisture basis

either from year to year or from location to location do not affect the protein content of the wheat (e.g. 1 CW 13.5%) offered for sale but rather affect the proportion of wheat available for sale at any specific protein level (e.g. 12.5, 13.5, 14.5%).

Intrinsic Quality Characteristics

Apart from those related to protein and weather damage, there is no evidence that Neepawa <u>on average</u> will give a consistently different quality at the same protein and grade when grown in different parts of western Canada. However, we do see quite marked variability in quality factors (e.g. gluten strength, flour color, etc.) from one farmer's field to another. This local variability is smoothed out by the grading and bulk-handling systems in western Canada, with the end result that cargoes of the same grade tend to have consistent and uniform quality.

That there may be a location (geographical) effect on intrinsic quality is suggested by two poorly substantiated observations:

- Western Canadian CWRS varieties (e.g. Katepwa) were found to produce wheat of poorer quality (e.g. much poorer flour color and lower absorption) when grown in Ontario rather than western Canada in 1986. This effect was, however, complicated by effects of weather damage.
- There is some suggestion that gluten strength decreases when hard red spring wheat varieties are grown further south. Thus, U.S. spring wheat varieties often appear unacceptable strong to Canadians when grown in Manitoba. Conversely, Canadian varieties often appear unacceptably weak when grown further south in North Dakota. This suggestion is complicated by differences in evaluation methods and philosophy between Canada and the U.S.

Moisture Content

This is an extremely important marketing factor. Due to a distinct change in market patterns (we now sell to a greater proportion of hot climate countries that cannot store wheat at a moisture content much above 12.5%) it is becoming increasingly obvious that Canada must make a major effort to reduce the moisture content of grain shipments. This would probably involve, in the long term, reduction of straight grade moisture limits and incentive to farmers to deliver cereal grains at lower moisture content. Historically the grain of lowest moisture content has originated in the south and, in particular, from the Pallisser triangle area.

Effect of Adverse Weather Conditions

The two major types of weather damage to which Prairie grain crops are exposed are:

a) Wet harvest conditions (producing sprout damage, weathering, mildew, etc.) with a frequency of a wet harvest every 3 years or so. Examples of years when severe widespread wet harvest conditions prevailed were 1968, 1977, 1985 and 1986.

b) Widespread severe frost (and associated immaturity) occurs perhaps 1 year in 8 with milestone years being 1974 and 1982. In 1982 the grade distribution was estimated to be 25-26-28-20% for 1 CW, 2 CW, 3 CW and Canada Feed wheat respectively, compared with about 70-25-5-0 in a good harvest year. Such grade losses equated to about $280 million for the 1982 crop.

Geographically the northern areas are more susceptible to adverse weather conditions and invariably produce wheat of lower average grade (e.g. 3 CWRS) compared with the south (average grade delivered is No. 1 CWRS).

A series of slides were shown indicating:

1-4 - Results of four different years of new crop wheat protein survey maps showing variation in protein content by location for the three prairie provinces.

5-8 - Maps showing average grade delivered by crop district for four different crop years.

9-10 - Dot map of western Canada, showing origin of carlot deliveries of barley and rapeseed. Coincidentally, these production areas correspond to the northern areas that tend to produce wheat of lower protein, lower grade and higher moisture content.

SPRING WHEAT DISEASES AND RESEARCH IN THE PEACE RIVER REGION

John G.N. Davidson, Plant Pathologist

Agriculture Canada Research Station, Beaverlodge, Alberta

The principal diseases, risks and research priorities for spring wheat in the Peace River region were established by surveys in the mid-1970's, supplemented by Alberta Agriculture surveys in the early 1980's, cooperative trials at the Beaverlodge Research Station (BRS) originating from other stations, and subsequent trials with selected diseases.

Damping-off occurs in cool, prolonged springs with good soil moisture as in 1986. No research.

Leaf Rust and Stem Rust are not a problem. Stem rust has not been seen in the last 12 years in the Peace. Leaf rust occurs occasionally on the plots late in the season but is rare in the field.

Loose Smut and Common Bunt, however, are potentially very serious, especially with early seeding in cool soils. Loose smut occurs throughout the Peace but so far at very low levels (< 0.1% in most cases). We have done some screening of advanced lines in the greenhouse. Bunt has seldom been found in surveys, and only one serious outbreak (5-10%). However, in cooperative seed treatment tests of inoculated seeds in plots, the check levels at BRS were as high or higher than anywhere else and, in an inoculated bunt screening plot test, levels up to 100% infected plants were obtained which indicates this disease's potential.

Loose smut and common bunt behave the same as elsewhere and therefore do not require research in the Peace. Screening of breeding lines for resistance is another matter and is essential. Our work is severely hampered by a chronic shortage of support staff to carry out screening for these and other diseases (see below).

Septoria Leaf Blotch is the only serious foliage disease of wheat in the Peace, and then only in wet seasons. Some field screening has been done, and we have a method for field inoculations, but both require wet weather. Shortage of staff has so far prevented controlled environment screening for resistance. Septoria head blight also occurs and is occasionally significant on susceptible cultivars such as Saunders.

Bacterial head blights, Glume Blotch, etc., also occur in wet seasons and on susceptible cultivars. Head Melanosis has only been found once in the field, on Park, and in the same season at the Beaverlodge Research Station (BRS) on certain breeding lines, now discarded.

Kernel Black Point can be found most years, usually at low levels. Cooperative tests from Lethbridge identified a wide range of resistance in BRS breeding lines. Other kernel discolorations occur, sometimes significantly in wet harvest periods, and lower the grades.

Fusarium Head Blight seldom occurs, but symptomless infections occur with sufficient frequency that there is a significant risk of mycotoxins developing in overwintered grain harvested the following spring according to an Alberta Environment Centre study.

Ergot is rarely a field problem on wheat in the Peace, and only occasionally in the plots.

Common root rot is the most prevalent disease of wheat, and reaches significant levels each year. Although never devastating, it may cause more yield losses than all the other diseases put together over a period of several years. Coop root rot tests run by Dr. R.D. Tinline have established that the same reversal of dominance of the principal causal fungi, Cochliobolus and Fusarium, occurs on wheat as for barley in the Peace. Similarly, we have had trouble establishing the significance of this to resistance ratings . We do resistance screening of advanced lines, and a multi-location uniformity test has been carried out for the past 4 years. Take-all has been found only once in the Peace.

In Summary, the most research has been done on common root rot because the problem is slightly different from elsewhere in the prairies. Screening for resistance to root rot, Septoria leaf blotch, bunt and loose smut are required for the breeding program, but we have been unable to get the support staff needed to do this on a regular basis.

WHEAT DISEASES OF THE PARKLAND AND NORTHERN ALBERTA

L. Piening, Plant Pathologist

Agriculture Canada Research Station, Lacombe, Alberta

The principle group of disease found on wheat in the main wheat producing belt of North America, the rusts, are not an economic problem in north and central Alberta. Leaf rust occurs from time to time on wheat in central Alberta and even stem rust can be found on susceptible cultivars such as Garnet and Red Bobs. Usually, the rusts arrive too late to affect yields. Stripe rust is infrequent in central Alberta and has been found mainly on Columbus. Other leaf diseases, such as Septoria, occur on wheat in most years. This disease also arrives late in the growing season and damage is minimal. It is often associated with senescens of the foliage. Tan spot is restricted to the eastern part of the province where damage is considered minimal. Another septoria disease, Glume blotch has been severe in some years where all the heads in a field were grey in colour. Losses were considered minimal. Root diseases, especially common root rot, is found in nearly all fields of wheat. This disease, caused by a complex of fungi made up of Fusarium spp and Helminthosporium sativum. The H. sativum component of the complex is dominant in root rot from wheat from all regions of the prairies except the Peace River area, where Fusarium spp are the dominant fungi. Annual yield losses average about 5-6% and thus this disease probably causes more yield loss over a period of time than any other disease. Take-all is becoming more widespread in the Parklands. It is, however, rare in the Peace River area. The white heads characteristic of this disease may be confused with those of dry land foot rot which is usually found on HY320, winter wheats, Oslo and Marshall. Dryland foot rot is caused by <u>Fusarium spp</u>.

Stem melanosis of Park wheat is chiefly restricted to the Parklands of Alberta, although it has been recorded from the Peace River region. Symptoms of stem melanosis occur in August. The necks of the stems (peduncles) turn dark brown and the heads become bleached in colour and fail to fill. The rachis is also brown and there may be some brown tissue of the stem beneath the lower nodes. This disease occurs generally as small patches in fields. This disease, caused by a bacterium was more prevalent on Park from 1975-1982, than during the past several years. Park is more susceptible than the other wheat cultivars and wheat is much more susceptible when grown on soil low in copper. Stem melanosis and is nearly always found on Park wheat on light sandy soils. This disease can be prevented by applying 3 to 4 kg of copper per hectare to the soil in the form of copper sulphate or copper chelate. The residual effect of the copper has been demonstrated for at least three (3) years following application.

In summary, unlike on the eastern prairies, diseases are not a major problem in wheat in the Parkland and northern Alberta, although periodic outbreaks of some disease such as glume blotch, stem melanosis, leaf rust or root rots, may occur.

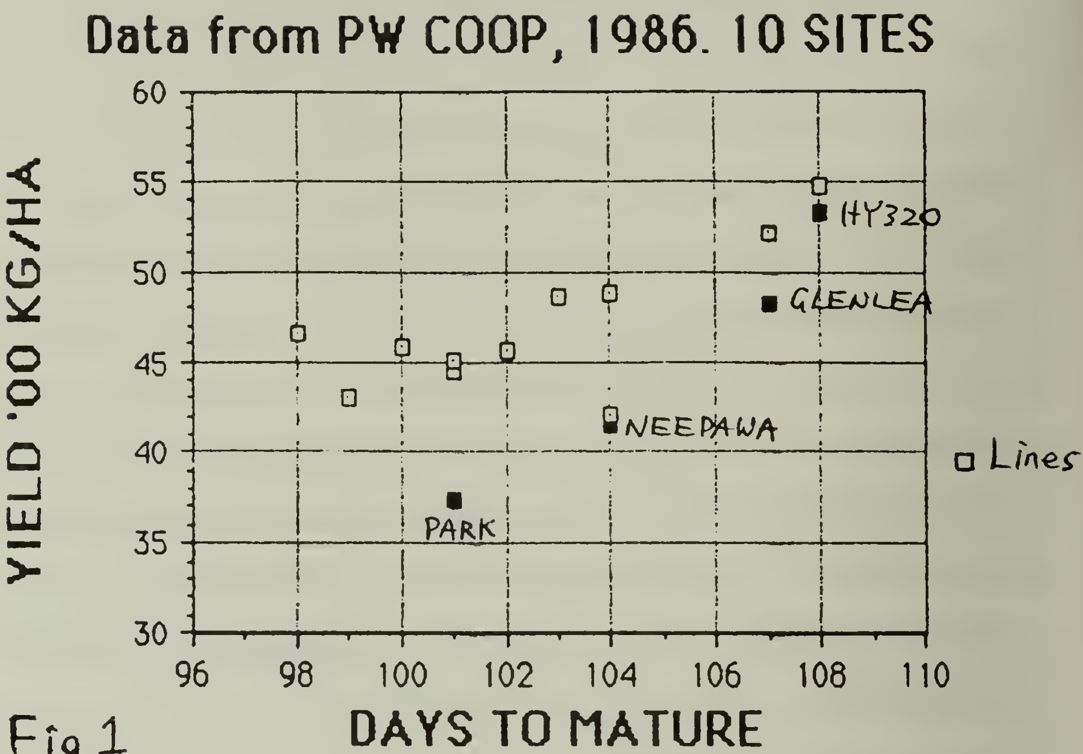
BREEDING WHEAT FOR SHORT GROWING SEASONS

K.G. Briggs, Department of Plant Science, Faculty of Agriculture and Forestry, University of Alberta, Edmonton, Alberta T6G 2P5

Abstract

The practical maturity standard for the Parkland region in 1987 is Neepawa CWRS wheat, the most popular and profitable variety in the region but which is still considered too late maturing by most farmers. The earlier maturing CWRS variety Park is lower yielding, as well as possessing the head melanosis problem, but no varieties as early as Park have been licensed since 1963. Data from collaborative 'B' and 'C' wheat trials in the Parkland in 1986 do indicate that earlier maturing materials with higher yields than Neepawa are now coming into the system from breeding programs that are actively selecting for and evaluating their lines in the Parkland region. Much greater improvements are genetically achievable. These lines include CWRS' wheat (with only slight gains in maturity and/or yield), utility wheats (with major gains in yield and maturity, including the new varieties Wildcat and Bluesky) and Canadian Prairie Spring Wheats (including Oslo). Canadian breeding effort for this region is minimal, compared to that for longer season areas, and includes programs at Agriculture Canada (Beaverlodge), the University of Alberta, the University of Saskatchewan, and Saskatchewan Wheat Pool. In all materials simultaneous gain in yield and earlier maturity is associated with a genetic lowering of protein level, suggesting that the CPS class may be best adapted to the region from a wheat quality point of view. Earlier maturity in all classes is desirable, to favour better grades, and

sprouting resistance is also desirable in all classes. Yield/maturity relationships are extremely significant for this region, as exemplified from typical results from the Parkland Wheat Coop (Figure 1, 1986 10 site mean in the Parkland). Results from a "maximum yield potential" trial conducted on high fertility, summerfallow at the University of Alberta in 1985 and 1986 suggests that CWRS wheat varieties may have a maximum yield potential of only 5100 kg/ha in the central Parkland (Edmonton region) whereas newer lines bred for the Parkland, including semidwarfs, may have yield potential as high as 6700 kg/ha. Greater varietal progress for the Parkland can be achieved by developing better coordinated, collaborative breeding programs for all types of wheat, combining resources of existing institutions working for the Parkland. Improved long term funding is required to do this effectively, in conjunction with improved agronomic procedures.



Data from PW COOP, 1986. 10 SITES
YIELD '00 KG/HA
60
55
50
45
40
35
30
96
98
100
102
104
106
108
110
DAYS TO MATURE
HY320
GLENLEA
NEEPAWA
PARK
Lines

Fig 1

TOWARDS A BREEDING METHODOLOGY FOR NORTHERN WHEAT PRODUCING REGIONS

P.J. Clarke, Wheat Breeding

Agriculture Canada Research Station, Beaverlodge, Alberta, TOH OCO

The Parkland Wheat Co-operative Tests have been conducted annually in the northern wheat producing regions of western Canada since 1977. Overall a total of one hundred thirty-eight advanced lines from western Canadian wheat breeding programs were evaluated at eight to twelve sites each year. The accumulated dataset therefore represents a significant accumulation of knowledge about wheat growth and development within these regions.

One of the first conclusions from the data is that comparing site means within or between years does not result in meaningful groups of locations. Neither has cluster analysis using squared differences between site means and overall means achieved meaningful groupings. The heterogeneity of the testing area is illustrated by the following table of rank correlation. The varieties used in this comparison represent a reasonably wide diversity of maturity and yield potential.

The strongest statement that can be made from these results is that in some years in Alberta it may be useful to group the data. Decisions based upon Saskatchewan groupings can be completely erroneous. In either case it appears that testing may have to to be done over a greater number of sites in order to make meaningful generalizations about the performance of breeders advanced lines.

There are serious implications for wheat breeding programs because of this regional diversity. A more rigourous evaluation of the data to

RANK CORRELATION [1] OF MEAN YIELD OF FIVE VARIETIES [2] OVER FOUR YEARS (1982 - 1985) IN THE PARKLAND WHEAT CO-OPERATIVE TESTS.

Years/No. of sites	Alberta Sites 4	Saskatchewan Sites 4	All Sites 8
1982 - 83	0.75	-1.00	0.11
1982 - 84	0.47	0.80	0.21
1982 - 85	0.70	-0.40	0.12
1983 - 84	0.57	-0.80	-0.21
1983 - 85	0.85	0.40	0.59
1984 - 85	0.47	0.20	0.14

1 - r
2 - Park, Neepawa, Glenlea, Wildcat, Bluesky

identify sub-regions has been undertaken by Agriculture Canada, Statistical Research Services.

Single site selection is obviously not the most effective method for meeting the needs of the region. Early maturing varieties will have to be broadly adapted to occupy substantial acreage. The corollary of this, that many locally adapted varieties will have to be developed, may be undesirable. Consider the situation with Canada Feed barley varieties. The large number of varieties to choose from often results in the legitimate complaint from producers that an intelligent choice for a particular locale cannot be made. Even if well informed producers enjoy having a choice between several varieties, seed growers may find it difficult to recover their costs if the variety they choose does not get substantial acreage. If the development of many locally adapted varieties is desirable then there is still a case for extensive testing.

The lack of parental germplasm is not an issue in the development of northern varieties. Sources of earliness, sprouting resistance, disease resistance, high yield and quality are available. Possibly the single biggest challenge facing those who are developing wheat varieties for the northern regions is establishing a method of effective selection.

Under the present system co-ordination of breeding efforts takes place at the 'B' or 'C' level of co-operative testing. Creation of an 'A' level test would be a useful first step in the expansion of northern wheat breeding efforts. The next logical development would be interregional testing of early generation homozygous lines. Both actions will require closer co-operation between research establishments.

The Canadian Grain Commission indicated at the Expert Committee on Grain Breeding Meeting in 1987 that CWRS entries in the Parkland Wheat Co-operative Tests would have to be placed in a southern co-operative test for at least one year prior to requesting support for registration. CGC officials stated that samples from the Parkland tests may not give a proper assessment of bread wheat quality. It follows then that similar quality evaluation prior to entry into the Parkland Wheat Co-operative Tests would be highly desirable. This would involve the co-operation of a southern research establishment.

WINTER WHEAT VARIETIES FOR THE PARKLAND ZONE

SOME COMMENTS ON THE POTENTIAL

Julian B. Thomas, Winter Wheat Breeder

Agriculture Canada Research Station, Lethbridge, Alberta

As a grain producing area, the Parkland has a relatively short and cool growing season with higher yields and more available moisture than regions to the south. The worst problem is removal of the crop from the field in good condition. Harvest is often interrupted by rain. The grain is bleached, loses test weight and even sprouts. Acreages of early crops like early six-row barley and polish-type canola are concentrated in the area. At the same time the acreages indicate a persistent interest in growing wheat, despite its late maturity. Winter wheat is both earlier maturing and higher yielding than spring wheat. At Lethbridge we are trying to extend the benefits of winter wheat to as many producers as we can. With strong support, we could make winter wheat contribute to agriculture in the Parkland.

Relative maturities of spring and winter wheat are affected by their seeding dates. Table 1 shows that winter wheat seeded in early to mid September ripens about two weeks earlier than spring wheat seeded on May 7th. At most sites these dates are on the late side of practicality for winter wheat and on the early side for spring wheat. This estimate of a two week advantage for winter wheat is therefore conservative.

Provided it can be overwintered satisfactorily, Norstar winter wheat is higher yielding than Neepawa spring wheat. This difference is greatest in situations where moisture is most limiting (Table 2).

Table 1. Maturities for Spring and Winter Wheat

	Julian Date Ripe (from Jan 1)		
	Neepawa*	Norstar	Neep-Nst
Lethbridge	218	206	+12
Saskatoon	227	206	+21
Indian Head	224	213	+10
Melfort	231	217	+14
Edmonton	235	228	+7
Lacombe	245	228	+17
Beaverlodge	247	235	+12
Average	232	219	+13

* Assumes May 7 seeding date for Neepawa

Table 2. Yields of Spring and Winter Wheat

	Yield at Lethbridge		
	Neepawa	Norstar	
	T/Ha.	T/Ha.	% Neep
Dryland	2.63	3.32	126
Irrigation	4.89	5.74	117

HY320 can equal or outyield Norstar but it also ripens 3-4 weeks later (Table 3). Furthermore winter wheats which have averaged 20% more yield than Norstar have now been identified (Table 4). In the long run we expect to maintain a clear yield advantage over any spring wheat.

Winter wheat and spring wheat could both be improved further for earliness through plant breeding (Table 3; Table 5). However some tradeoff must usually be made in terms of reduced yield, reduced protein content etc. Varieties like Wildcat or Redwin, with improved yield and no

Table 3. Performance of Spring Wheats in the Parkland.

	Protein Content	Days to Ripe	Yield as % Neepawa
PT301	13.4	101.9	106.4
Park	15.1	104.5	93.8
PT303	11.7	104.8	119.7
Wildcat	15.1	106.1	107.2
Neepawa	14.9	107.0	100.0
Bluesky	14.1	108.0	111.1
HY320	12.2	110.5	127.1
Glenlea	13.9	111.2	110.2

Table 4. Performance of winter wheats in Southern Alberta

	Protein Content	Julian Date Ripe	Yield as % Norstar
Norstar	12.6	215.1	100.0
Redwin	14.0	216.7	107.2
ID0180	11.6	215.0	120.2

proportionate loss in maturity or protein content are found occasionally (Table 3; Table 4). Such varieties slowly raise the level at which yield, maturity and protein are traded off, re-establishing these inverse relationships at higher levels.

Winter wheat offers a striking combination of high yield and early maturity unequalled by any spring wheat. Obviously, these advantages of winter wheat only exist if the crop overwinters in good condition. Since winter wheat is not widely grown in the north it is also plain that its

Table 5. Julian Date Ripe for Five Winter Wheats at Lethbridge

	Dryland	Irrigation	Average
Pau 45	194.7	200.9	197.8
Bezostaya	196.8	206.0	201.4
Winalta	197.0	206.1	201.6
Norstar	200.0	208.4	204.2
Sundance	200.2	209.4	204.8

overwintering in the region is not easy. Several traits are needed to improve the odds for successfully overwintering and cropping winter wheat in the Parkland region (Table 6).

Table 6. Traits Required in a Winter Wheat for the Parkland Zone

1.	Resistant to diseases of cold soil: Snow Mould and Bunt
2.	Cold Resistance equal to Norstar
3.	Adapted to Early Seeding: Resistant to Barley Yellow Dwarf Virus Resistant to Wheat Streak Mosaic Virus
4.	Resistant to Stubble-Borne Diseases: Mildew, Tan Spot, Leaf Blotch, Root Rot

In the Parkland, winterkill is often caused by snowmould. Snowmould usually develops under snow in the spring, especially where thawing is slow. Canadian winter wheats have poor resistance to snowmould. Wheats with resistance to these fungi have been identified and we are beginning work to transfer this resistance. Unfortunately the lines with best snowmould resistance also have low cold resistance. Until snowmould resistant lines with a moderate or high degree of cold resistance are developed we cannot assess how much of a difference this resistance will make in the field.

If hardened properly, Norstar crowns can withstand brief exposure to temperatures of -18 to -23°C. This should be adequate for much of the Alberta Parkland. In this area, snow is usually deeper and soil temperatures are generally less extreme than they are further east, where winter wheat is currently gaining in popularity. Since winters in the north are longer, improving the duration of winter hardiness may be more important than increasing its peak.

Seeding into standing stubble provides insulation from the cold air, both by added snow pack and even in the absence of snow. The stubble also provides protection from water and wind erosion. By increasing snow pack, such practices increase the likelihood of kill from snowmould. Therefore, benefits from stubbling-in winter wheat will depend on the relative importance of cold versus snowmould as causes of winterkill. A great deal more research needs to be done on this question right across the Parkland zone.

In the north, soils are likely to be colder shortly after seeding than they are in the south. Under such conditions, winter wheat is more liable to infection by bunt than it is in the south. Excellent resistance to bunt is available and rapid progress is being made transferring this resistance to Canadian winter wheats.

In the north, best expression of both snowmould and cold resistance require a relatively early seeding date. Since spring crops are also later than average in the north, we can expect at least some overlap between late spring cereals and winter wheat. In such circumstances virus diseases will be transferred from the old spring crop to the new winter crop. We can definitely expect Barley Yellow Dwarf Virus which is vectored by several aphids and probably expect Wheat Streak Mosaic Virus which is vectored by the Wheat Curl Mite. Good resistance to both these diseases exists in perennial grasses and progress has been made transferring this resistance to wheat.

Diseases we can expect to encounter in winter wheat stubble include powdery mildew, tan spot, Septoria leaf blotch, and common root rot. Resistance has been reported in wheat for all these diseases although they are all more or less difficult to deal with in a breeding program. Until reliable agronomic information on the benefit of stubble seeding is available, the potential importance of these diseases is hard to assess.

What definite conclusions can we draw from this? Transfer of snow-mould resistance to Canadian winter wheats would certainly extend their area of adaptation northward although it is difficult to say at this juncture by how much. This will make the early maturity, drought resistance and high yield of winter wheat available to a greatly increased number of wheat producers.

To achieve the maximum extension of the area of adaptation, winter wheats with the entire package will be needed. In particular they must have the traits needed for early seeding. I suspect that to develop such varieties will require a major new initiative of about thirty years duration. However, we would not have to wait that long for the first benefits to appear. Improvements would be incremental. Varieties with at least some of the relevant traits would become available in a shorter time frame as the breeding program began to put the pieces together. Individually each would permit at least some northward extension of the winter wheat area.

WINTER WHEAT - A PROMISING FUTURE FOR NORTHERN REGIONS?

G.W. Clayton, Agronomist

Agriculture Canada, Fort Vermilion Experimental Farm

Growing winter wheat requires the same amount of management that goes into producing spring seeded wheat. In addition, winter crops are affected by factors which affect overwintering and vigor of the crop in the spring. Cold hardiness, or the ability of the plant to withstand cold temperatures during the winter is a problem outside the traditional winter wheat growing areas in western Canada. Continuous, heavy snow cover in northern agricultural regions insulates the soil so that soil temperatures rarely fall below 10°C (usually -7°C or less) at the 5 cm depth, a temperature that well hardened winter wheat cv. Norstar would be able to survive. However, these winter conditions provide a suitable environment for snow mould pathogens.

In northern regions, susceptibility to snow mould may be more limiting to winter wheat production than the degree of cold hardiness, in situations where continuous snow cover persists. Although the hardening process may occur in a normal manner, spring dehardening can be a critical stage in successful production of winter wheat (Fowler and Gusta, 1977) which may vary among regions and years. A relationship between the level of cold hardiness (or the dehardening process) and snow mould infection may exist in areas where snow remains for a longer period of time and soils remain cool into May. The duration and the rate of the dehardening process may affect the plants ability to overcome the effects of the snow mould infection, particularly when levels of infection are non-lethal.

Presently, a study in conjunction with Dr. Gaudet at Lethbridge is on-going to evaluate hardening, dehardening and snow mould infection of winter wheat plants seeded at two dates at both Lacombe and Fort Vermilion. Hopefully this study will give some basic knowledge on how plants harden and deharden, and where and when snow mould infection occurs at these different latitudes.

Date of seeding trials at Fort Vermilion (58°N Lat.) have established that yields are optimal at seeding dates of August 1 - August 8. Winter wheat plants seeded at this time go into winter with large, healthy crowns and 2 - 5 tillers per plant. As seeding date is delayed into late August and September, the hours of sunshine decrease rapidly and ambient air temperatures are cooler, resulting in slow plant growth and progressively smaller plants at freeze-up. As planting date was delayed throughout August, decreased seeds per head and decreased kernel weight contributed to declining yields. As further planting delays occurred throughout September, the reduction of number of heads per m^2 was the dominant factor affecting further reductions in yield. Fowler & Gusta (1977) showed that dry weight of crown tissue was closely correlated with LT_{50} of winter plants and that the development stage of winter wheat plants greatly affects its cold hardiness and survival (Legge et al., 1983; Fowler, 1982). It appears that a number of factors that affect cold tolerance also affect the ability of the plant to overcome non-lethal snow mould infection.

Results of rate of seeding trials and depth of seeding trials are less well-defined, although it appears that seeding at a rate of approximately 105 kg/ha and seeding shallow would best suit production of winter wheat in northern regions. However, a lack of uniformity in stress levels, particularly from snow mould pathogens, and the presence of partial winter-kill in some plots creates a situation which makes it difficult to assess differences accurately.

In 1985, seven commercial fields of winter wheat were seeded between August 8 and August 25 in the Fort Vermilion area. Three of these fields were worked under in the spring of 1986 due to general mortality throughout the field or large patches of dead plants. A general inspection in the spring showed that all seven fields had some level of snow mould damage, that level of damage being unacceptable to three of the farmers. Further inspection of these fields indicated that winter wheat development was inadequate at freeze-up or a large fertility imbalance was evident where patches of winter wheat had died. One farmer had underseeded winter wheat to barley in the spring of 1985 and had good stand establishment throughout 1986.

It appears that when winter wheat is seeded in the first two weeks of August, yields are optimal and crop maturity can be as much as 2 - 3 weeks ahead of spring wheat in the Northern part of the Peace River region. Farmers in northern regions grow winter wheat to spread their workload and to start harvesting before their spring crops are mature.

The Prairie Pools have estimated the winter wheat acreage in the Peace River country at 7,000 for 1986, up from 3,000 acres in 1985. Over the last 10 years, average yields of winter wheat have been 31.5 bushels per acre compared to 29.1 bushels per acre for spring wheat. Some farmers have reported the quality of their winter wheat crop as 1 CWRW which, at today's price, is equivalent to 3 CWRS, a grade most commonly found for spring wheat in the Peace.

The potential for winter wheat to become an important crop in the northern regions of agriculture is quite promising. However, problems with snow mould and the lack of sound agronomic information are limiting factors to the production of winter wheat in these regions. As more information is collected on production techniques, further problems may be identified and existing problems may be solved. It is essential for a research effort that involves breeders, pathologists and agronomists to explore methods to take winter wheat from a high risk crop to one that is agronomically sound if the potential promise is to become a reality.

In summary, some factors that reduce the risk of growing winter wheat in the Peace River region include:

- select fields that are well drained and have not had a forage crop in the last four years.
- seed during the first week of August, into a firm, moist seedbed.
- maintain a fertility balance, add Phosphorus with seed on soil test data.
- fall spray to control weeds.
- if N required, 34-0-0 should be broadcast in late fall or early spring.

Literature cited:

Fowler, D.B. 1982. Date of Seeding, fall growth and winter survival on winter wheat and rye. Agron. J. 74: 1060-1063.

Fowler, D.B. and L.V. Gusta. 1977. Influence of fall growth and development on cold tolerance of rye and wheat. Can. J. Plant Sci. 57: 751-755.

Legge, W.G., D.B. Fowler, and L.V. Gusta. 1983. Cold Hardiness of winter wheat tillers acclimated under field conditions. Can. J. Plant Sci. 63: 879-888.

SNOW MOLD OF WINTER WHEAT

D.A. Gaudet, Plant Pathologist

Agriculture Canada Research Station, Lethbridge, Alberta

Successful cultivation of winter wheat remains restricted to the southern Canadian prairies despite efforts of agronomists and breeders to establish the crop in central and northern regions. Commercial winter wheat cultivars possess sufficient winter hardiness to survive in most regions of Alberta in years when snow cover is sufficient to insulate the crop against very low ambient temperatures. However, the prolonged and persistent snow cover in central and northern Alberta allows low temperature fungi, called snow molds, to attack and severely damage the winter wheat.

Using fall applications of mercury based fungicides in Lacombe, L.J. Piening demonstrated a dramatic increase in winter survival in winter wheat. More recently, J.G.N. Davidson at Beaverlodge has demonstrated improved winter survival and yields in the Peace River District following a fall application of fungicides. In addition to positive responses following treatments of ascomycete- and basidiomycete-specific fungicides, improved winter wheat survival was also observed using fungicides specific to water molds. These studies confirmed that winterkill in winter wheat is due to complex interactions involving two or more snow mold fungi. In annual snow mold surveys of winter cereals conducted in the spring in central and northern Alberta over the past four years, cottony snow mold (Coprinus psychromorbidus) was the most frequently encountered snow mold followed by snow scald (*Sclerotinia borealis*) and pink snow mold (*Gerlachia nivalis*). Losses from molds ranged from trace to 100%.

To date, there are no satisfactory controls for snow mold diseases in winter wheat. Currently, fungicide control is economically impractical. Winter wheat varieties suitable for production in western Canada possess little or no snow mold resistance although a resistant variety of soft white winter wheat is currently being used to control the disease in the Pacific Northwestern United States. Due to the erratic nature of snow mold development in the field, a technique was developed to uniformly screen winter wheat lines for resistance to *C. psychromorbidus* under controlled conditions. Several lines screened to date exhibit considerable resistance to *C. psychromorbidus* but these wheats are not sufficiently winterhardy for production on the Canadian prairies.

Snow mold severity is strongly influenced by seeding date. In central and northern Alberta, the optimum seeding date for the susceptible variety Norstar ranges between August 1 and 15. However, snow mold often severely reduces wheat yields despite early seeding.

Expansion of winter wheat production to the deep snow areas of central and northern Alberta will depend on breeding varieties that combine snow mold resistance with adequate levels of cold hardiness. A breeding program to combine these two traits is currently underway at Lethbridge.

WINTER WHEAT DISEASES AND RESEARCH IN THE PEACE RIVER REGION

John G.N. Davidson, Plant Pathologist

Agriculture Canada Research Station, Beaverlodge, Alberta

Winter wheat is a speculative and risky crop in the Peace River region because of the great susceptibility to snow molds of all cultivars yet tried. In the occasional bare soil winter (< 1 year in 10) plants may also die from cold stresses. Only a few inches of snow are needed to protect the crown from the cold, but the same snow keeps the temperatures high enough (above -10°C) at the crown for snow molds to grow and infect dormant crowns.

Snow molds are a heterogeneous group of taxonomically unrelated fungi with the ability to grow at low temperatures. Some of them are pathogenic to dormant plants in the general range of +2° to -10°C, and most go dormant in the summer. Generally, there are 2 or more pathogenic snow molds in any given field, i.e. more than 1 kind of resistance is probably required, or more than 1 kind of fungicide.

Tests at Beaverlodge over the last 10 years, plus cooperative surveys and trials with Lethbridge (D. Gaudet) and with agronomists at Dawson Creek (J. Dobb) and Ft. Vermilion (G. Clayton), have confirmed that well developed plants (early August seeding dates) survive snow mold attacks the best whereas, in a bare soil winter, seedlings (early to late September seeding dates, depending on latitude) survived cold stresses the best. Seed treatments with fungicides were ineffective in controlling snow molds.

Fungicides sprayed on plants in late fall shortly before freeze-up have produced yield increases up to 300% better than the check treatment.

Even larger % increases are possible where snow mold pressure is high, but actual yields may be depressed nevertheless. Relatively high rates have to be used to give protection for the 5-6 months required, so treatments are relatively expensive. Determining the likely cost-benefit ratio in advance of spraying requires the currently non-existent ability to predict the weather for 6 months, i.e. deciding on whether to spray is strictly a gamble. Cultural methods of controlling snow molds, e.g. snow removal, are not practical on a field scale.

The 2 principal snow molds in the Peace are *Coprinus psychromorbidus* and *Myriosclerotinia borealis* which belong to different major taxonomic groups. Broad spectrum fungicides are not equally effective on both and are not as effective as narrow spectrum systemics on either, but the latter only control one type well. *M. borealis* is more severe under deep and prolonged snow, and plants with infected crowns do not recover. *C. psychromorbidus* is more important under moderate snow cover, and plants with only partially infected crowns at snow melt may recover but with reduced yield and delayed maturity. Other snow molds present may include *Fusarium nivale* which in the Peace is primarily active in September and October provided there is good moisture, and seems to do little under the snow. A low temperature strain of *Pythium* sp. is often present and shown by selective fungicides to be pathogenic; it appears to act in concert with *C. psychromorbidus*, especially at snow melt and while the ground is saturated after that. At least 3 other snow mold pathogens also occur, but their significance on winter wheat is either minor or unknown.

Conclusion: we appear to have a very long way to go in the Peace to get economic control of snow molds of winter wheat either by resistance or by fungicides.

Summer diseases of Norstar winter wheat, the only cultivar now grown, are the same as for spring wheats, but it is susceptible to virtually everything and is more susceptible to powdery mildew in the field.

THE IMPORTANCE OF WHEAT TO THE NORTHERN PRODUCER

Maurice Fines, Research Director

B.C. Grain Producer Association

Introduction

The B.C. Grain Producers Association is a commodity organization representing the grain farming industry of northern B.C. There is a potential membership of about 800, we feel that this year we should reach at least a 50% level and hope that the level may be even higher. The need for a commodity organization has long been recognized. As the difficulties of agriculture become even more evident farmers find themselves in the position of having to try to solve the problems they are faced with. A major problem that has been recognized, is the shortage of crops suited and more regionally adaptable to northern agriculture.

Wheat has always been very important to the viability of grain farming in the grain growing areas of northern Canada. We find ourselves in the unfortunate position of not having a variety of wheat that is well enough suited to our northern growing climate that will compete well in the ever growing competitive world market. We have seen the maturity yield barrier broken with the development of "Otal and Jackson" barley and are very supportive to the development of a CWRS wheat with these same maturity-yield potentials.

History

Wheat has been grown in the northern Parkland and Peace River regions for a long time. With the introduction of the early fur trade and the Missions established along the river system of western Canada, there was always some hopeful soul that tried his hand at farming, in 1893 Reverend Gough Brisk at Fort Dunvegan won the world wheat championship at the Chicago Exposition, later Mr. Herman Trelly, of Wembley, Alberta became World Wheat King in 1932 with his field of Marquis. It seems that since then modern science has moved forward, and with the rust and insect infestations of the prairies, varieties were introduced that would combat these problems. With this thrust forward in plant breeding we, as northern wheat growers, have lost both our Regal Status and our competitiveness in even the Canadian wheat scene. However with the use of varieties that were bred for more southern climates, wheat is still a very stable economic crop for northern agriculture. This is a fact even though we continue to grow non-adapted varieties, i.e. Neepawa which has a maturity period of 102 - 104 days.

Economics

Farmers tend to try to grow crops that better return a profit. This is an economically acceptable practice if you wish to survive. However, world prices and sound agronomic practices do not necessarily go hand in hand. The northern Parklands and Peace regions generally seem to have a varying acreage pattern of barley, wheat and canola. In recent years the introduction of canola into the grain production areas has caused a decline in acreage of barley. In retrospect we feel that this can contribute to inferior agronomic practices, i.e. continuous cropping of canola has caused soil fertility deterioration, noxious weed buildup, due to limited available and costly herbicides, as well as, at times, a build up of undesirable insects and fungi. Canola can be a profitable crop if managed properly, but if economics becomes the chief factor, sound agronomic practices are often neglected.

Barley acreage production has grown steadily since the mid 1950's. Not because of higher monetary returns but rather it's adaptation to the long days and the shorter frost free period.

There is no profit in growing the lower grades of wheat, the price of the feed grades is little better than the price of barley, and at least barley can yield better and, because it is early, harvesting can be done successfully. Frozen CWRS wheat has never demanded a premium!

We feel that high grade wheat has a complementary relationship with the other major grain crops. High grade wheat has a better historic economic return. It can be continuously cropped, tolerates a broader spectrum of herbicides and in northern Canada has minimal insect and rust susceptibility.

The northern grain belt has unique conditions such as soil types, shorter frost free period, longer daylight hours, to name a few. This makes it essential that plants must be selected, and have varietal testing carried out in the area that production is intended. Often there have been varieties that were enveloped in the more southern regions which, when taken north, did not respond favourably, i.e. Columbus wheat. We feel that much of the work should be done at the Research Station at Beaverlodge to take advantage of it's northern location.

Summary

There is little future in trying to grow crops that are not adapted to the area. Canadian farmers are second to none in their expertise and production techniques. We must have the proper crops to grow. The uniqueness of the north limits the varieties that can be imported from other parts of the world. We are so far behind other grain producing countries in the field of crop research that unless there is a concentrated effort the future is indeed gloomy. We simply must catch up and have the necessary technology transfer if we are to stay in business. The only limiting factor that we should accept in wheat breeding research is moisture. Average precipitation for the area is 16 inches, this is sufficient to produce a lot of bushels.

The goal that must be achieved is a short seasoned, 90 day, high yielding, high quality CWRS wheat that has the ability to consistently grade #1 and #2, adapted for the northern Canadian grain belt. The maturity yield barrier has been broken in barley. High protein is attainable as is shown in the Agriculture Canada publication, "Quality of 1986 wheat". The technology that is in place today demonstrates that with proper financing and organization the reality of an early high quality wheat is achievable. The development of this desired wheat variety would allow wheat to take its proper place in both the agronomic and economic sphere and contribute to greater stability in the northern grain belt of Canada.

CO-ORDINATION OF NORTHERN WHEAT DEVELOPMENT

Ken Beswick, Chairman, Alberta Grain Commission

This is a daunting position for someone like me to be in. Most of my life has been spent as a farmer, and moreover as one who farms in a 130+ day frost-free season. I know just enough about plant breeding to get myself into trouble, and I know even less about plant pathology. Nonetheless, although far from being an expert, last winter I learned a tremendous amount about wheat quality and I had a unique sort of view of how the whole industry fits together. By that I mean the industry that supports farmers on both sides - those of you who develop cultivars suitable for our climate, and those who handle transport and sell grain after farmers have produced it. Those things I learned last winter have come in handy every day in my new role with the Alberta Grain Commission. For those of you who may not know, the Alberta Grain Commission's mandate is to monitor all aspects of the grains and oilseeds industry and to facilitate wherever possible actions that serve to increase the net income of Alberta farmers.

The shape of our industry today has been molded by many hands. The institutions and regulations that have been developed to serve the grain industry in western Canada have been in response to the specific conditions that exist in western Canada. (And to a certain extent by our traditional European markets.) We generally view the region as a whole as one characterized by substantial year to year variability, and one with generally pretty hostile weather for grain production.

But we all know that this generalization is much too simplistic. The real fact is that different regions within the western grain production area have very different characteristics from each other, and these differences are reliable.

The fact that these differences between regions in western Canada are reliable would seem to dictate that our research efforts in plant breeding would be diverse, but I don't think that we can claim that this has been true for wheat.

We have a group of CWRS and CWAD cultivars that are unquestionably world class, but after we've said that we've said it all. For those farmers who have season length problems, or who have substantial amounts of moisture or who have other conditions different from our "standard" view of the west we have provided very little.

Where are our wheats suitable for intensive management, our wheats suitable for irrigation, our winter wheats suitable for continuous cropping conditions, our wheats with yields suitable for feed uses, our wheats suitable for brewing and distilling, and our wheats suitable for regions requiring early maturity?

The facts are that we have done a fine job in providing suitable wheats for the "average" wheat grower, for our marketing institutions and for the premium world markets, but in so doing we have forced a great many square farmers to fit into round holes. We all know what those square farmers started to do in the past few years - they circumvented the system and made everybody wake up. I think that the plant breeding community must take responsibility for all of the regions of western Canada, not just the convenient ones, and I think that many in the plant breeding community share that view.

We're all here today to talk about wheats for areas requiring early maturity because that is one area that we haven't done much for. Our only suitable CWRS cultivar is Park, and millers tell me that if they identify a delivery point where Park is present they will not select any wheat from that point. That doesn't say too much for Park from a quality point of view. We have some good CU varieties, but these are wheats looking for a market!

The problem for Parkland wheats, from a farmer's point of view, is not so much shortage of frost-free days but shortage of useable frost-free season. These areas have growing days on both ends, spring and fall, that we can't use because of excessive moisture in the fields. I worry that if breeders succeed in developing cultivars of bread-type spring wheat for these areas we will end up with quality that won't sell or else yield that farmers can't live with.

It is, nonetheless, important that these farmers have wheat varieties - varieties of a type for which there is a market - that can be grown reliably. It is simply not enough to say that grain producers in short season regions should grow canola or oats or barley instead of wheat. Or at least its not fair to tell them not to grow wheat until we've genuinely tried, and failed, to provide them with good wheat varieties - and I don't think we've done that yet.

As I stated at the outset, I know little about plant breeding and wheat quality so I certainly don't know how much success is possible in breeding for milling quality in a short season spring wheat. But I do know that milling quality winter wheats can be produced in short season areas, and I don't believe that we've given winter wheats an honest try in the

Parkland and northern areas. I know that we have cold tolerance and snow mold problems, but what have we done about it? I believe that a big part of the answer is in agronomic practices rather than in genetics. If cold tolerance could be solved agronomically and snow mold resistance could be achieved through breeding I think the chances are good that we would have a winner.

For nearly twenty years I have been praising the merits of winter wheat to anyone who would listen, and to many others who weren't at all interested in listening too. For the southern prairies it is the finest answer we have to our problems of rainfall distribution, soil conservation and high input costs. We solve all of our major problems with one answer. Input costs are reduced by 50%, yield is increased by 25%+, soil salinity and wind erosion are mere memories, and our crops are up and growing when spring rains come. We don't have problems with poor spring seeding conditions and wet harvest conditions with the regularity that short season areas do, so winter wheat has other advantages to northern areas as it is for southern areas, but for different reasons.

We should also note that unlike CPS wheats, winter wheat is a wheat class with quality that is immediately acceptable to most world markets. We seem to be told that the quality we should aim for in CPS wheats is "as close as possible, in terms of protein, strength and hardness to winter wheat". Why work so hard to duplicate something we already have?

Whether winter wheat can be the finest answer for areas needing early maturing wheat or not is not yet known. But until we've made a serious attempt to determine whether or not it can be, we should not discard the possibility.

Keep in mind one challenge. Farmers are much quicker to respond to markets and economic forces than the "system" is, and the plant breeding community is driven by the "system". I recognize that the very nature of your breeding programs makes it difficult to change direction, but I don't think that this is the reason we have not responded to the need for early maturing wheats.

Many in this room have recognized the need for some time, yet progress has been slow. I think that effective coordination of breeding efforts to achieve industry targets has been lacking. This targeting and coordination is a responsibility of the industry rather than of individual breeders and stations and it is the industry as a whole, under the leadership of Ag Canada's research branch, that must become more responsive. That is our challenge.

NORTHERN WHEAT RESEARCH:

Observations and Suggestions

Paul Sim, Senior Policy Analyst, Western Canadian Wheat Growers Association

Thank you, Mr. Chairman, for inviting the Western Canadian Wheat Growers Association to participate in today's discussion and for the effort you have made in organizing this seminar.

I would like to apologize on behalf of the Board of Directors of the WCWGA for not being able to have one of our Parkland region directors here today who might be better able to address the issues at hand. Unfortunately, due to time constraints and other commitments, this was not possible.

Since my formal training is in that "terrible science" of economics, I will be the first to admit my shortcomings when it comes to discussing wheat breeding and production issues. With this in mind, I will keep my remarks brief so that we can proceed with a discussion of the information raised today.

What I will do is present a few observations and ideas from the perspective of a policy analyst with a farm organization and also as a farmer from southern Saskatchewan who is faced with a substantially different set of production parameters than farmers in the north. Where I farm and was raised, "north" is anything north of the #1 highway.

I believe that there has been a tendency in the past to view western Canadian wheat producers as a homogeneous group, with a bias towards the southern growing areas. This attitude has been evident, over the years, in the establishment of research priorities as well as in our marketing, handling and transportation infrastructures. Such a view is misguided, because it fails to recognize the obvious environmental and productivity differences between various geographical regions. Those products which respond well to the conditions in my region - low rainfall, high BTUs and a longer growing season - are obviously not the same products to meet the needs of growers such as Maurice Fines in the Peace River region - where lack of rainfall is less of a concern but the length of the growing season is an obvious restriction.

It must be noted that this bias is being addressed, and the fact that we are here today is a positive indication of the higher profile which northern grain production research is achieving.

When examining the problems associated with wheat production in northern regions and the potential solutions, it is important to focus attention not only on plant breeding, but also on other aspects of production and marketing which may serve to limit the ability of northern producers to grow and market wheat profitably. The research, production, and marketing arms of this western grains industry must be co-ordinated in such a way as to provide producers in **all** regions with an opportunity to maximize returns based on an effective allocation of available resources. Such an objective implies that the appropriate tools and technologies for each region must be developed.

The recent "unlicensed wheat problem" provides an example of what can happen when the various aspects of the grains industry are not properly co-ordinated. A group of producers felt that the system was not responding to the requirements of their individual businesses or geographic regions. Consequently, they took it upon themselves to import products which they felt would offer a greater opportunity to maximize returns. We then found ourselves with a grading and marketing system which was incapable of dealing with this new material and which was too inflexible to respond in an effective manner.

The whole problem stemmed from a lack of market research, which resulted in an inability to set proper research priorities. It also demonstrated that our governing institutions are sometimes unable to adapt effectively to a changing environment. A group of producers were left in a situation where the available resources did not meet their requirements; and they took action to force change.

Northern wheat producers find themselves in much the same situation - discouraged by the lack of appropriate tools and technology to address the problems they experience. What can we do to arrive at an effective and co-ordinated solution?

Obviously we require a blueprint of how research in this area should proceed. Let me suggest one possible process for developing this blueprint. These ideas are certainly open for discussion and alteration.

1. Convene a meeting of a small group of interested individuals (6 - 10 people) to develop an agenda for a Northern Wheat Research Program. The mandate of this committee would be to establish research priorities in the areas of:

   - Wheat breeding and varietal development for northern regions.
   - Institutional constraints to northern wheat production.
   - Production technology improvements for northern wheat production.

   To the extent that it is possible, this group should represent the major facets of the industry including representatives from producer groups, the research community and the marketing sector.

2. Demonstrate the economic benefits which can be derived from the research priorities outlined by the committee. The work done by Professor Apedaile would provide an excellent starting point for this analysis. This economic information could be used as a selling point to those responsible for allocating research funds.
3. Use existing market research and product development knowledge to help determine where research efforts should be concentrated.
4. Develop a strategy to attract appropriate funding for the program from whatever sources may be available.
5. The committee should re-evaluate the program on a regular basis to determine whether the focus or objectives should be altered based on changing information.

The success of any research effort, such as that outlined above, will be partly dependant on raising the profile of northern wheat research amongst producers and amongst those who control the purse strings for allocating funds. That is why I believe that it is important to have producer involvement in the development of the program from the outset. A program which is developed through the efforts of credible researchers and has the support of producers is more likely to be successful in attracting the required funding.

This is one possible plan of action for addressing the concerns brought forward today. It is obviously short on detail and leaves much room for further development. However, I hope that before we leave today, we can agree to what the next step should be in formulating a solution to the problems experienced by northern wheat producers.

Thank you very much.

WORKSHOP PARTICIPANTS

Briggs, Keith G.	Dept. of Plant Science, Fac. of Agric. & Forestry, Univ. of Alberta, Edmonton, AB T6G 2P5
Piening, Lu	Plant Pathologist, Agriculture Canada Research Branch, Bag Service 5000, Lacombe, AB T0C 1S0
Kibite, Solomon	Agriculture Canada Research Branch, Bag Service 5000, Lacombe, AB T0C 1S0
Zuzens, D.	Dept. of Plant Science, Univ. of Manitoba, Winnipeg, MAN R3T 2N2
Hughes, G.R.	Dept. of Crop Science & Plant Ecology, Univ. of Sask., Saskatoon, SASK S7N 0W0
Sim, Paul	Western Canadian Wheat Growers Assn., 4401 Albert St. Regina, SASK S4S 6B6
Hucl, Pierre	Sask. Wheat Pool, #15 Innovation Blvd., Saskatoon, SASK S7N 2X8
Beswick, Ken	Alberta Grain Commission, 305-7000 113 St., Edmonton, AB T6H 5T6
Taylor, Gregory	Dept. of Botany, Univ. of Alberta, Edmonton, AB T6G 2E9
Zhang, Guichang	Dept. of Botany, Univ. of Alberta, Edmonton, AB T6G 2E9
Kutschera, Kurt	Dept. of Plant Science, Univ. of Alberta, Edmonton, AB T6G 2P5
Thomas, Julian B.	Agriculture Canada Research Station, Lethbridge, AB T1J 4B1
Tipples, Keith	Grain Research Lab., Canadian Grain Commission, 1404-303 Main St. Winnipeg, MAN R3C 3G8
DePauw, Ron	Agriculture Canada Research Station, Box 1030, Swift Current, SASK, S9H 3X2
Harding, Howard	Agriculture Canada Research Station, 107 Science Cres., Saskatoon, SASK S7N 0X2
Clayton, George	Agriculture Canada Experimental Farm, Box 126, Fort Vermilion, AB T0H 1N0

Wolfe, Robt.	Agriculture Canada Research Station, Box 29, Beaverlodge, AB T0H 0C0
Crowle, Leigh	Agriculture Canada Research Station, 107 Science Cres., Saskatoon, SASK S7N 0X2
Salmon, Don	Alberta Agriculture, Bag # 47, Lacombe, AB T0C 1S0
Tkachuk, Russel	Grain Research Lab., Canadian Grain Commission, 1404-303 Main St., Winnipeg, MAN R3C 3G8
Evans, Ieuan R.	Alberta Agriculture, Agric. Bldg. 7000 - 113 St., Edmonton, AB T6H 5T6
Berkenkamp, B.	Agriculture Canada Research Station, Lacombe, AB
McLeod, J.G.	Agriculture Canada Research Station, Box 1030, Swift Current, AB S9H 3X2
Wright, Tim	Melfort Research Station, Box 1240, Melfort, SASK S0E 1A0
Bowren, Ken	Melfort Research Station, Box 684, Melfort, SASK S0E 1A0
Fines, Maurice	B.C. Grain Producer Assoc., Box 6235, Fort St. John, B.C. V1J 4H7
Apedaile, L.P.	Dept. of Rural Economy, Univ. of Alberta, Edmonton, AB T6G 2H1
Woods, Don	Agriculture Canada Research Station, Box 29, Beaverlodge, AB T0H 0C0
Davidson, John G.N.	Agriculture Canada Research Station, Box 29, Beaverlodge, AB T0H 0C0
Clarke, Philip J.	Agriculture Canada Research Station, Box 29, Beaverlodge, AB T0H 0C0