Pesticide Price Differentials Between Canada and The U.S.

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1.0 STUDY INTRODUCTION

This study was initiated because of concerns raised by farmers in North Dakota and Minnesota that prices for identical pesticide products were higher in the U. S. than in Canada. About ten years ago Canadian farmers had expressed a similar concern and they were able to get a pesticide import program developed which allows individual growers to import U.S. pesticides into Canada. Legislation has been proposed in the U.S. to allow the importation of Canadian pesticides into the U.S. (S394 - A bill to amend the Federal Insecticide, Fungicide, and Rodenticide Act to permit a State to register a Canadian pesticide for distribution and use within that State, Feb. 1999). This difference in pesticide pricing between Canada and the U.S. for similar products has been reported at other national border crossing points e.g. Ontario vs Great Lake States (McEwan, 1996).

In this period of low commodity prices, it is expected that farmers will be reducing costs of production wherever they can. Although pesticide expenditures are not high for the study crops in the Canadian/U.S. prairie area compared with some crops and areas, they are relatively high compared with per acre profits. A few dollars of extra cost can make the difference between a profitable and an unprofitable year. The crops focused on in this study are spring wheat, barley, canola and potatoes. The specific study area is comprised of the prairie provinces of Canada and the northern tier U.S. states of North Dakota and Minnesota. These two areas in general have similar climates and technology and represent the area where price differentials for pesticides are a concern among farmers.

The restriction in the movement of pesticides across country borders is one of the basic reasons we expect prices for similar pesticides to differ between dealers in the U. S. and those in Canada. However, there are other factors that contribute to the observed differences in price and pesticide availability. Different patent status of products, different costs to provide pesticide products in different locations, and a different willingness of growers to pay for products are sometimes involved. In addition, pesticide manufacturers consider the pest control demand from other locations, crops and substitute products in pricing their products.

This study compares pesticide prices between the U. S. and Canada, and examines reasons that pesticide prices might differ in the study crops and areas. The emphasis is on herbicides because these make up a large share of the total crop pesticide expenditures. Comparisons of pesticide use and pesticide expenditures per acre are for the most recent period (1996-1999), however data was examined over a longer term for comparing pesticide prices.

Even if prices of similar pesticide products differ between farmers in the U. S. and Canadian locations, this might not lead to cost of production differences. Farmers can choose different pesticide bundles and use non-chemical, pest management inputs when confronted with relatively expensive pesticide prices. In this study we have selected Manitoba and North Dakota from our study areas and have examined and compared pesticide expenditures per treated acre across these locations. Many herbicide product to product and weed program comparisons are performed and we estimate the change in pesticide expenditures per treated acre if all pesticide products could be purchased at the price found in the low-price location.

1.1 SUMMARY OF FINDINGS

A summary of the main findings found from conducting the study are now presented.

1. There are differences in unit prices between North Dakota/Minnesota and Manitoba for some of the more frequently purchased pesticides. This finding is based on dealer surveys carried out over the 1993-1999 period and adjusting for chemical concentration and the exchange rate (Thomsen, 1999). Prices used in the comparison between Manitoba and North Dakota/Minnesota are averages across about 20 dealers, and represent a large share of the pesticides sold in the study area. Herbicides like Roundup Original, Liberty, Puma, and Buctril M have lower prices in Manitoba. However, products such as MCPA, Treflan, and Poast have slightly lower prices in North Dakota. Several of the widely used herbicides like 2,4-D and Banvel have similar prices on both sides of the border.

   There are many reasons why pesticide prices vary between the two regions and they include: differences in patent expiry dates; differences in market size and costs; differences in pesticide demand (e.g. farmer preferences, willingness to pay); and differences in the number of substitute products available. Several products, which are widely used in other crops and locations, tend to have many pesticide alternatives and non-chemical pest controls. Consequently these products have similar prices in both study locations (e.g. Banvel and 2,4-D). This is consistent with the notion of less pricing power by pesticide sellers when there are many substitute products or practices. From a manufacturer's perspective, the U.S. and Canada represent two distinct markets for pesticide sales.

2. In general, availability of pesticides does not seem to be a problem for either region. There are examples of uneven registration between the two countries and there are more pesticides registered for canola in Canada than in the U.S.. However, because of Section 18 registrations in North Dakota, there does not appear to be a major shortage of pesticides for canola production. Section 18 authorizes the EPA (Environmental Protection Agency) to allow states to use a pesticide for an unregistered use for a limited time if EPA determines that emergency conditions exist. The canola acreage is expanding in North Dakota/Minnesota, but it is still much larger in Canada.

3. North Dakota farmers use different herbicides for weed protection when growing wheat,

barley, canola and potatoes than Manitoba farmers. North Dakota farmers tend to use herbicides which are lower priced such as Banvel, MCPA and 2,4-D more frequently than producers in Manitoba. The exact reasons for North Dakota producers spending less on weed control are unclear. But possible explanations are: more use of non-chemical weed control; lower potential crop yield e.g. larger areas with a semi-arid climate causing variable yields; and relative prices of pesticides.

4. Pesticide bundles also vary between provinces and states. The most frequently used herbicides used in Manitoba are different from those used in Saskatchewan. Similarly, there are differences in the frequency of use of various pesticides between North Dakota and Minnesota. For example in the wheat crop, it is more common for farmers in Minnesota to use Roundup and Far Go than producers in North Dakota. In the 1996 North Dakota wheat crop, 2.5% of the treated acres received Roundup.

5. When herbicide expenditures were estimated on a per acre treated basis, North Dakota farmers were spending less than Manitoba producers. The per cent difference that Manitoba farmers were spending over North Dakota farmers by crop was: wheat - 202; barley - 169; canola - 41; and potatoes - 29. Herbicide products selected by Minnesota wheat growers tend to be more like those in Manitoba. Thus, it is anticipated that expenditures on a per acre treated basis are more similar to those in Manitoba.

6. Selected herbicide product to product and weed program comparisons showed Manitoba either the same price or less expensive than North Dakota. However, there were two herbicide combinations in which North Dakota was lower priced and they were: canola - Treflan and Poast; potatoes - Sencor and Poast.

7. North Dakota and Saskatchewan herbicide expenditures per treated acre align better than the comparison between North Dakota and Manitoba. Intuitively this makes sense given that both areas have similar yield potentials and likely use non-chemical weed control frequently. However, there was still a difference of US$3 - 4 on a per treated acre basis with North Dakota spending less in the three crops of wheat, barley and canola.

8. The simulated impact of purchasing lower priced pesticides in either Manitoba or North Dakota using existing herbicide market shares is small on a per treated acre basis (usually less than US$.50/acre). The one exception to this statement is for the study crop of potatoes which would see about a 19% drop in herbicide expenditures for North Dakota. The magnitudes of the changes in pesticide market shares that would occur with lower pesticide prices are unknown at this time, but the fact that farmers will buy more of any given product when its price falls is generally true.

9. From reviewing state and provincial cost of production budgets it can be seen that pesticides represent about 10 to 18% of the overall cost of production for the crops in question. Pesticides are just one of several inputs needed to grow a crop.

10. Lower herbicide expenditures in North Dakota do not necessarily mean lower costs of production or higher profitability in crop production. North Dakota farmers may or may not have higher costs of wheat production than farmers in Manitoba because of higher land, labour and management costs associated with non-chemical weed control. Similarly, higher expenditures in Manitoba do not imply higher overall cost of production and less profitability.

2.0 PESTICIDE PRICING AND ECONOMIC THEORY

Prices of similar or identical goods often differ between various geographical locations, both within and between countries. While a majority of the active ingredients in pesticides are manufactured in the United States and Europe, there are a variety of formulations in both the U.S. and Canada that are designed to address local crop, climate, and pest conditions. The patent and registration system for these pesticide products are separate for the U.S. and Canada, and trade is not permitted from Canada to the U. S. at the retail level. These factors act to limit the availability of substitute formulations and products for use in both markets.

The goal of this section is to develop the economic framework that would allow one to understand the reasons that prices may vary from one geographic location to another. This section will be comprised of the following cases that demonstrate the most relevant explanations for this price differential (if it exists):

a. the base case where prices of similar pesticide products do not differ in a major way between the U.S. and Canada,
b. the case where prices of similar pesticide products differ as a result of differences in the demand (the farmer's willingness to pay) for the pesticides in the two countries,
c. the case where prices of similar pesticide products differ as a result of differences in costs that arise due to the variation in the size of the market and other delivery and sales factors in the two countries,
d. the case where prices of similar pesticide products differ as a result of the ability to segment markets due to differences in demand (particularly those related to the availability of substitute formulations) in the two countries, and
e. the case where prices of similar pesticide products differ as a result of different patent and/or registration requirements in the two countries.

A more detailed description of the economic terms used in this section is provided in Appendix 1.

2.1 Why Prices Might Be The Same Or Law of One Price

First, to compare prices across country borders it is necessary to use a single currency. To do this, prices in one country are expressed in the currency of the other country by using the exchange rate between the currencies. Exchange rates are set by market forces and for the most part are independent of the actions of multinational pesticide companies. We will compare prices by using U.S. dollar prices and pesticide expenditures found by using 1999 exchange rates. (See Appendix 1 For Descriptions on Exchange Rates and the Law of One Price.)

For some pesticides, the price differential between the U.S. and Canada will be initially insignificant or converging to insignificance over time. According to economic theory, one would expect prices of identical or highly similar goods to converge over time if trade is permitted. Price convergence occurs due to the existence of arbitrage opportunities that occur when the price of a good is higher in one location than the price of the same good in another location. By arbitrage opportunities, we mean that an individual could buy at the lower price location and then transport and sell at the higher price location in order to make a profit. If this occurs, the demand for the good will increase in the lower-price location. Assuming no offsetting increase in supply, this increase in demand will drive up the price at that location. At the same time, the increase in sales in the higher price location will increase the supply of the good. Assuming no offsetting increase in demand, this increase in supply will drive down the price at that location. These arbitrage activities will continue until the prices are the same for identical products, and no profit opportunities remain from trade. This is known as the Law of One Price (Yarborough and Yarborough, 1994).

The Law of One Price fails to hold if a number of conditions do not exist. In terms of pesticide price convergence, the most important factors limiting arbitrage seem to be the legal restriction which prevents the flow of final pesticide products across country borders and differences in local cost and demand conditions that generate the need for location-specific formulations or products. In "The Law of One Price in International Trade: A Critical Review", Miljkovic outlines a number of factors that contribute to the failure of price convergence. These factors include exchange rate risk, transportation and other transaction costs that arise in the trade of goods due to the geographical separation of markets, and differences in the export demand elasticities which lead to market specific pricing decisions. (Miljkovic, 1999). Another factor contributing to price divergences is the existence of non-traded factors of production embodied in traded goods. Even if the U.S. and Canada attempted to increase trade volumes by making registration requirements for pesticide products the same in the two countries, differences in the costs of inputs that cannot effectively be traded would mediate against complete price convergence. For example, land and its associated weeds used in the production of wheat are not very mobile between countries. Thus, differences in weed levels will cause price differences even if trade occurs (Engel and Rogers, 1996). As a result of these and other factors cited in the trade literature, we should not expect complete price convergence even if all trade barriers were removed. The major impediments to price convergence are explained in the following sections.

2.2 Demand Generated Price Differentials

The demand for particular pesticides by farmers is partially derived from the demand for the final product (salable crop) that is produced with the use of pesticides. The differences in this derived demand for pesticides between the U.S. and Canada can be explained by differences in the following factors: the willingness to pay (demand) or price for the salable crop; the potential crop yield without use of the particular pesticide; the potential crop savings associated with pest infestations and pesticide effectiveness, and the price and availability of pest control substitutes. The demand for the salable crop depends on consumer tastes and income, the retail price of the crop facing the consumer, and the availability and price of substitutes for that crop. The potential crop yield depends on the characteristics of the particular crop, the soil and climate conditions, and the management capabilities of the producer. Alternative pest controls include other pesticides and non-chemical approaches. Finally, the crop saved depends on the degree of pest infestation and the related crop damage and the pesticide effectiveness associated with the particular pest specie and active ingredient. All of these demand conditions frequently vary from location to location. One would expect higher demand for pesticides in a location where yield potential, pest infestation, and crop prices are higher. A higher efficacy of a particular pesticide or higher prices for alternative pesticides will also expand demand for the former pesticide.

The impact on price differentials of demand differences is illustrated in Figure One. The demand for a particular pesticide (D_A) is higher in location A, so the resulting price for the pesticide in location A would be higher than that in location B for selling a particular quantity (Q) of that pesticide. Notice that the two locations could be either two points in one country or two separate countries. For this study, we can think of A and B locations as farms in North Dakota and Manitoba, respectively.

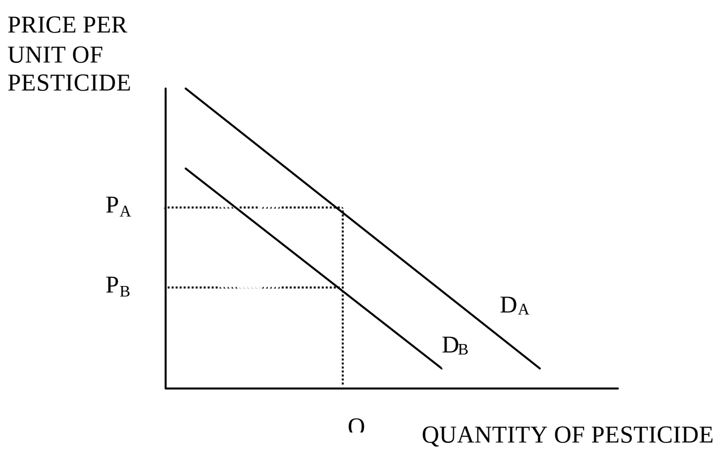


Figure 1. The effect of pesticide demand on pesticide prices for two locations

2.3 Production Costs and Small Market Generated Price Differentials

The price charged for a good supplied in the market is determined by the interaction of supply and demand. On the supply side, the costs incurred by the supplier and its impact on profit opportunities determine the price that he must receive for supplying the good. There are a number of factors that affect costs in the supply of pesticides, but one of the most important is the size and geographic concentration of the market facing the supplier.

A large market allows the supplier to take advantage of economies of scale which tend to lower costs per unit of the pesticide supplied. These economies of scale for a large pesticide market (particularly one that is geographically concentrated) are related to overhead costs and inventory holding costs. Overhead costs can include: insurance payments, administrative costs, advertising expenditures, and any other expenditures that are relatively fixed regardless of changes in the volume of sales. Inventory costs per unit of pesticide sales for dealers with small markets can be sizeable because capital is tied up in materials that are stored for possible sale. In all cases, differences between the U.S. and Canada can lead to a significant difference in costs. This, in turn, will lead to a difference in pesticide prices as illustrated in Figure Two.

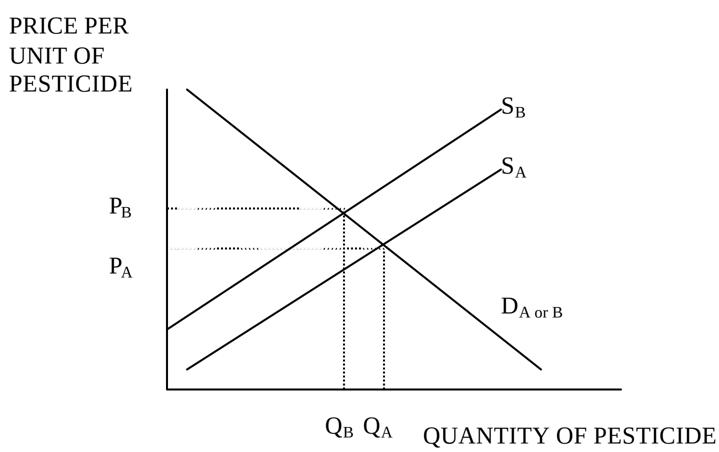


Figure 2. Price differences in countries A and B due to higher production costs in country B

With the supply of a particular pesticide in Canada given by S_B and the supply of the same pesticide in the U.S. given by S_A , one can see that the market clearing price in Canada (P_B) will be higher than that in the U.S. (P_A) for any equivalent demand.

2.4 Market Segmentation Generated Price Differentials

Market segmentation and the resulting opportunities for the seller to charge different prices to different consumers can occur when the demand for a good or the price responsiveness of demand for that good differs for different groups of consumers. This responsiveness of units sold to changes in price (the price elasticity of demand in economic terms) is largely determined by the availability of pest control substitutes (see Appendix 1 for a detailed discussion of pest control substitutes) . In terms of pesticides, this would mean that the demand for a particular pesticide would be more price responsive (more elastic) if there exists one or more substitute products that will meet the biological and economic requirements fulfilled by the original pesticide. The higher the elasticity of demand due to the greater number of substitutes, the lower the price that can be charged to the farmer.

To be concrete, suppose that we have wheat being grown with only one major weed specie, X, in country A, but the wheat growers have to contend with weeds X and Y in country B. In country A, there are four or five different herbicides that are registered for use that are effective at controlling weeds X. However, suppose there are only two herbicide products that effectively control both weeds X and Y in country B. Consequently, the herbicide sellers in country B face fewer competitive products. As a result, the sellers in country B face a less elastic demand (D_B) and marginal revenue (MR_B) curves, than the demand (D_A) and marginal revenue (MR_A) curves facing the sellers in country A. (See Appendix 1 for an explanation of price elasticity of demand, marginal revenue, and price setting behavior using the MR curves.) In this situation, we expect the price of the herbicides to be higher in country B. This is illustrated in Figure 3 and Figure 4.

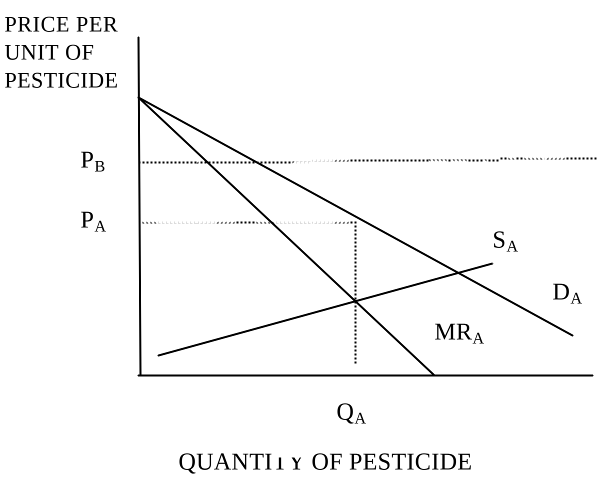


Figure 3. Elastic demand (many substitutes)

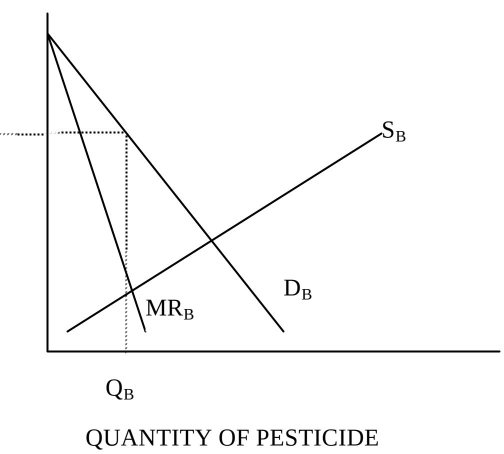


Figure 4. Inelastic demand (few substitutes)

2.5 Patent Status and Registration Generated Price Differentials

Patents awarded to pesticide suppliers to stimulate research and development provide the patent holder with exclusive control over the production of a particular active ingredient or formulation for a given length of time. This gives the manufacturer more flexibility in setting prices since they are the only legal seller of the pesticide. This will lead to prices being set above the level that would occur in the absence of patent protection.

The registration requirements for a new pesticide can differ between countries. Also, pesticide companies may choose to register a product in one country but not another based on the regulatory stringency as well as the usual demand and supply factors described above. Therefore, differences in regulatory stringency can make the set of products available for use different in two countries. We would expect the country with more stringent registration requirements and more patent protection to experience higher prices for pesticides.

The patent or regulatory stringency situation can be illustrated with graphs similar to those in Figure 3 and Figure 4 above. More stringent registration requirements and more patent protection will lead to fewer pesticide substitutes. This can be shown as the seller facing a less elastic demand (Figure 6) than that which would be faced with the availability of more substitutes. The latter case is illustrated in Figure 5. The less elastic (more inelastic) demand case (Figure 6) leads to higher pesticide prices. Qualitatively, these results are equivalent to those in the segmented market case. The key difference is that differences in patent or registration status between countries underlie this section while other economic forces that generate different demand elasticities underlies the last case. The main similarity in both cases is the number and closeness of substitute products to the currently used pesticide.

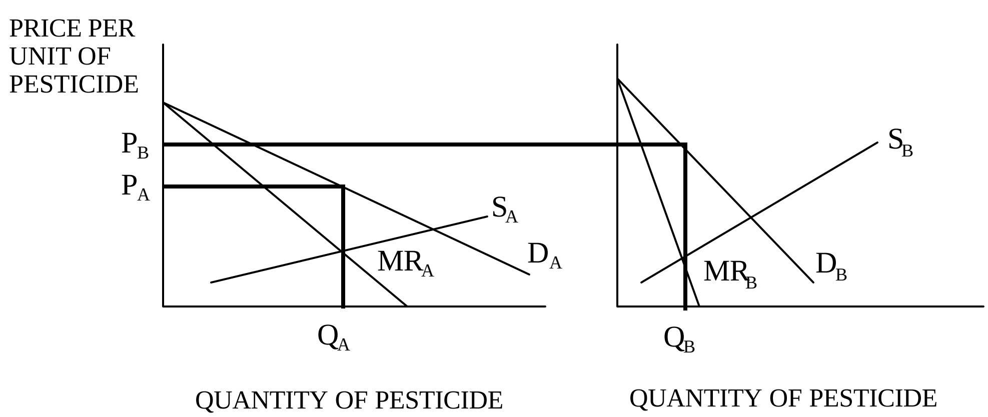


Figure 5. Elastic demand (less stringent registration requirements)

Figure 6. Ineslastic demand (more stringent registration requirements)

3.0 PRICE DIFFERENCES FOR PESTICIDES

In this section pesticide pricing trends in Manitoba and North Dakota/Minnesota are summarized. Analysis is performed on the Manitoba and North Dakota/Minnesota price series to test for anomalies. Pricing differences across jurisdictions are not unique to Manitoba and North Dakota/Minnesota. Other studies have also demonstrated pesticide price differences across jurisdiction. In this section we summarize a study by McEwan (1998) which examined pesticide price differences between Ontario and Great Lake States, and a study by the Australian Prices Surveillance Authority (1993) which examined pesticide pricing in various countries. We conclude this section by discussing reasons why pesticide prices differ between regions.

3.1 Pesticide Pricing Trends in Manitoba and North Dakota/Minnesota

Several studies have examined pesticide pricing in the prairie provinces. Table 1 illustrates the trends in average nominal prices for pesticides in Manitoba from 1993 to 1999 (Thomsen Corporation). The Thomsen survey is performed 3 times annually i.e. May, June and October; and the reported prices are defined as cash and carry. Enumerators collect the data by either phone, fax or personal visitation. A random sample of over 25 dealers in each country participate in the survey and attempts are made to get at least 20 price quotes per product in each region. When adjusting for exchange rate to compare product prices, the mid-day rate given by the Bank of Canada is used. Many of the outlets participating in the survey are affiliated with a central buying group.

Over the 1993 - 1999 time period, there are some products displaying a price decline, but generally most are up 1 to 5% per year. It is interesting to note that the price of Roundup dropped 10% in 1995 while Malathion jumped 48% in 1999. Year to year price changes for North Dakota and Minnesota are shown in Table 2. Most pesticide products have increased in price over the 1993 - 1999 period, however there are some exceptions such as MCPA, Poast, and Trifluralin. Similar to the Ontario price study presented later, the Thomsen report shows that Manitoba and North Dakota/Minnesota pesticide prices do not move in harmony with each other.

Table 3 depicts the % difference in pesticide prices between Manitoba and North Dakota/Minnesota from 1994 to 1999. From this table it is possible to see several products higher priced in North Dakota/Minnesota relative to Manitoba. Notable products with a higher price include: Liberty, Lontrel/Stinger, Roundup Original/Ultra, Avenge, BuctrilM/Bronate, Hoe Grass/Hoelon, Pardner/Buctril, and Puma. There are products lower priced in North Dakota and a couple of examples are Furadan and Malathion. Notice that many of these price differences have existed for some time and in general there has been little change in the size of the price difference over the study period.

Table 1 : The Average Change in Manitoba Pesticide Prices for 1993-1999

Herbicide	Unit	% Change						1993-99
		94/93	95/94	96/95	97/96	98/97	99/98	Avg % Change
2,4-D Amine	10 l	7.1	7.1	7.3	4.2	1.2	0.2	4.52
Assert 300-SC	10.8 l						0.9	0.90
Assure	8 l						-0.3	-0.30
Atrazine Liquid	10 l		3.9	5.2	5.2	7.4	0.2	4.38
Avadex EC	22.7 l	0.5	1.2	0.8	0.8	4.7	-18.2	-1.70
Avadex G	22.7 kg	2.6	-3.8	3.6	0.3	7.0	-3.8	0.98
Avenge	20 l	4.1	6.0	5.6	1.1	5.4	5.0	4.53
Banvel	10 l	3.8	2.8	3.2			0.4	2.55
Basagran	9 l						0.4	0.40
Buctril M	8 l	5.6	4.3	2.8	3.9	0.1	5.1	3.63
Curtail M	8 l						2.9	2.90
Dithane DG	20 kg						-1.5	-1.50
Edge Granular	25 kg						0.1	0.10
Eptam 8-E	10 l						-4.5	-4.50
Furadan	4 l	2.9	-1.6	4.1	4.6	3.9	0.8	2.45
Hoe Grass	20 l	0.4	-5.1	0.5	7.6	2.7	0.0	1.02
Liberty	13.5 l						-1.0	-1.00
Lontrel	4.45 l						2.1	2.10
Lorsban	10 l	2.4	-0.5	1.5	6.2	0.2		1.96
Malathion	10 l	-7.7	10.3	-0.6	8.1	11.3	48.1	11.58
MCPA Amine	10 l	3.7	10.8	4.7	2.8	2.8	-1.0	3.97
MCPA Ester	10 l						-0.6	-0.60
Pardner	8 l						0.9	0.90
Poast Ultra	case						0.5	0.50
Puma	8.1 l						0.0	0.00
Reglone	10 l	5.4	1.4	1.0			3.5	2.82
Rival EC	9 l	6.8	3.5	2.8	7.5	-1.2	-1.7	2.95
Roundup Original	10 l	0.5	-10.0	0.0	0.4	-0.7		-1.96
Roundup Transorb	10 l							
Roundup Transorb bulk	115 l							
Sevin XLR	10 l	2.1	2.3	1.1	3.3	7.0	3.9	3.28
Stampede	10 kg						9.5	9.50
Treflan QR5	25 kg	5.1	5.6	2.5	6.7			4.97
Counter 5G	20 kg						-2.9	-2.90
Bravo 500	10 l						-1.8	-1.80
Ronilan EG	12 kg						0.3	0.30
Tilt	5 l						0.0	0.00

Source: The Thomsen Corporation, 1999

Table 2: The Average Change in North Dakota/Minnesota Pesticide Prices for 1993-1999

Herbicide	Unit	% Change						1993-99
		94/93	95/94	96/95	97/96	98/97	99/98	Avg % change
2,4-D Amine	gal	10.5	-2.9	11.0	2.4	4.6	-12.9	0.37
Assert 2.5S	gal							
Assure II	gal							
Atrazine Liquid	gal			13.3				13.30
Avenge	gal	6.1	-3.4	5.8	8.1	-1.3	1.9	2.63
Banvel	gal	4.7	-0.6	4.9	8.7	-3.4	-4.1	0.92
Basagran	gal							
Curtail M	gal							
Dithane DF	gal							
Far-Go G	lb	2.0	3.6	0.4	1.6	-2.3	1.1	1.98
Furadan	gal	7.5	-1.0	3.5	1.0			2.75
Hoelon	gal	7.6	-2.7	1.5	7.1	-3.0	-0.6	0.38
Lorsban	gal		-0.4	8.1	-2.1	1.9		1.88
Malathion	gal	1.9	4.3	18.6				8.27
MCPA Amine	gal	4.4	-2.6	11.4	0.8	-3.5	-12.3	-1.03
Poast 2.5 gal	gal					-1.9	-11.7	-6.80
Puma	gal							
Roundup Original RT	bulk/gal	2.1	2.3			-0.7		1.23
Sevin XLR	gal	0.1	2.7	4.7				2.50
Treflan EC	gal	-0.3	2.6	-3.3	9.2	-2.3		1.18
Trifluralin EC	gal	1.4	-1.0	1.1			-14.5	-3.25

Source: The Thomsen Corporation, 1999

Table 3: The Per Cent Difference in Price For Selected Pesticides Between Manitoba and North Dakota/Minnesota

Herbicides	Crop	1994	1995	1996	1997	1998	1999	Avg % Difference All Years
Atrazine Liquid	none		-7.3	-12.9			11.8	-2.80
Edge 5G/Sonalan 10G	Canola						10.1	10.10
Liberty	Canola						-39.6	-39.60
Assure - Assure II	Canola/Potatoes						-10.6	-10.60
Poast & Ultra/Poast	Canola/Potatoes		-3.4	38.9	29.4	17.0	33.5	23.08
Fortress/Buckle	Canola/Wheat/Barley						-13.1	-13.10
Lontrel/Stinger	Canola/Wheat/Barley						-28.5	-28.50
Rival/Treflan Trifluralin 99 EC	Canola/Wheat/Barley	-4.4	-2.6	3.8	1.2	-3.1		-1.02
Rival/Treflan Trifluralin 99 EC	Canola/Wheat/Barley	-4.4	-2.6	3.8	1.2	-3.1		-1.02
Roundup Original-Transorb/Ultra	Canola/Wheat/Barley	-40.0	-45.9	-46.0		-55.3	-39.1	-45.26
Roundup Transorb/Ultra RT Bulk	Canola/Wheat/Barley						-26.9	-26.90
Treflan QR5-Granular-TR10	Canola/Wheat/Barley	-3.1	3.5	8.3	4.1		14.5	5.46
Eptam 8-E/Eptam 7-E	Potatoes						-14.9	-14.90
2,4-D Amine	Wheat/Barley	-11.1	-1.9	-4.1	-2.3	-15.0	-2.6	-6.17
2,4-DLV Ester	Wheat/Barley						36.6	36.60
Assert 300-SC/Assert 2.5S	Wheat/Barley						-12.7	-12.70
Avadex/Far-Go EC	Wheat/Barley	-24.7	-24.9	-24.3	-28.9	-25.3	-41.6	-28.28
Avadex/Far-Go G	Wheat/Barley	-2.5	-9.3	-5.5	-8.5	-5.1	-10.0	-6.82
Avenge	Wheat/Barley	-30.8	-24.0	-23.4	-29.5	-28.7	-26.9	-27.22
Banvel	Wheat/Barley	2.2	5.9	5.2		-1.0	3.2	3.10
Basagran	Wheat/Barley						-0.7	-0.70
Buctril M/Bronate	Wheat/Barley	-45.6	-42.3	-32.9	-31.1	-30.3	-26.7	-34.82
Curtail M	Wheat/Barley						-15.5	-15.50
Hoe Grass/Hoelon	Wheat/Barley	-25.2	-27.0	-27.1	-27.8	-27.6	-27.5	-27.03
MCPA Amine	Wheat/Barley	-12.9	-0.8	-5.7	-4.0	-3.2	8.7	-2.98
MCPA Ester	Wheat/Barley						3.6	3.60
Pardner/Buctril	Wheat/Barley						-25.0	-25.00
Puma	Wheat/Barley						-35.2	-35.20
Stampede	Wheat/Barley						22.8	22.80
Fungicides								
Dithane DG/DF	Potatoes/Wheat						2.7	2.70
Tilt	Wheat/Barley						-11.3	-11.30
Insecticides								
Furadan	Canola/Potatoes	26.8	26.2	28.1	31.6			28.17
Lorsban	Canola/Potatoes	-8.7	-8.6	-13.4	-7.3	-13.8		-10.36
Malathion	Canola/Potatoes	27.8	35.3	14.7		12.2		22.50
Sevin XLR	Canola/Potatoes	24.3	24.0	20.8		12.5		20.40

Note: blank spaces denote prices not available

Source: The Thomsen Corporation, 1999

3.2 Pesticide Price Differences Between Ontario and U.S. Great Lake States

For the 1993 - 1998 time period, Ontario has enjoyed a price advantage over neighbouring Great Lake States for several pesticide products. Some of the larger volume pesticide products which are typically lower cost in Ontario are: Dual, Pursuit, Roundup, MCPA, Sencor, Reglone, Pardner, Counter, Bravo, and Dithane. If all the pesticide products surveyed in the Ontario Farm Input Monitoring Project are indexed according to Ontario's 1993 usage, the Ontario advantage over U.S. states has ranged from 3% in 1993 to about 14% in 1997. Table 4 illustrates average pesticide prices in Ontario and neighboring U.S. states from 1993 - 1998. Average yearly price changes were about 2 - 5% in both countries. Care should be used when interpreting these average yearly price changes since the U.S. prices have been converted to Canadian dollars, thus some of the difference in the annual price changes could be caused by simple exchange rate fluctuations during the study period. Many of the herbicides lower priced in the comparison between Ontario and the Great Lake States are also lower in Manitoba relative to North Dakota/Minnesota.

It is important to note that while Ontario may have a price advantage in some herbicides, this is not the case when discussing many insecticides and fungicides. For insecticides, U.S. average prices were approximately 20 percent lower than Ontario prices for products such as Furadan 480 DF, Sevin XLR, Malathion 500 EC and Ambush.

Table 4: Summary of Pesticide Price Differences Between Ontario and Great Lake States

	Unit	Average Price 1993-98 Ontario	U.S.	% Difference	Average Yearly Change 1993-98 Ontario	U.S.
Herbicide						
2,4-D Amine 470 (470 g/L SN)	10 litre	44.46	44.98	-1.17	5.90	4.62
Atrazine 480 (480 g/L SU)	10 litre	46.77	45.73	2.22	5.58	4.53
Banvel 480 (480 g/L SN)	10 litre	282.83	291.53	-3.08	3.06	6.40
Bladex 90 DF (90 DF)	10 kg	155.40	168.29	-8.29	1.68	5.46
Dual (960 g/L EC)	10 litre	202.95	236.11	-16.34	0.45	4.74
Dual (960 g/L EC) (BULK)	litre	19.59	22.81	-16.44	1.55	5.92
Frontier (900 g/L EC)	9.5 litre	368.15	357.71	2.84	2.05	-3.22
MCPA Amine 500 (500 g/L SN)	10 litre	55.26	60.32	-9.16	4.97	5.28
Pursuit (240 g/L SN)	3.3 litre	635.76	774.61	-21.84	3.51	5.89
Reglone (200 g/L SN)	10 litre	214.33	243.11	-13.43	3.34	4.04
Roundup (356 g/L SN)	10 litre	90.67	175.05	-93.06	-2.34	5.49
Sencor 75 DF (75% WG)	2.5 kg	173.81	188.52	-8.46	-0.36	-2.02
Sutan+ (800 g/L EC)	10 litre	66.99	62.02	7.42	-5.27	2.68
Basagran (480 g/L SN)	9 litre	230.34	224.69	2.45	3.38	5.52
Prowl (400 g/L EC)	9.5 litre	86.98	95.59	-9.90	3.04	4.75
Pardner (280 g/L EC)	8.0 litre	123.60	187.40	-51.62	3.80	4.08
Treflan 545 (545 g/L EC)	9.45 litre	118.72	126.87	-6.86	2.13	3.48
Devrinol 50 W (50% WP)	1.81 kg	48.55	46.80	3.60	3.53	6.31
INSECTICIDE						
Furadan 480F (480 g/L FP)	4 litre	118.31	97.52	17.57	1.39	5.67
Malathion 500 EC (500 g/L EC)	10 litre	81.09	65.85	18.79	5.75	5.47
Sevin XLR+ (480 g/L LI)	10 litre	112.26	93.15	17.02	2.65	5.92
Counter 15 G (15% G)	20 kg	94.58	113.63	-20.14	3.70	6.06
Dyfonate 20 G (20% G)	20 kg	137.23	156.44	-14.00	2.82	0.58
Guthion 50 WP (50% WP)	2 kg	51.60	50.01	3.08	-0.68	4.16
Ambush 500 EC (500 g/L EC)	litre	119.45	90.42	24.30	2.69	5.26
Thiodan 4 EC (400 g/L EC)	10 litre	120.59	155.43	-28.89	6.02	2.97
FUNGICIDE AND OTHER						
Bravo (500 g/L EC)	10 litre	115.84	133.26	-15.04	2.98	4.78
Captan 50 W (50% WP)	15 kg	135.66	127.29	6.17	4.04	6.68
Dithane M-45 (80% WP)	20 kg	162.00	183.68	-13.38	2.64	2.97
Benlate 50 WP (50% WP)	2 kg	109.66	101.68	7.28	2.25	4.47
Nova 40 W (40% WP)	.56 kg	103.50	106.04	-2.45	0.77	1.90
Ethrel (240 g/L LI)	10 litre	190.37	176.53	7.27	-0.86	-4.40

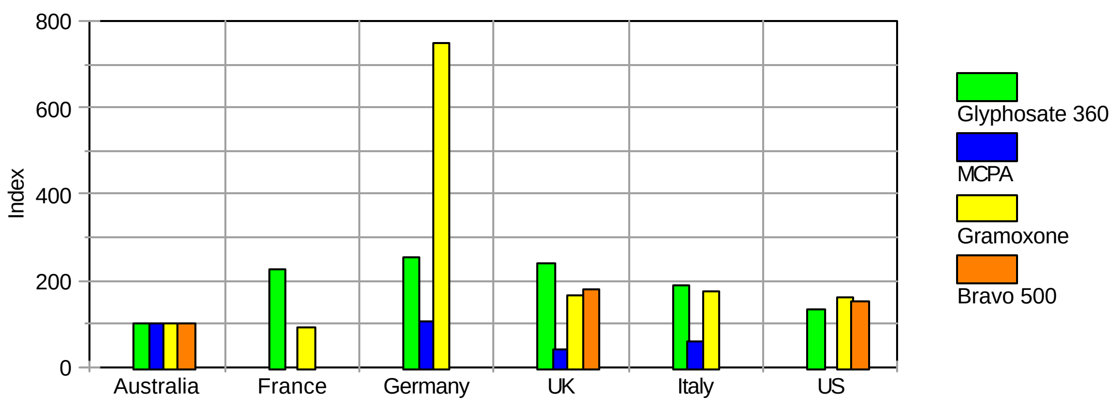
Source: McEwan, 1998

3.3 Pesticide Prices Differences - 1993 Australia Prices Surveillance Authority Study

The following discussion is based on results found by the Prices Surveillance Authority in Australia completed in 1993. This report is relevant to this comparison of prices between North Dakota and Manitoba for a variety of reasons. It clearly documents similar products having different prices in various countries despite free trade existing. Further the study breaks down pesticide costs by component.

Figure 7 compares international pesticide pricing and shows substantial differences in prices across countries for the same products. For reasons given in the study individual country markets are in effect largely insulated one from the other even though free trade may exist. As a result the farm chemical industry at a global level is not a competitive industry with respect to prices. While Australian firms do compete, the majority of their products are sufficiently differentiated for firms to be able to be price setters not price takers. Such differentiation can occur from a natural source (resistance, seasonal factors) or from value-added delivery systems.

Figure 7 Overseas Price Index Comparison



Source: Price Surveillance Authority, 1993

The Price Surveillance Authority also undertook the task of surveying manufacturers to analyse costs associated with supplying chemicals to farmers. At the manufacturer level it was found that active ingredient accounted for 55.2% of the wholesale price for locally formulated products. Other key items contributing to cost are marketing and sales expenses - 12.9%; packaging - 2.7%; and net profit margin - 6.8%. Other administrative type expenses including research and development, warehousing, distribution, logistics and administration, interest and credit provision, royalties and licence fees and product registration costs etc. accounted for the remaining costs. Complete accounting of costs associated with farm chemicals is depicted in Table 5.

The Australian report also concluded that pesticide pricing is not cost based but determined according to what the market will bear given the high proportion of costs accounted for by the active ingredient (this is similar to demand and market segmentation price differentials discussed in Section 2). Farmers in whichever country needing the chemical the most and exhibiting a higher willingness to pay, are charged the highest prices.

Table 5: Composition of Costs Associated with the Supply of Farm Chemicals

Cost Category	Percent of Ex-Factory Sale Price	
	Local	Imported
Active ingredient/Cost of formulated import	55.2	59.9
Operating expenses	1.0	0.0
Other manufacturing costs	6.3	2.2
National R&D component	1.8	0.3
Packaging	2.7	1.8
Marketing/Sales	12.9	10.7
Warehousing	1.1	2.4
Distribution	2.5	2.0
Logistics and admin	5.2	4.3
Interest and credit provision	1.6	1.1
Royalties, license fees, etc.	0.6	1.6
Maintenance of registration on active	1.4	2.3
Other costs (rebate)	1.0	0.1
Net profit margin	6.8	5.7
Total (ex factory sale price)	**100.00**	**100.00**

Source: Prices Surveillance Authority, 1993

3.4 Reasons For Pesticide Price Differences

This portion of the report attempts to rationalize why pesticide price differences occur in the selected study area i.e. the prairie provinces of Canada and North Dakota/Minnesota, for certain products. A questionnaire was mailed to the various pesticide manufacturers asking for insights into the pricing of their products but unfortunately few responses were received. Hence, most of the text below is based on theory and discussions with individuals having experience in these markets.

To see a copy of the questionnaire refer to Appendix 4.

It is important to note that not all pesticides are priced differently in the two different markets. As an example of similar prices, the Canadian dollar price of the herbicide Banvel is shown in Figure 8 for Manitoba and for North Dakota/Minnesota (Thomsen, 1999). We might expect prices to be similar for Banvel in the U.S. and Canada even without trade because there are many substitute products in both countries, it is off patent, and it has been available for a long period of time. Each of these factors is associated with a high degree of competition similar to the existence of arbitrage opportunities discussed in the general theory section.

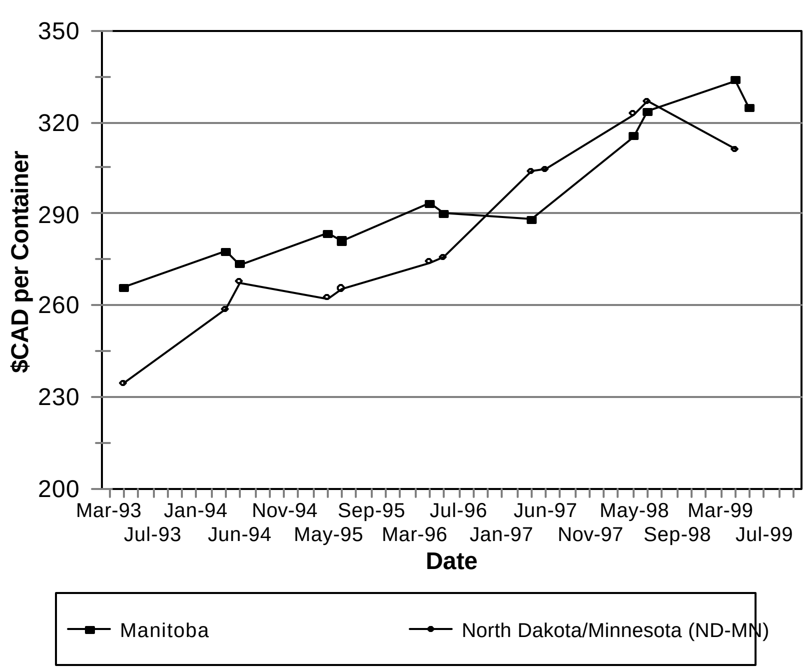


Figure 8 Manitoba vs. North Dakota/Minnesota Banvel Price

3.4.1 Demand Generated Price Differentials

Recall from theory that demand generated price differentials can be explained by differences in: the willingness to pay, the potential crop yield without use of the pesticide, potential crop savings, and the price and availability of pest control substitutes. An example of a derived demand price difference would be a higher price paid for a herbicide such as Buctril in a U.S. wheat producing area compared to a Canadian location as a result of a higher weed infestation level in the U.S.. The price of wheat, yield potential, and all other relevant factors are assumed to be equivalent in the two areas so that the only difference is the weed infestation level. Farmers with a higher yield potential without the herbicide, would have a higher willingness to pay for a given pesticide type and quantity.

3.4.2 Production Costs and Small Market Generated Price Differentials

Market size is another factor affecting pesticide pricing patterns. In small acreage crops where economies of size can't be obtained, normally it would be expected that pesticide prices would be higher. Indeed this seems to be the case with several insecticides and fungicides since they tend to be lower priced in the much larger U.S. market which can use these products on several crops.

3.4.3 Market Segmentation Generated Price Differentials

From reviewing the list of products gathered in the Thomsen report it was difficult to determine if market segmented price differentials exist. Perhaps it occurs in some of the smaller market crops that rely heavily on insecticides and fungicides for production. In these crop situations it is possible for one country to have only one or two effective products registered while the other country has several, thus in the country with only one or two products available, the price is higher. However with regard to the 4 crops of wheat, barley, canola and potatoes there did not appear to be any obvious products exhibiting this kind of behaviour.

3.4.4 Patent Status and Registration Generated Price Differentials

Typically, when a product is on patent protection (designed to allow manufacturers to recoup original investment costs) prices are higher. From the list of products reviewed, a good example of this occurring might be the product Roundup Original which is off patent in Canada but still on patent in the U.S. until the fall of 2000. The price of Roundup Original in Canada is generally 40 to 50% less than in the U.S. as reported by the various pesticide price surveys. A comprehensive list of pesticide patent dates was not made to see if other examples of uneven patent protection exist for the main products used to grow wheat, barley, canola and potatoes.

3.4.5 Other Reasons for Pesticide Price Differentials

Another reason why specific pesticide groups might have different prices in Canada than in the U.S. is the availability of substitutes (this is a combination of the factors listed above). In the U.S. a product may only have registration for wheat and barley whereas in Canada, the same product may be registered in wheat, barley, canola, flax and sunflowers. Thus in Canada, there can be more chemical substitutes for the various large acreage crops than in the U.S. which may have the product only registered on 1 or 2 crops. Typically, market size and value of pest control determines additional crop registrations. See Appendix 2 for overview of World, U.S. and Canadian pesticide markets.

It is important to recognize that in-season exchange rate changes generally have little impact on pesticides prices. Normally, pesticide prices are set in the spring and change very little throughout the growing season regardless of fluctuations in exchange rate. Year to year exchange rate changes can alter pesticide prices if the active ingredient or the formulation takes place in another country and there has been a currency correction in either the country of origin or the importing country. As was shown in the Australian report the cost of pesticide active ingredients normally represents about 55 to 60% of the final cost of bringing the product into the market place.

Differences in registration costs between the U.S. and Canada were not analyzed to determine any potential impact on pesticide pricing. Product availability is discussed in the next section of the report.

4.0 PESTICIDE MARKET SHARES IN STUDY AREAS

This section of the report discusses pesticide availability and herbicide market share data for the four study crops i.e. wheat, barley, canola, and potatoes, for the two study areas i.e. 3 prairie provinces in Canada and the two U.S. states of North Dakota and Minnesota. Herbicides are the only pesticide type considered in this section because they constitute the bulk of the chemical cost in growing wheat, barley, and canola. This rationale may not hold true for potatoes because of the heavy reliance on fungicides and insecticides needed to grow this crop. This section also describes why herbicide market shares differ between geographic regions.

4.1 Pesticide Availability in the U.S. and Canada

The two study areas have separate pesticide regulatory systems. Pesticide registrations do not occur simultaneously in both study areas and consequently short-term or long-term availability differences can occur. A complete listing of pesticides registered for use by crop in the U.S. and Canada is given in Appendix 5. A summary of the information supplied in Appendix 5 is provided in Table 6. The information supplied in this Appendix was supplied jointly by the Environmental Protection Agency and the Pest Management Regulatory Agency and represent the registration status as of April 20,1999. In each of the four crops there are products not registered in the U.S. that are registered in Canada and vice versa. The crop with the highest number of pesticides not registered in the U.S. is canola. Some notable products not registered in the U.S. but yet are important to canola production are Lorsban and Furadan. Some other recent examples of uneven pesticide availability include the product Admire used in potato production. Until this year the product was registered in North Dakota but not in Manitoba. Other pesticides available in North Dakota prior to Manitoba include: Prism; Prowl; and the seed treatments Maxim and Simcoat.

Table 6 : Summary of Pesticides Registered for Use in Wheat, Barley, Canola and Potatoes

	Crop	Type of Herbicide	# of Pesticides	# Not Reg'd in Canada	# Not Reg'd in U.S.	Not Reg'd in Canada but Significant[1]	Not Reg'd in U.S. but Significant
(i)	Wheat	Herbicides	54	16	11	2	5
		Insecticides	36	24	3	10	3
		Fungicides	35	25	4	11	2
(ii)	Barley	Herbicides	35	4	7	2	1
		Insecticides	31	14	6	7	6
		Fungicides	18	9	4	4	4
(iii)	Canola	Herbicides	28	1	21	1	14
		Insecticides	18	3	14	2	14
		Fungicides	17	3	13	2	13
(iv)	Potatoes	Herbicides	20	2	3	2	3
		Insecticides	27	--	--	--	--
		Fungicides	17	--	--	--	--

[1] Significance rating is based on industry recommendations

Table 7 looks at whether pesticides with large market share used in Manitoba are available to North Dakota growers and vice versa. The registration of pesticide products is in constant flux. Thus, there may be products listed as not registered (April 20, 1999) which have now become registered. Further this table does not account for the Section 18 registrations received for several canola pesticides in North Dakota. Still, this table clearly illustrates the difference in terms of the pesticide products which companies have chosen to register in the two locations. In general, pesticides having large market share are available in each location with the notable exception of canola. With this crop, clearly North Dakota has fewer of the large volume pesticides registered. Specific Manitoba pesticides used in canola production but yet are not registered in North Dakota are: Roundup Original, Muster, Select, Furadan, Lorsban, and Benlate - Toss N Go. However, it should be recognized that many of these products have Section 18 registrations, and Roundup Ultra received full registration in 1999 for use in canola. Pesticides receiving recent registration in North Dakota are: 1998 - Express, Assert, and Harmony Extra; 1999 - Puma and Acclaim for wheat and barley. Specific canola pesticide products receiving Section 18 registrations in North Dakota are: Sonalon; Stinger; Muster; Herbicide 273; Liberty; Raptor; and the insecticide Warrior. The Section 18 for Muster is only for seed canola. In 1998, pesticide use data reports the following acres treated with Section 18 products in North Dakota for canola: Warrior - 5,000; Stinger - 56,000; Ronilan - 12,300 and Muster - 3,927.

From reviewing pesticide registrations it would appear that the two locations of Manitoba and North Dakota have similar access to pesticides frequently used in the production of wheat, barley, and potatoes. The canola crop in North Dakota is limited in the number of pesticides registered for use in this state. However, producers do have access to many of the products used in Manitoba canola production through Section 18 registration. This general comment on availability may not be true for different production systems and market niches i.e. irrigated and Durum wheat. For different production systems and higher valued niches that are more likely to use newer technology, a year or two difference in registration timing can impact on individual growers desiring a specific pesticide for production. Still on average, the evidence suggests availability of pesticides for use in the production of the four study crops in either location is not a critical problem.

It should also be noted that the Canadian and U.S. regulatory environment has a significant impact on the availability of new pesticide technology to producers and can weaken a country's competitive position by increasing production costs, reducing yield potential, or restricting crop mix. To register a new active ingredient in Canada, estimated registration costs are in the range of $2 million and this cost has been increasing over time. Canada has approximately 5 crops (wheat, barley, canola, corn, and soybeans) with a significantly large pesticide market potential to justify this expenditure (Appendix 2). Many smaller markets are not significantly large enough to warrant these costs and consequently pesticide registration may not be pursued for these markets. In the U.S. (1/3rd of the global pesticide market), crops of major interest to manufacturers usually are the larger acreage ones like corn and soybeans or the higher valued crops such as cotton and peanuts. There has been much discussion between Canada and the U.S. over possible ways to harmonize the registration of pesticides in both countries.

Table 7: Availability of Large Market Share Pesticides in North Dakota and Manitoba

Crop	Top Products In Manitoba	Top Products In North Dakota	Manitoba Product Available in North Dakota	North Dakota Product Available in Manitoba
Wheat				
(i) Herbicides	Refine Extra	2,4-D	Y	Y
	Puma	MCPA	N	Y
	Horizon	Banvel	N	Y
	Buctril M	Bronate	Y	Y
	Estaprop		Y	Y
(ii) Insecticides	Lorsban	Lorsban	Y	Y
	Cygon	Cygon	Y	Y
(iii) Fungicide	Tilt	Tilt	Y	Y
Barley				
(i) Herbicides	Buctril M	2,4-D	Y	Y
	Achieve Extra	MCPA	Y	Y
	Estaprop	Express	N	Y
	Refine Extra	Banvel	Y	Y
	Achieve 80 PG	Treflan	Y	Y
(ii) Insecticides	Lorsban	Lorsban	Y	Y
	Cygon	Cygon	Y	Y
(iii) Fungicide	Tilt	Tilt	Y	Y
Canola				
(i) Herbicides	Roundup Original	Poast	N	Y
	Liberty*	Treflan	Y	Y
	Muster*	Assure II	N	Y
	Select	Sonalon*	N	Y
	Poast Ultra	Stinger*	Y	Y
(ii) Insecticides	Furadan	Furadan	N	Y
	Lorsban	Lorsban	N	Y
(iii) Fungicide	Benlate - Toss N Go	Benlate	N	Y
Potatoes				
(i) Herbicides	Sencor 75	Sencor 75 DF	Y	Y
	Lorox/Afolan	Pendulum	Y	N
	Gramoxone	Diquat	Y	Y
	Roundup Original	--	Y	N
	Prism	--	Y	Y
(ii) Insecticides	Admire	Admire	Y	Y
	Furadan	Furadan	Y	Y
	Thiodan	Thiodan	Y	Y
(iii) Fungicide	Dithane DG	Dithane DG	Y	Y
	Bravo	Bravo	Y	Y

Note: Product Registrations were as of April 20, 1999 and do not include Special Section 18 Registrations. Products denoted by asterisk have Section 18 registration.

4.2 Manitoba, Saskatchewan, and Alberta Herbicide Market Shares by Crop for 1997 & 1998

The information used to develop Table 8 has been collected by Criterion Research Corporation and Stratus Agri-Marketing. The data is purchased by pesticide sellers and is considered statistically accurate on an individual product basis. The data is based on a random sample of farms and is collected on a per acre treated basis. Table 8 displays the % of total acres treated by herbicide product for wheat, canola, barley and potatoes in the prairie provinces of Manitoba, Saskatchewan and Alberta. From Table 8 it can be seen that the market share of the various herbicide products varies greatly between provinces. Saskatchewan tends to use larger volumes of low cost per acre herbicides than Manitoba and Alberta. For example in wheat production, 2,4-D treated 14.4% of treated acres in Saskatchewan whereas in Manitoba 2,4-D was only used on 1.6% of the treated wheat acreage for the 1997 - 1998 time period. The exact reasons for different herbicide market shares is uncertain, however yield potential is one possible reason. Saskatchewan yields tend to be lower than those in Manitoba, many areas in the south are semi-arid i.e. low rainfall, thus farmers tend to practice low input farming and are generally thought to be conservative in their spending habits. To see the variance in provincial average yields by crop see Appendix 3.

With the crop of canola, the relative market share of the various herbicides varies between provinces but herbicide ranking tends to remain the same. The exception to this statement is the herbicide Muster which in Manitoba is ranked 3rd (market share of 12.46%) whereas in Saskatchewan, Muster is ranked 5th (market share of 6.85%).

The herbicides used for weed control in wheat tend to be similar to those used in barley, however the ranking of herbicide preference is usually different between provinces. For example in Manitoba, the herbicide Refine Extra has a market share of 7.54% (of total treated acres) but in Alberta this product has 13.34% market share.

Table 8: Herbicide Market Shares in Alberta, Saskatchewan and Manitoba for 1997-1998 (% of Total Acres Treated)

	Crop	Province & Product	% Treated Acres	Province & Product	% Treated Acres	Province & Product	% Treated Acres
(i)	**Wheat**	**Manitoba**	**%**	**Saskatchewan**	**%**	**Alberta**	%
		Refine Extra	12.76	2,4-D	14.43	Horizon	11.16
		Puma	12.47	Roundup	10.80	Refine Extra	9.46
		Horizon	9.86	Buctril M	9.72	Roundup	9.10
		Estaprop	9.65	Puma	9.47	2,4-D	7.52
		Buctril M	8.41	Horizon	6.94	Buctril M	5.88
(ii)	**Barley**	**Manitoba**		**Saskatchewan**		**Alberta**	
		Achieve	11.22	Roundup	11.63	Refine Extra	13.34
		Estaprop	9.85	2,4-D	11.55	Assert	10.59
		Achieve Extra	9.61	Buctril M	9.47	Achieve Extra	9.42
		Champion Plus	8.76	Achieve Extra	8.28	MCPA	9.31
		Refine Extra	7.54	MCPA	7.87	Roundup	8.60
(iii)	**Canola**	**Manitoba**		**Saskatchewan**		**Alberta**	
		Roundup	15.21	Roundup	19.64	Roundup	14.33
		Liberty	13.11	Liberty	11.77	Poast	12.38
		Muster	12.46	Poast	10.34	Lontrel	9.51
		Poast	10.38	Edge	8.83	Liberty	9.05
		Edge	8.90	Muster	6.85	Muster	8.60
(iv)	**Potatoes**	**Manitoba/Alberta**					
		Lexone/Sencor	32.05				
		Lorox/Afolan	13.45				
		Gramoxone	13.00				
		Roundup	11.85				
		Prism	6.85				

Source: Criterion Research Corporation and Industry Analysts

In summary, herbicide market shares vary greatly between Canadian prairie provinces with Manitoba frequently using greater amounts of more expensive herbicides on a per acre treated basis. Given that it is unlikely that pesticide prices vary greatly between provinces (McEwan and Deen, 1997), it is hypothesized that some of the difference in herbicide selection is driven by yield differences between provinces which translates into less revenue to pay for higher priced herbicide products. The real or perceived value of the pesticides in Saskatchewan is less than in other higher yielding regions of the prairies as seen by use of lower cost pesticides on a per acre treated basis.

4.3 North Dakota and Minnesota Herbicide Market Shares

1996 market shares of herbicides used in North Dakota are given in Table 9. The reported % planted acres treated are ones that have received one or more herbicide applications. Herbicides applied as a tank mixture were totaled separately unless a commercial premix was used. Thus, acres treated can exceed 100% of the planted acres.

Herbicide market shares for Minnesota are from the National Agricultural Statistics Service and are averages of 1995 and 1997. Data was only available for spring wheat and potatoes. Principal market shares in the wheat crop were: MCPA - 62%; 2,4-D - 43%; Harmony - 39%; and Fenoxaprop in various forms (Cheyenne, Dakota, Accent) - 44%. Potato market shares for common herbicides are: Diquat - 70%; Lorox - 10%; Dual - 9%; and Poast - 9%.

The specific ranking of the top 4 or 5 herbicides by crop in 1996 for North Dakota was: (i) wheat - 2,4-D, Banvel, MCPA and Express; (ii) barley - 2,4-D, MCPA, Express, Banvel, and Treflan; (iii) canola - Poast, Treflan, Assure II, Sonalon, and Stinger; (iv) potatoes - Diquat, Poast, Prowl, Matrix, and Sencor. These herbicide market shares are expected to vary by state similar to changes found between Canadian provinces. Thus, states with higher yielding crops are more likely to use higher priced herbicides. This seems to hold true, for when 1997 National Agricultural Statistics data is reviewed for the state of Minnesota, greater amounts of the higher priced herbicides Far Go (8.51% of treated acres) and Roundup (5.48% of treated acres) are used. The Minnesota two year average wheat yield is 37 bu/acre while North Dakota has an average wheat yield of 27.5 bu/acre.

In North Dakota and Minnesota for wheat and barley production, low cost per acre treated products tend to have the largest market shares e.g. 2,4-D, Banvel, and MCPA. Given the recent movement into canola production in North Dakota (1992 - 21,400 acres; 1997 - 480,000 acres) and the lack of specific canola pesticides until recently, it is not surprising that Poast and Treflan have the largest market share (44.8% and 34.9% respectively) on a per acre treated basis. Herbicides used for weed control in wheat also tend to be used heavily in barley production.

In 1996, 2,4-D is reported to have treated almost 50% of the North Dakota wheat and barley crops. For the wheat crop, MCPA was applied to 16% of the acres in 1996, compared to 19% in 1992, and to 28% in 1989. Dicamba was applied to 29% of the acres in 1996, compared to 26% of the acres in 1992, and 22% in 1989. Trifluralin was applied to 8 % of the wheat acreage in 1996 compared to 12% in 1992 while wheat acreage treated with sulfonylurea type herbicides (e.g. Harmony and Express) was 32% in 1996 and was greater than the approximately 21% in 1992. Insecticides were applied on 4% of the wheat acreage in 1996.

MCPA was applied to 23% of the North Dakota barley acreage in 1996 which was the same as in 1992. Sulfonylurea herbicides were applied to 30% of the barley acreage and trifluralin to 8%. Insecticides were applied to an estimated .8% of the acres. It is interesting to note that in the potato crop, there would appear to be strong competition between Sencor, Prowl, Matrix and Poast with each having similar market share at about 13 to 15%. Potato acres were treated with twelve different insecticides. Cabofuran (Furadan) was applied to 108% of the acres and was the most frequently used insecticide.

Table 9: Herbicide Market Shares in North Dakota by Crop Type for 1996 (% Planted Acres Treated)

Wheat	% Planted Acres Treated 1996	Canola	% Planted Acres Treated 1996	Barley	% Planted Acres Treated 1996	Potato	% Planted Acres Treated 1996
2,4-D	49.8	Stinger	1.6	2,4-D	45.3	Roundup Ultra	9.5
Banvel	28.9	Sonalon	2.9	Banvel	7.2	Sencor	11.6
MCPA	15.8	Assure II	3.8	MCPA	22.5	Prowl	15.4
Express	13.1	Poast	44.8	Express	17.3	Matrix 25DF	13.5
Bronate	–	Treflan	34.9	Treflan	6.7	Poast	15.3
Treflan	–					Diquat	35.6
						Treflan	6.2

Source: Pesticide Use and Pest Management Practices for Major Crops in North Dakota, 1996

4.4 Why Do Herbicide Market Shares Differ Between Study Areas

There are many reasons why the herbicide market shares vary between study areas. Reasons for variation across study areas are similar to some of the reasons already discussed for variation within a study area. Possible reasons include: crop yield potential; pesticide cost; crop safety; residue carry over; specific weed problems; soil types; product availability; crop production practices; and the amount of non-pesticide farm procedures and methods used.

Typical non-pesticide farm procedures and methods used in North Dakota and their frequency of use are: crop rotation - 76%; summer fallow - 42.3%; row crop cultivation - 40.5%; rotary hoe - 38%; and variety selection - 57%. Similar data is not available for the 3 Canadian prairie provinces, however it is known that the use of summer fallow is quite common in Saskatchewan and typically practiced on about 1/3rd of the workable acres. Further, producers in each of the 3 Canadian prairie provinces tend to practice crop rotation with a normal rotation of cereals followed up by an oilseed crop. These potential differences in management practices and producer preferences between the two study jurisdictions all have a cumulative effect on why the herbicides used in each region differ.

With respect to the canola crop and why herbicide market shares differ between Manitoba and North Dakota, it is important to realize that canola is a relatively new crop in the northern tier U.S. states. Thus one would anticipate that with canola acreage doubling almost every year in North Dakota and with the availability of Section 18 products, that herbicide market share data will look considerably different in a couple of years.

The herbicide bundles used in North Dakota tend to be more similar to bundles used by Saskatchewan producers than Manitoba producers. Both North Dakota and Saskatchewan producers more frequently use low cost per acre pesticide treatments. Yield potential appears to be one reason on the large acreage crops of wheat, barley and canola.

Weed species, pesticide distribution, farm size and structure were discussed with various state and provincial weed specialists, farm groups, and farm supply dealers and it was determined these were similar in the two study regions. In North Dakota the main weed problems reported were: wild oats; green/yellow foxtails; kochia; Canada thistle, bind weed and twitch grass. Specialists in Manitoba concurred that these were their main weed problems as well. Likewise the distribution network from the manufacturer to the farmer was thought to be similar thus providing little evidence as to why pesticide market shares would be so different between North Dakota and Manitoba. Farms on both sides of the border were approximately the same size thus intuitively, it is expected that producer purchasing power should be similar as well. Typically, retailer margins for pesticide sales are 5% to 15% depending on the specific pesticide product. Also, anecdotal evidence suggests that there is strong dealer competition present on both sides of the border i.e. large number of dealers on both sides of the border for producers to buy pesticides from.

5.0 IMPLICATIONS OF PESTICIDE PRICES AND MARKET SHARES

This section of the report discusses existing herbicide costs per acre treated, compares herbicide program costs, and potential savings buying lower priced pesticides. In addition, state and provincial budgets are reviewed to put pesticide costs into context within the total cost of production for each crop. Be aware, the expenditure per acre treated calculations have several limitations and represent no individual producer.

5.1 Procedures for Comparing Costs Per Acre

In order to analyse the impacts of different pesticide prices between North Dakota and Manitoba the four study crops of wheat, barley, canola and potatoes were used. Pesticide market share information was obtained from multiple sources. In North Dakota, the Pesticide Use and Pest Management Practices for Major Crops in North Dakota 1996 was used while for Manitoba, 1997 and 1998 market survey information completed by Criterion Research Corp. and Stratus Agri-Marketing were used. It should be noted that the Canadian data available for potatoes represents only the two provinces of Alberta and Manitoba. Saskatchewan normally only grows 5,000 to 7,000 acres of potatoes and hence market share data is not collected for this province. The 1997 National Agricultural Statistical Service market share data was available, but unfortunately only for spring wheat and potatoes. Industry specialists suggested there would be little change in market shares between years and thought the 1996 North Dakota data was most complete. It should be noted that the pesticide market share information really hadn't changed much from 1992.

The North Dakota Agricultural Statistical Service participated in the design of the survey and was in charge of printing and mailing the survey, telephone follow-up of non-respondents, and summarization and analysis of the survey results. A sample of about 4,000 farm operators reported acres treated by crop for the general pesticide categories to the North Dakota Agricultural Statistics Service. To see the market share by pesticide product for the various crops in North Dakota and Manitoba refer back to Tables 8 and 9. Recall Table 8 is the % of total treated acres whereas Table 9 is % of planted acres treated. The information from Tables 8 and 9 were used to determine acres treated by product to provide a consistent comparison between the 2 regions.

Pesticide prices used in the analysis came mainly from the Thomsen report, however, occasionally prices from the North Dakota and Manitoba weed guide books had to be used if the Thomsen report lacked a particular pesticide price. The prices used from these weed guide books are the manufacturers' suggested retail price. Pesticide application rates were standardized in the two different jurisdictions and verified by state and provincial weed specialists. A listing of chemical rates, prices and market shares used in the analysis can be seen in Appendix 6. Not all the products listed in Appendix 6 e.g. insecticides and fungicides, were used in the per acre treatment cost calculations. The exchange rates used to convert 1997 and 1998 Canadian prices to U.S. dollars were 1.3843 and 1.4831 respectively. These values are the average daily noon hour rates supplied by the Bank of Canada for 251 days. The expenditures per acre presented in the analysis do not include minor use herbicide products, application costs, or other weed management costs such as mechanical weeding. License fees and common additive materials have been included into the calculated costs per acre.

It is important to realize some of the limitations of this analysis. Firstly, only pesticide market share information for 1996 was available for North Dakota. There was 1997 National Agricultural Statistical Service market share pesticide data for the crops of potatoes and spring wheat, but to have consistency the 1996 North Dakota Pesticide Use and Pest Management Practices guide was used. When the 1997 NASS data was used results were similar to those found using the 1996 North Dakota data. The second limitation of the analysis is having to use multiple sources for the pricing data. While the Thomsen report was the main source of the data, pesticide prices were obtained from weed guide books to complete the analysis. The third limitation is that fungicides and insecticides are not included in the analysis. In Canada for the crops of wheat, barley, and canola market share information was simply not available for these two pesticide types. The fourth limitation is for the crop of spring wheat, higher valued specialty wheats that may use different or more expensive pesticides have not been split out of the wheat budgets. Rather these wheat varieties have been lumped in with the general wheat numbers presented. The data to compare pesticide costs between wheat varieties is not kept. Fifthly, herbicides with smaller market shares on a per acre treated basis have been left out of the analysis and only the top 4 or 5 products have been used in the North Dakota calculation, whereas Manitoba had products with smaller market shares frequently left in. This can cause the overall cost per acre treated to be underestimated because some small market products may have high costs on a per acre basis.

Despite these limitations to the analysis, the results generated do serve as approximate indicators of producer expenditures on chemicals for the four study crops on a per acre treated basis.

5.2 Existing Expenditures Per Acre in North Dakota, Manitoba and Saskatchewan for Herbicides - 1997 & 1998

Table 10 depicts the estimated expenditure on herbicides for the four study crops in the locations of Manitoba and North Dakota. Based on 1997 and 1998 pesticide market shares and prices for Manitoba, the average cost/treated acre on pesticides for wheat, barley, Canola and potatoes was US$7.65, US$8.42, US$12.57, and US$21.02 respectively. Using the 1996 market share information and 1997 and 1998 prices, producers in North Dakota spent US$2.53, US$3.13, US$8.92, and US$16.24 on herbicide treatments in the four study crops. This means on average, producers in Manitoba spent US$5.12/acre, US$5.29, US$3.65 and US$4.78 more on herbicide control than those in North Dakota for the crops of wheat, barley, canola and potatoes. It should be recognized that these state and provincial cost estimates represent no one individual producer since it is highly unlikely that a wheat grower in North Dakota would spray his crop with a combination of 2,4-D, Banvel, MCPA, Express and Bronate. However, these expenditures represent best estimates for the two study regions.

Table 10: Estimated Expenditure on Herbicides by Crop in Manitoba and North Dakota for 1997 and 1998

	Crop	Location	Year	Treated Crop Acres	Average Cost/Acre 1997/98 US$	Avg Diff Between Manitoba & North Dakota US$/Acre	Avg Difference as a Percent
(i)	**Wheat**	Manitoba	1997	5,152,758			
			1998	4,190,669	7.65		
		North Dakota	1997	13,642,700			
			1998	13,642,700	2.53	5.12	202
(ii)	**Barley**	Manitoba	1997	1,466,390			
			1998	1,333,736	8.42		
		North Dakota	1997	2,623,900			
			1998	2,623,900	3.13	5.29	169
(iii)	**Canola**	Manitoba	1997	2,926,080			
			1998	2,902,219	12.57		
		North Dakota	1997	168,400			
			1998	168,400	8.92	3.65	41
(iv)	**Potatoes**	Manitoba	1997	133,175	21.02		
			1998	129,360			
		North Dakota	1997	135,200	16.24		
			1998	135,200		4.78	29

These results are somewhat surprising given that the Thomsen price data showed that for many similar pesticide products, prices were cheaper in Manitoba. The main reason for this difference in cost per acre between North Dakota and Manitoba is that the bundles of frequently used pesticides in the two regions tend to be different. It is more typical for North Dakota farmers to use low cost per acre herbicides while producers in Manitoba use higher priced ones. As stated earlier, there can be many reasons for this difference in pesticide use. However, usually crop yields tend to be higher in Manitoba for the four study crops selected to analyse differences in per acre pesticide costs. Average wheat yields in North Dakota for 1996 and 1997 are 27.5 bu/acre while Manitoba average yields for a similar time period are 35 bu/acre or 7.5 bushels higher. This extra yield represents additional revenue for Manitoba producers thus increasing the likelihood of purchasing more weed control. The same arguments can be made for barley and canola with Manitoba yields being 10 bu/acre higher in barley and 2.8 bu/acre for canola. Average potato yields tended to be slightly higher in North Dakota than those found in Manitoba.

Table 11 was completed to illustrate the difference in pesticide use between provinces and to show how the difference in pesticide expenditure on a per acre basis narrows when Saskatchewan is compared to North Dakota. Average pesticide costs in Saskatchewan for the crops of wheat, barley, and canola were US$5.80, US$6.97, and US$12.76 respectively (market share data for potatoes grown in Saskatchewan was unavailable). Thus producers in Saskatchewan spend less money on herbicides than those in Manitoba and fall more in line with the expenditures made in North Dakota. However, there is still about a US$3-4/acre difference in wheat chemical costs with North Dakota spending less. The fact that expenditures in North Dakota and Saskatchewan align better makes intuitive sense given that yield potentials are similar. Additionally, there is likely to be more use of non-chemical weed control in the lower yield areas of North Dakota and Saskatchewan. If 6 year average yields are compared between Manitoba and North Dakota, the yield advantage for Manitoba decreases to 3 bu./acre for wheat, 6 bu./acre for barley, 0 bu./acre for canola and -33 cwt./acre for potatoes. 6 year average yields between Manitoba and Minnesota tend to be very similar except in potatoes with Minnesota yields being higher. This longer time frame deflates somewhat the argument of higher yields therefore higher pesticide expenditures.

Table 11: Estimated Expenditure on Herbicides by Crop in Saskatchewan and North Dakota for 1997 and 1998

	Crop	Location	Year	Treated Crop Acres	Average Cost/Acre 1997/1998 US$	Avg Diff Between Sask and North Dakota 1997/1998
(i)	**Wheat**	Saskatchewan	1997	19,320,292		
			1998	11,084,848	5.80	
		North Dakota	1997	13,642,700		
			1998	13,642,700	2.53	3.27
(ii)	**Barley**	Saskatchewan	1997	4,974,593		
					6.97	3.84

			1998	4,336,014		
		North Dakota	1997	2,623,900		
			1998	2,623,900	3.13	
(iii)	**Canola**	Saskatchewan	1997	5,463,540	12.76	
			1998	6,384,602		
		North Dakota	1997	168,400	8.92	
			1998	168,400		3.84
(iv)	**Potatoes - no data available for Saskatchewan**					

5.3 Expenditures by Herbicide Program and Crop

To compare what impact different pesticide prices would have on a per acre basis between North Dakota and Manitoba similar pesticide products were used and the results are depicted in Table 12. Application rates have been adjusted so that similar amounts of active ingredients are being sprayed per acre. In general, the product to product comparisons show that on a per acre basis, costs were either the same or lower in Manitoba. Product comparisons that were noticeably higher in North Dakota were Bronate, Achieve, Poast, Roundup, and Stinger. It is interesting to observe that several of the larger market share herbicides exhibit little difference in cost and examples include: 2,4-D, Banvel, MCPA, and Treflan. The one product that North Dakota appears to have a cost advantage in is Sencor which is a frequently used potato herbicide. These results are not surprising given the previous discussion on the Thomsen price data.

Table 12: Comparisons of Cost Per Acre on Selected Pesticide Products[1]

	Crop	Manitoba vs North Dakota Comparison Products[2]	$US/Acre 1997 Diff	$US/Acre 1998 Diff	Cost Rating[3]
(i)	Wheat	2,4-D Amine vs 2,4-D Amine	-0.27	-0.54	same
		Buctril M vs Bronate	-4.33	-3.96	MB lower
		Puma vs Puma	na	-5.06	MB lower
		Assert 300 vs Assert 2.5S	1.11	-1.57	MB lower
		Banvel vs Banvel	-0.12	-0.02	same
		Refine Extra vs Harmony Extra	0.99	0.97	same
		MCPA vs MCPA	-0.36	-0.33	same
(ii)	Barley	2,4-D vs 2,4-D	-0.27	-0.54	same
		Buctril M vs Bronate	-1.87	-1.69	MB lower
		Puma vs Puma	na	-5.06	MB lower
		Assert 300 vs Assert 2.5S	1.11	-1.57	MB lower
		Banvel vs Banvel	-0.12	-0.02	same
		Refine Extra vs Harmony Extra	0.86	0.85	same
		Achieve 80DG vs Achieve 40DG	-4.28	-3.85	MB lower
		MCPA vs MCPA	-0.36	-0.33	same
(iii)	Canola	Poast Ultra vs Poast	-0.13	-0.86	same
		Treflan vs Treflan	0.67	0.27	same
		Lontrel vs Stinger	-6.29	-8.96	MB lower
(iv)	Potatoes	Sencor 75DF vs Sencor 75DF	2.90	-0.19	ND lower
		Poast Ultra vs Poast	-8.00	-8.48	MB lower
		Roundup Original vs Roundup Ultra	-8.01	-11.13	MB lower
		Reglone vs Diquat	-1.82	-3.21	MB lower

Note:

[1] Cost per acre was calculated using the same amount of active ingredient in each jurisdiction. Unit prices were obtained from either the 1999 Thomsen report or the 1999, 1998 North Dakota/Manitoba weed guide books.

[2] Puma was not registered in 1997 and 1998 for the crops of wheat and barley in North Dakota, however, it did receive registration in 1999. Harmony Extra and Express were registered in 1998 in North Dakota.

[3] Cost Rating - is an indication of the significance of cost differences to growers overall cost of production. If the cost per acre was ±$1 in either North Dakota or Manitoba, the cost rating was

assumed to be the same.

Another comparison between North Dakota and Manitoba was performed using product combinations that have similar chemistry or active ingredients. As expected, Manitoba costs per acre treated were usually lower for many of these comparisons. There were two herbicide combinations in which North Dakota was lower priced and they were: canola - Treflan and Poast against Poast and Muster; and potatoes - Sencor and Poast against Sencor and Poast.

5.4 Expenditure Savings if Current Products Bought at Lower Prices Using Current Market Shares

Table 13 attempts to quantify the potential savings that North Dakota or Manitoba farmers could experience if they were able to purchase lower priced pesticides from the other region. Existing pesticide market shares in the two regions have been kept constant. The potential savings, expressed in terms of US$ per acre, of buying lower priced pesticides from the other region is minimal for wheat, barley, and canola. There is some savings i.e. US$3.04, for the North Dakota potato crop. Thus allowing the purchase of current pesticides at the lowest price location i.e. either Manitoba or North Dakota, will not lower overall producer pesticide expenditures very much. The one exception to this statement is for the study crop of potatoes which would see a drop of about 19% in herbicide expenditures in North Dakota. The major assumption used in this analysis is that when producers are given an opportunity to buy lower priced pesticides, existing market shares would remain. It seems more likely producers would alter pesticide market shares somewhat to maximize profit potential.

Table 13: Estimated Impact of Purchasing Lower Priced Pesticides in Either Manitoba or North Dakota Using Existing Market Shares

	Crop	Location	Average Potential Cost/Acre US$	Average Existing Cost/Acre US$	Average Difference Between Existing and Potential Cost/Acre-US $/Acre
(i)	**Wheat**	Manitoba	7.45	7.65	0.20
		North Dakota	2.27	2.53	0.26
(ii)	**Barley**	Manitoba	8.29	8.42	0.13
		North Dakota	2.86	3.13	0.27
(iii)	**Canola**	Manitoba	12.57	12.57	0.00
		North Dakota	8.53	8.92	0.39
(iv)	**Potatoes**	Manitoba	20.45	21.02	0.57
		North Dakota	13.20	16.24	3.04

Note: Existing pesticide market shares were assumed to remain constant

In summary, while pesticides tend to be lower priced in Manitoba than in North Dakota, when existing expenditures are analyzed on a per acre treated basis, Manitoba producers generally have higher expenditures. The exact reasons why are unclear, however the 3 most likely explanations of more frequent use of low priced herbicides in North Dakota are: lower potential crop yield; relative prices of pesticides; and more use of non-chemical weed control. Remember, there are limitations in the analysis and no farmer ever uses all of the comparison products at the same time. It is still possible for individual growers in North Dakota applying higher priced pesticides, to have on a per treated acre basis, chemical costs greater than those found for Manitoba and Saskatchewan.

5.5 State and Provincial Cost of Production Comparisons Using Crop Budgets

In order to gain insights into the relative importance of pesticides in costs of production, various state and provincial crop budgets have been summarized in Table 14. These summaries should be viewed as rough estimates of projected crop costs given historical yields and input costs. There has been no attempt to standardize the various assumptions used to compile each budget such as depreciation and interest charges. It is extremely difficult to compare accurately, detailed cost of production budgets because of different ways of handling all the various crop grades, freight costs and production methods. For example in 1999 with the canola crop, it is estimated that over 70% of the acres grown in the Canadian prairies is genetically modified while only 10 to 15% is in North Dakota. Given these budget methodology weaknesses, surprisingly the expense items only vary moderately between individual states and provinces. The crop having the largest variance in chemical cost between the U.S. and Canada is potatoes. This difference in cost for the two regions can be explained by the different amounts of fungicides and insecticides being used.

Notice however, the large difference in cost for chemicals between these budgets and those based on actual expenditures. For example in the crop budget for wheat in North Dakota, chemicals are estimated to be US$13.35 while the estimated expenditure was US$2.53 per acre. These numbers are not comparable because the values reported in Table 14 are estimated chemical costs on a per planted acre basis not per acre treated.

From scrutinizing the various summarized state and provincial budgets it can be seen that pesticides normally represent 11% to 12% of the total cost of production for wheat and barley; 10% to 15% for canola; and 15% to 18% for potatoes. This is important because the implications are that pesticides are only one of many factors that can affect individual crop profitability. Fertilizer for example, actually represents a larger share of the cost of production and thus can have more impact on profitability than chemicals. Further, potential revenue differences (e.g. proximity to markets) between North Dakota and Manitoba could also impact on overall profitability of the various crops between the two regions.

Table 14 State and Provincial Cost of Production Budgets - (US$ per Acre)

Expense Item	Wheat		Barley		Canola		Potatoes	
	Cda	US	Cda	US	Cda	US	Cda	US
Seed and Treatment	6.85	8.57	5.73	7.63	8.89	20.23	125.33	175
Fertilizer	18.27	17.93	17.85	16.27	22.51	24.43	70.82	86.93
Chemicals	13.49	13.35	12.7	13.03	19.97	14.19	153.01	217.44
Other Variable Costs	40.85	27.18	42.72	28.11	44.28	23.46	487.38	559.38
Total Fixed Costs	29.8	54.43	30.23	58.85	30.32	55.99	159.93	176.84
Total Variable and Fixed Costs	**109.26**	**121.46**	**108.56**	**124.01**	**125.97**	**138.3**	**996.47**	**1215.59**

Source: States used to compile the U.S. budget numbers were: North Dakota, South Dakota, Minnesota, and Wisconsin. Provincial Crop Budgeting Aids from Manitoba, Saskatchewan and Alberta were used to assemble the Canadian numbers.

In conclusion, most of the evidence presented points to higher chemical costs in North Dakota. This evidence includes the Thomsen report and the comparison of pesticide products and programs. However, when average expenditures per acre are calculated, results indicate North Dakota spends less than either Manitoba or Saskatchewan in the four study crops. Despite the limitations in the expenditure per acre calculation, these results seem reasonable given the high frequency of low cost per acre herbicide treatments in North Dakota. For the most part, the reasons why this difference in herbicide expenditure per acre exists is not clear. The three most likely explanations of the more frequent use of low priced herbicides in North Dakota are: relative prices of pesticides; lower yield potential; and more use of non-chemical weed control.

These results do not mean that individual farmers using higher cost pesticide programs in North Dakota are not paying more for chemical control than producers in Manitoba using a similar pesticide program. Lower herbicide expenditures do not necessarily mean lower costs of production or higher profitability in crop production. Pesticides represent about 10-18% of total production costs for the four study crops.

APPENDIX 1

Supplemental Descriptions for the Economic Theory Contained in Section 2

Glossary of Terms

Demand - indicates the quantity of a good that consumers are willing to purchase at any given price. Alternatively, it indicates the maximum price that consumers are willing to pay for any given quantity of a good.

Derived Demand - the demand for a factor input to the production process (for example pesticides in the production of wheat) that results from the level of demand for the final product (wheat).

Marginal Cost (MC) - the additional cost associated with producing (supplying) an additional unit of a good.

Marginal Revenue (MR) - the additional total revenue (the number of units sold multiplied by the price per unit received) associated with increasing the quantity demanded by one unit.

Price Setting Pricing - in a price searching market (a market with few sellers of a product), after determining the best output quantity by equating marginal revenue and marginal cost, the supplier charges the highest price that the consumer is willing to pay for this quantity, which is their marginal willingness to pay as reflected by their individual or identifiable group demand curve. Therefore, the price setter has some control over setting the product price to particular groups or segments of customers.

Market Segmentation and Price Differentiation (Discrimination) - the ability to distinguish between different groups of consumers (usually in terms of their different elasticities of demand) and to charge different prices to different groups in an effort to charge each group the maximum price that they are willing to pay for a good. In terms of pesticide pricing, this market segmentation often occurs by geographic location, but it may differ across crops or groups of crops.

Price Elasticity of Demand - the responsiveness of the quantity demanded of a good to a change in the price of the good. Mathematically, it is defined as the % change in the quantity demanded divided by the % change in the price for the same time periods. The demand for a good is said to be elastic if the change in the quantity demanded is greater in percentage terms than the change in price. This indicates the consumer is very sensitive to price changes in the quantities purchased. The demand for a good is said to be inelastic if the change in quantity demanded is less in percentage terms than the change in price. This indicates that the consumer is not very sensitive in number of units purchased to price changes.

Substitutes - a good is said to be a substitute for another good if it is perceived by the consumer to provide the same qualities or fulfill the same needs as that of the original good. A more detailed discussion of substitutes in pest control will be provided in the next section.

Supply - indicates the quantity of output that a supplier is willing to supply for a given price. Alternatively, it indicates the minimum price that a supplier is willing to accept for supplying a given quantity of output.

Yield Potential - the crop output per unit of land when a particular pest control input (pesticide, crop tillage, etc.) is not used. It reflects the particular long-term soil, pest density, and crop management capital available at a given location.

Substitutes in Pest Control

There exists a variety of pesticide products generated from single or multiple active ingredients due to the different possible formulations. These formulations vary with the following : the concentration level of the active ingredient(s), the combinations of multiple active ingredients, and combinations of active ingredients with other chemicals to enhance the effectiveness of delivery. These different formulations are often required to satisfy the pesticide control demand associated with different crops, climates, soil conditions, and pest combinations.

The availability of these different formulations also provide the farmer with one potential method to replace (substitute away from) a presently employed pesticide that is no longer cost effective or available. Some possible scenarios for this type of substitution would include: (1) two or more products with the same active ingredient but with different brand names and/or manufacturers, (2) two products that share a common active ingredient but with one product containing a second active ingredient, or (3) two products with different active ingredients that control a similar set of pests. The key factor is that the different formulations must all perform the same biological function in pest control (that is reduce crop damage) as the original pesticide to be considered a viable substitute.

In addition to alternate formulations, another possible source of substitution is non-chemical. In many cases, the farmer may be able to alter the mix of inputs used to produce a particular crop. The farmer could use different farming techniques or additional labor and/or capital (equipment) to limit the quantity of pesticides necessary for effective crop production. The ability to undertake this type of substitution is sometimes limited, but it may be particularly relevant in the case of weed control. For example, capital (tractors and other tilling equipment) and/or labor could replace or limit the need for the application of herbicides to control for weeds. For insects and crop diseases effective substitutes include land, different crop varieties that are more pest tolerant, and information to reduce pesticide use per unit of crop yield protected.

The potential use of substitute pest control measures depends on two factors. First, there must exist technological feasibility, particularly with regards to alternative pesticide formulations. There must exist formulations that address the biological needs fulfilled by the pesticide in current use. Even if they exist, these alternative formulations must be made available to the farmer. The registration requirements and patent protection often limit this availability.

Second, these alternative formulations must be economically viable. The search costs associated with obtaining information as to the existence and availability of these alternative formulations may discourage efforts at substitution.

Exchange Rates and the Law of One Price

The exchange rate between the currencies of any two countries is the number of units of one country's currency that it takes to purchase one unit of another country's currency. For example, the exchange rate between the U.S. and Canada is the number of U.S. dollars it takes to purchase one Canadian dollar (or alternatively the number of Canadian dollars it takes to purchase one U.S. dollar). To see the importance of exchange rates, assume that a particular pesticide sells for $ 15.00 (U.S currency) per quart in the U.S., while the same pesticide sells for $ 20.00 (Canadian currency) per quart in Canada. In numerical values, the pesticide would appear to be less expensive in the United States. However, assume that the exchange rate is one-half (.5) U.S. dollar for one Canadian dollar. Therefore, if prices were both denominated in U.S. dollars, the price would be $ 15.00 in the U.S. and $ 10.00 (multiply the 20 Canadian dollar price by .5 U.S. dollars per Canadian dollar) in Canada. When accounting for exchange rates, the price is now lower in Canada. As a result, any meaningful comparison of prices must take into account exchange rates. However, exchange rates move over time.

Exchange rates are determined by the interaction of the demand and supply for foreign currency. Foreign currency is demanded in order to be able to purchase goods from a foreign supplier, and reflects consumer income and other factors. The supply of currency (and all legal tender) is controlled by actions of the central banks of the respective countries. Since the trade in pesticides makes up a very small percentage of total trade between the U.S. and Canada, movements in the exchange rate are determined by factors other than those in the pesticide market. While not determined in the pesticide market, exchange rate movements over time change the relative price of a particular pesticide in the two countries. From the previous example, a decrease in the value (a depreciation) of the U.S. dollar from .5 U.S. dollars for one Canadian dollar to .9 U.S dollars for one Canadian dollar will lead to a new price of $ 18.00 (the 20 Canadian dollar price multiplied by .9 U.S. dollars per Canadian dollar) per quart for the pesticide in Canada. Therefore a depreciation of the U.S. dollar in terms of Canadian dollars will make the pesticide relatively more expensive in Canada. Comparing this $ 18.00 price in Canada to the $15.00 price in the U.S., this may lead to more exports of this pesticide from the U.S. to Canada if this is permitted under the pesticide registration laws.

When including exchange rates, the Law of One Price (see Section 2.1) states that any two identical goods denominated in the same currency must sell for a price that differs only by the transportation costs incurred when shipping goods from one location to another for resale. Factors that prevent or limit this convergence of prices include the following: transportation or other transactions costs that are high enough to discourage arbitrage activities, segmented markets and price setting power that limit the availability of substitutes, and trade barriers that limit the movement of goods across country borders. In the case of pesticides, at least two of these factors are present. In particular, different patent and registration requirements act as trade barriers that impede the flow of pesticides between the U.S. and Canada. While exchange rate movements may change the relative price of a particular pesticide in the two countries, the price differential would disappear (or at least diminish significantly) if these barriers to the arbitrage process were lessened or eliminated.

APPENDIX 2

An Overview of the World, U.S. and Canadian Pesticide Markets

Overview of Pesticide Industry

In 1998, the world pesticide market was valued at about $U.S. 31 billion excluding GMO's (genetically modified organism's) which is a 5% increase from the 1997 level of $U.S. 29.5 billion. In 1998 GMO sales were estimated to be $U.S. 1.6 billion or 5% of the crop protection market, compared to 2.2% in 1997. In real dollar terms, the global agrochemical market value was essentially flat with an increase of only .1% in 1998, following four years of real growth. The regional split of the global pesticide market in 1998 was as follows: North America - 32%; Latin America - 16%; Western Europe - 26%; Eastern Europe - 3%; Far East - 18%; and the rest of the world 5%.

The world pesticide industry is dominated by a relatively small number of manufacturers (about 14) supplying a large number of active ingredients. It is estimated that 9 to 10 of these companies produce 90% of the world's active ingredients. The top 4 ranked manufacturers in terms of sales are: Novartis; Monsanto; Zeneca; and AgrEvo with each having sales over $U.S. 2.5 billion.

The companies are generally vertically integrated since they produce formulations as well as make the basic materials, however, increasingly, the formulation process is tendered out to specialized, large scale, low cost formulators. For many of the manufacturers, the production of agricultural chemicals is only a small part (10 to 15%) of the total economic output from these companies. Most are involved with pharmaceuticals, animal health, nutrition, consumer health, and industrial chemicals.

The crop pesticide industry is undergoing rapid change with increased global rationalization as many companies merge or downsize their infrastructure. Much of this change has been driven by the high cost to research and then develop new technologies. The recent flush of acquisitions that have taken place in the biotechnology and seeds sector over the last two years have generally been driven by the wish to increase access to germplasm for basic research, to expand a company's research capability, or to bring improved marketing capability or market share. At present there are no genetically manipulated small grain cereals on the market, however, this is not the case for several crops such as corn, soybeans, canola, potatoes, and etc. Through biotechnology, genes that control specific functions are being added, modified, or turned off.

U.S. Pesticide Industry

The U.S. is normally ranked 1st with close to 30% of the global market share while Canada typically represents 2 to 3% and ranks 8th or 9th. The U.S. has many large acreage crops and several with high chemical input demands. From a manufacturers perspective, this means the U.S. receives considerable attention and has significant impact when determining new product registrations. U.S. crops normally thought to influence a manufacturer's decision making are: corn, soybeans, cotton, peanuts, and many of the specialty horticulture crops. Market size and product demand are important factors when determining product price, since pesticide pricing is not cost based but determined according to what the market will bear.

Canadian Pesticide Industry

For the time period of January 1, 1997 to December 31, 1997, the Crop Protection Institute of Canada reports total retail sales of pesticides in Canada at $1.430 billion. Annual total sales figures have been increasing. In 1988 industry estimates of market size was $840 million in nominal terms. From Table 15 it can be seen that in terms of total Canadian pesticide sales for the 1997 year, herbicides represent 80.7%; insecticides 7.2%; fungicides 6.7% and specialty products 5.4%. Herbicide product sales for 1997 by region are: 40% in Saskatchewan; 25.8 in Alberta-B.C.; 16.2% in Manitoba; 14.3% in Ontario; 3.6% in Quebec; and less than 1% in Atlantic Canada. In 1997, total sales of herbicides amounted to $1.083 billion with 81.9% of that activity occurring in Western Canada. The West dominates the Canadian market place for herbicide expenditures on many field crops such as wheat - 97.7%; barley 96.6%; and canola and other oilseeds - 98.6% of total sales in 1997. Table 16 provides a more detailed breakdown of the Canadian marketplace in terms of herbicide sales by major crop type.

From a global context, the pesticide industry in Canada is normally thought to be modest in profit potential for a manufacturer. The main reasons for this are: the large acreage crops in Canada (wheat, barley, canola) are grown using extensive agricultural practices i.e. low input use, and thus require modest amounts of pesticides on a per acre basis.

Table 15: Sales Summary of Pest Control Products in Canada - ('000)

	Years Ending December 31				
	1994	1995	1996	1997	% of Total Sales for 1997
Herbicides	825,131	906,008	950,923	1,155,118	81
Insecticides	94,930	114,203	104,239	103,340	7
Fungicides	70,693	73,401	81,463	96,322	7
Specialty Products	65,548	67,795	60,570	76,107	5
Total	1,056,302	1,161,407	1,197,195	1,430,887	100

Notes:
1. Values expressed are at the Manufacturers' Selling Price and should not be compared to prior year reports which were valued at the higher estimated retail prices.
2. Values in the above categories are not comparable to previous reports due to reclassification of some product groups.
3. Specialty Products include Rodenticides, Soil Fumigants/Nematicides, Growth Regulants, Livestock Pesticides and Seed Treatments.

Table 16: Sales of Herbicide Pest Control Products - for the year ending December 31, 1997 ('000)

Products	$ Sales									
	BC/Alta	Sask	Manitoba	% of Total Sales West	Ontario	Quebec	Atlantic	% of Total Sales East	1997 Total	1996 Total
Wheat	118,900	193,664	71,958	98	8,004	797	173	2	393,495	334,937
Barley	66,499	70,453	26,504	97	2,520	2,640	526	3	169,141	139,626
Soy & Field Beans	1,363	604	1,546	4	79,723	12,347	952	96	96,534	76,662
Canola, Mustard/Other Oil Seeds	76,065	121,921	64,465	99	2,766	738	157	1	266,111	197,263
Corn	915	20	385	2	60,014	21,681	497	98	83,512	82,309
Chemfallow	5,265	17,534	928	97	597	99	23	3	24,413	20,506
Others	10,483	28,051	9,226	96	966	874	361	4	49,962	25,256
Sub Total	279,490	432,247	175,011	82	154,589	39,143	2,689	18	1,083,168	876,558
Total Herbicides	**294,118**	**434,453**	**178,051**	**79**	**187,455**	**48,607**	**12,434**	**22**	**1,155,118**	**950,923**

Source: Crop Protection Institute of Canada

APPENDIX 3

Historical Crop Acres Grown by Province and State for The Four Crops of Wheat, Barley, Canola and Potatoes

A1. Production Statistics for Wheat by Year - Canada

Province	Total Acres Harvested (000)	Yield bu/acre	Total Prod'n (000 tons)
1997			
Manitoba	3,880	31.7	3,693.0
Saskatchewan	17,025	28.3	14,338.5
Alberta	6,675	37.9	7,539.0
1996			
Manitoba	4,200	38.3	4,823.9
Saskatchewan	17,950	34.3	18,134.9
Alberta	7,345	39.8	8,586.0
1995			
Manitoba	3,990	31.4	3,752.9
Saskatchewan	15,925	28.8	13,887.1
Alberta	6,725	40.4	8,088.0
1994			
Manitoba	4,095	33.2	4,073.9
Saskatchewan	15,630	29.1	13,321.4
Alberta	6,180	33.8	6,164.9
1993			
Manitoba	4,900	27.3	4,009.4
Saskatchewan	17,895	30.1	16,530.0
Alberta	7,390	39.6	8,399.8
1992			
Manitoba	5,150	41.4	6,402.0
Saskatchewan	20,470	30.3	17,820.0
Alberta	8,045	30.6	6,975.0

Source: Statistics Canada
1997 Manitoba Agriculture Yearbook
Agricultural Statistics 1997, Saskatchewan Agriculture and Food
Alberta Agriculture Statistics Yearbook

A2. Production Statistics for Barley by Year - Canada

Province	Total Acres Harvested (000)	Yield bu/acre	Total Prod'n (000 tons)
	1997		
Manitoba	1,350	57.3	1,857.6
Saskatchewan	4,350	46.3	4,884.0
Alberta	5,600	57.5	7,044.0
	1996		
Manitoba	1,550	62.6	2,328.0
Saskatchewan	4,400	55.3	5,904.0
Alberta	5,800	61.3	7,800.0
	1995		
Manitoba	1,150	53.0	1,464.0
Saskatchewan	4,100	48.3	4,800.0
Alberta	5,150	61.9	6,984.0
	1994		
Manitoba	1,050	58.1	1,464.0
Saskatchewan	3,650	49.3	4,320.0
Alberta	4,900	55.2	6,024.0
	1993		
Manitoba	1,100	51.8	1,368.0
Saskatchewan	3,700	52.7	4,680.0
Alberta	5,100	64.4	6,960.0
	1992		
Manitoba	1,050	68.6	1,728.0
Saskatchewan	2,930	49.5	3,480.0
Alberta	4,800	51.3	5,352.1

Source: Statistics Canada
1997 Manitoba Agriculture Yearbook
Agricultural Statistics 1997, Saskatchewan Agriculture and Food
Alberta Agriculture Statistics Yearbook

A3. Production Statistics for Canola by Year - Canada

Province	Total Acres Harvested (000)	Yield bu/acre	Total Prod'n (000 tons)
	1997		
Manitoba	2,280	27.4	1,562.5
Saskatchewan	5,600	21.0	2,975.0
Alberta	4,000	23.1	2,250.0
	1996		
Manitoba	1,550	30.4	1,177.5
Saskatchewan	3,880	24.9	2,500.0
Alberta	3,150	25.0	1,875.0
	1995		
Manitoba	2,325	23.3	1,352.5
Saskatchewan	6,100	18.7	2,900.0
Alberta	4,450	24.3	2,675.0
	1994		
Manitoba	2,500	26.2	1,637.5
Saskatchewan	6,550	21.4	3,499.9
Alberta	5,000	21.8	2,725.0
	1993		
Manitoba	1,820	22.0	1,000.0
Saskatchewan	4,580	22.9	2,625.0
Alberta	3,650	26.1	2,375.0
	1992		
Manitoba	1,550	28.1	1,087.5
Saskatchewan	3,100	21.0	1,625.0
Alberta	2,850	21.6	1,487.5

Source: Statistics Canada
1997 Manitoba Agriculture Yearbook
Agricultural Statistics 1997, Saskatchewan Agriculture and Food
Alberta Agriculture Statistics Yearbook

A4. Production Statistics for Potatoes by Year - Canada

Province	Total Acres Harvested	Yield cwt/acre	Total Prod'n (000 cwt)
1997			
Manitoba	70,500	210.8	14,863
Saskatchewan	8,500	244.7	2,083
Alberta	30,500	290.0	8,845
1996			
Manitoba	68,500	198.1	13,571
Saskatchewan	6,500	229.3	1,495
Alberta	30,000	315.0	9,451
1995			
Manitoba	60,000	170.7	10,243
Saskatchewan	6,100	229.3	1,402
Alberta	29,500	297.7	8,783
1994			
Manitoba	54,500	216.6	11,807
Saskatchewan	4,800	264.6	1,272
Alberta	29,000	277.8	8,058
1993			
Manitoba	48,000	154.0	7,392
Saskatchewan	4,300	213.8	924
Alberta	27,700	269.0	7,385
1992			
Manitoba	49,000	169.2	8,289
Saskatchewan	4,800	235.9	1,129
Alberta	26,100	230.0	6,003

Footnote: Saskatchewan grows mostly a high quality seed potato.

Source: Statistics Canada
1997 Manitoba Agriculture Yearbook
Agricultural Statistics 1997, Saskatchewan Agriculture and Food
Alberta Agriculture Statistics Yearbook

B1. Production Statistics for Wheat by Year - U.S.

State	Total Acres Harvested (000)	Yield bu/ac	Total Production (000 bu)
	1997		
North Dakota	10,970	24.0	266,540
South Dakota	2,419	28.0	67,713
Minnesota	2,405	32.0	76,970
Wisconsin	7	35.0	245
Montana	4,480	28.8	129,080
	1996		
North Dakota	12,440	31.0	392,880
South Dakota	2,274	36.9	83,970
Minnesota	2,510	42.0	105,430
Wisconsin	10	35.0	350
Montana	4,380	25.9	113,600
	1995		
North Dakota	11,080	27.0	299,160
South Dakota	1,232	28.0	34,496
Minnesota	2,212	32.0	70,760
Wisconsin	8	30.0	240
Montana	4,065	34.7	140,950
	1994		
North Dakota	11,200	32.0	355,150
South Dakota	2,012	25.9	52,078
Minnesota	2,511	28.0	70,275
Wisconsin	9	30.0	270
Montana	3,528	30.0	105,840
	1993		
North Dakota	10,720	31.0	332,320
South Dakota	2,038	27.0	54,972
Minnesota	2,258	31.0	69,990
Wisconsin	10	29.0	290
Montana	2,814	36.8	103,434
	1992		
North Dakota	11,330	40.5	466,940
South Dakota	2,533	33.9	85,992
Minnesota	2,760	50.0	137,970
Wisconsin	21	40.0	840
Montana	2,697	31.1	83,901

Source: USDA - NASS Crops Production Data by States

B2. Production Statistics for Barley by Year - U.S.

State	Total Acres Harvested (000)	Yield bu/ac	Total Production (000 bu)
	1997		
North Dakota	2,250	45.0	101,250
South Dakota	130	38.0	4,940
Minnesota	540	51.0	27,540
Wisconsin	65	55.0	3,575
Montana	1,200	53.0	63,600
	1996		
North Dakota	2,600	55.0	143,000
South Dakota	145	44.0	6,380
Minnesota	520	64.0	33,280
Wisconsin	75	53.0	3,975
Montana	1,200	43.0	51,600
	1995		
North Dakota	2,250	45.0	101,250
South Dakota	160	38.0	6,080
Minnesota	580	50.0	29,000
Wisconsin	72	48.0	3,456
Montana	1,200	52.0	62,400
	1994		
North Dakota	2,400	55.0	132,000
South Dakota	310	42.0	13,020
Minnesota	600	50.0	30,000
Wisconsin	84	53.0	4,452
Montana	1,200	44.0	52,800
	1993		
North Dakota	2,400	49.0	117,600
South Dakota	360	42.0	15,120
Minnesota	650	58.0	37,700
Wisconsin	70	46.0	3,220
Montana	1,100	58.0	63,800
	1992		
North Dakota	2,650	65.0	172,250
South Dakota	380	54.0	20,520
Minnesota	675	75.0	50,625
Wisconsin	80	52.0	4,160
Montana	1,200	44.0	52,800

Source: USDA - NASS Crops Production Data by States

B3. Production Statistics for Canola by Year - U.S.

State	Total Acres Harvested (000)	Yield Lbs/ac	Total Production (000 Lbs)
	1997		
North Dakota	480	1,230	590,400
South Dakota			
Minnesota			
Montana			
	1996		
North Dakota	217	1,380	299,460
South Dakota			
Minnesota			
Montana			
	1995		
North Dakota	211	1,220	257,420
South Dakota			
Minnesota			
Montana			
	1994		
North Dakota	126	1,400	176,400
South Dakota			
Minnesota			
Montana			
	1993		
North Dakota	46.5	1,230	57,195
South Dakota			
Minnesota			
Montana			
	1992		
North Dakota	21.4	1,530	32,742
South Dakota			
Minnesota			
Montana			

Footnote: Canola is not commercially grown in Wisconsin. Canola is not in the top 25 commodities for cash receipts for the USA.
Source: N.D. Agricultural Statistics Service, USDA Report R:ab67060a

B4. Production Statistics for Potatoes by Year - U.S.

State	Total Acres Harvested	Yield cwt/acre	Total Prod'n (000 cwt)
1998			
North Dakota	122,000	235	28,670
South Dakota	4,800	260	1,248
Minnesota	73,000	290	21,170
Wisconsin	83,500	370	30,895
Montana	10,600	300	3,180
1997			
North Dakota	110,000	200	22,000
South Dakota	4,400	220	968
Minnesota	73,000	280	20,440
Wisconsin	85,000	355	30,175
Montana	10,400	320	3,328
1996			
North Dakota	131,000	220	28,820
South Dakota	4,800	280	1,344
Minnesota	82,000	300	24,600
Wisconsin	85,000	390	33,150
Montana	10,200	315	3,213

Footnote: Price per cwt for 1998 is based on the price for December 1998 not a yearly average. Montana data is probably based on seed potato production and prices.

Source: USDA - NASS Crops Production Data by States

APPENDIX 4

Survey Questionnaire Sent to Pesticide Manufacturers

PESTICIDE PRICE INFORMATION FOR CANADA AND THE UNITED STATES

Conducted by
Ken McEwan and Bill Deen
Ridgetown College-University of Guelph

Objectives

This request for information forms part of the data gathering stage for a research project studying farm pesticide prices in both Canada and the United States. The study is investigating price and availability differences between the 2 countries for the major pesticides used in growing Hard Red Spring Wheat, Feed Grade Barley, Canola and Potatoes.

Confidentially

Please indicate which data/information is proprietary. This data/information will be treated with the strictest confidence and will only be presented in aggregate form, so that individual companies cannot be identified.

Return Date

Please complete and return this questionnaire by Email or fax before **Friday, July 30, 1999**.

Enquiries

	Phone Number	Email Address	Fax Number
Ken McEwan	(519) 674 - 1531	kmcewan@ridgetownc.uoguelph.ca	(519) 674 - 1530
Bill Deen	(519) 674 - 1604	bdeen@ridgetownc.uoguelph.ca	(519) 674 - 1600

Please complete the following questions regarding the pesticide **Treflan** (trifluralin - 545g/l EC) and its usage in the 4 study crops of: Hard Red Spring Wheat, Barley, Canola and Potato production. Please indicate if the product is not used in the various study crops.

1. A) Canada - Approximately how many acres where treated with this product in the 3 prairie provinces? (Complete only for applicable crops)

i) Hard Red Spring Wheat

1995	**1996**	**1997**	**1998**
Acres	Acres	Acres	Acres

ii) Feed Grade Barley

1995	**1996**	**1997**	**1998**
Acres	Acres	Acres	Acres

iii) Canola

1995	**1996**	**1997**	**1998**
Acres	Acres	Acres	Acres

iv) Potatoes

1995	**1996**	**1997**	**1998**
Acres	Acres	Acres	Acres

B) U.S. - Approximately how many acres were treated with this product in the Northern Tier States? (Complete only for applicable crops)

i) Hard Red Spring Wheat

1995	1996	1997	1998
Acres	Acres	Acres	Acres

ii) Feed Grade Barley

1995	1996	1997	1998
Acres	Acres	Acres	Acres

iii) Canola

1995	1996	1997	1998
Acres	Acres	Acres	Acres

iv) Potatoes

1995	1996	1997	1998
Acres	Acres	Acres	Acres

2. For the crops of Hard Red Spring Wheat, Barley, Canola and Potatoes, what is the approximate market share of this pesticide in each crop? (Check one response per crop if applicable)

i) Canada

Market Share	**Wheat**	**Barley**	**Canola**	**Potatoes**
Less than 10%	______	______	______	______
10 to 19.9%	______	______	______	______
20 to 29.9%	______	______	______	______
30 to 39.9%	______	______	______	______
40 to 49.9%	______	______	______	______
Greater than 50%	______	______	______	______

ii) U.S.

Market Share	**Wheat**	**Barley**	**Canola**	**Potatoes**

Less than 10%				
10 to 19.9%				
20 to 29.9%				
30 to 39.9%				
40 to 49.9%				
Greater than 50%				

3. What has been the pricing history for this pesticide at the farm level within Western Canada? Note units are Canadian dollars per litre/kg/g of product.

1995	1996	1997	1998
$ per Litre/kg/g	$ per Litre/kg/g	$ per Litre/kg/g	$ per Litre/kg/g

4. What has been the pricing history for this pesticide at the farm level within the Northern Tier U.S. states? Note units are US dollars per gallon/lb./oz of product.

1995	1996	1997	1998
$ per gallon/lb/oz	$ per gallon/lb/oz	$ per gallon/lb/oz	$ per gallon/lb/oz

5. If there have been price changes between 1995 and 1998 greater than 5% (up or down) in either Canada or the U.S. for this product, what are the most important factors for these price changes. Rank their importance. (1 most important; 6 least important)

	Canadian Rank	U.S. Rank
Inflation		
Cost of Production		
New Product Competition		
Loss of Patent Protection		
Other		
Other		

6. If there are differences in farm gate pesticide prices between the Canada and the U.S., rank the following reasons and explain why. (1 most important; 8 least important)

	Rank	Explanation
Market Segmentation	______	______________________
Exchange Rate Differences	______	______________________
Competition From Other Products	______	______________________
Patent Protection	______	______________________
Importing Duties on Active Ingredient	______	______________________
Value of Pest Controlled	______	______________________
Other ___________________________	______	______________________
Other ___________________________	______	______________________

7. Elaborate fully, on the #1 and #2 ranked response in question 6.

Rank 1

Rank 2

8. If there are no differences in farm gate pesticide prices for the product in question between Canada and the U.S., explain why.

Explanation

9. In the crops of Hard Red Spring Wheat, Barley, Canola, and Potatoes what are the main competitive pesticides the product competes against?

Wheat	**Barley**	**Canola**	**Potatoes**

1. ______ ______ ______ ______
2. ______ ______ ______ ______
3. ______ ______ ______ ______

10. What comments do you have about pesticide pricing in Canada?

11. What comments do you have about pesticide pricing in the United States?

Thanks for completing the survey. Please send the results by **Friday, July 30, 1999** to either Ken McEwan or Bill Deen at Ridgetown College-University of Guelph:

Ken McEwan	kmcewan@ridgetownc.uoguelph.ca	fax - (519) 674 - 1530
Bill Deen	Bdeen@ridgetownc.uoguelph.ca	fax - (519) 674 - 1600

Process Used to Conduct the Survey

Each of the major pesticide manufacturers was contacted by telephone in early July of 1999 to ask for participation in completing the pesticide pricing survey. The survey was E-mailed to the appropriate Canadian contact person within each company asking them to be the focal point for their firm and to co-ordinate Canadian and U.S. responses to the questions. Thus, the researchers were to receive only one response per company with both Canadian and U.S. answers to the various questions. A follow-up E-mail was sent to the manufacturers towards the latter part of July reminding them to complete the pricing survey.

APPENDIX 5

Pesticide Registrations in Canada and The United States for The Crops of Wheat, Barley, Canola and Potatoes

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	Registered y/n[1] United States	Significant Pesticide?[2] y/n
Wheat	Herbicide	Quinclorac	Accord	y	y	y
Wheat	Herbicide	Tralkoxydim	Achieve	y	y	y
Wheat	Herbicide	Carfentrazone ethyl	Aim 40 WDG	n	y	y
Wheat	Herbicide	Metsulfuron-methyl	Ally	y	y	y
Wheat	Herbicide	Triasulfuron	Amber	y	y	y
Wheat	Herbicide	Imazamethabenz	Assert	y	y	y
Wheat	Herbicide	Atrazine	Atrazine	n	y	n
Wheat	Herbicide	Triallate	Avadex, Far-Go	y	y	y
Wheat	Herbicide	Difenzoquat methyl sulfate	Avenge 200C	y	y	y
Wheat	Herbicide	Dicamba	Banvel	y	y	y
Wheat	Herbicide	Chitosan	Chitosan	n	y	n
Wheat	Herbicide	Clomazone	Command	n	y	n
Wheat	Herbicide	Metolachlor	Dual, Dual II	n	y	n
Wheat	Herbicide	IBA	Early Harvest PGR, Early Harvest PGR-IV	n	y	n
Wheat	Herbicide	2,4-DB	Embutox, Cobutox	y	n	y
Wheat	Herbicide	2,4-DP/2,4-D	Estaprop/Turboprop 600/Dichlorprop-D	y	y	y
Wheat	Herbicide	Tribenuron-methyl	Express and various premixes	y	y	y
Wheat	Herbicide	Chlorsulfuron	Glean, Telar	y	y	y
Wheat	Herbicide	Paraquat	Gramoxone	y	y	n
Wheat	Herbicide	Diclofop-methyl	Hoe-Grass, Hoelon	y	y	y
Wheat	Herbicide	Clodinafop-propargyl	Horizon	y	n	y
Wheat	Herbicide	Fenridazon	Hybrex	n	y	n
Wheat	Herbicide	Diuron	Karmex	n	y	n
Wheat	Herbicide	Metribuzin	Lexone	y	y	n
Wheat	Herbicide	Linuron	Linuron 480	y	y	n
Wheat	Herbicide	Clopyralid	Lontrel, Stinger	y	y	y
Wheat	Herbicide	Flamprop-m-methyl	Mataven	y	n	n
Wheat	Herbicide	MCPA	MCPA	y	y	y
Wheat	Herbicide	Fenoxaprop-ethyl	Option II	n	y	y
Wheat	Herbicide	Bromoxynil octanoate	Pardner	y	y	y
Wheat	Herbicide	Prosulfuron	Peak	y	y	y
Wheat	Herbicide	Fenoxaprop-p-ethyl	Puma	y	n	y
Wheat	Herbicide	Diquat	Reglone, Diquat	y	n	n
Wheat	Herbicide	Glyphosate/glufosinate ammonium	Roundup Fastforward	y	n	y
Wheat	Herbicide	Glyphosate	Roundup Transorb, Touchdown, Glyfos, Renegade, Victor	y	y	y
Wheat	Herbicide	Propanil	Stampede	y	y	y
Wheat	Herbicide	Fluroxypyr	Starane	y	y	y
Wheat	Herbicide	TCA	TCA	y	n	n
Wheat	Herbicide	Picloram	Tordon	y	y	n
Wheat	Herbicide	Trifluralin	Treflan, Rival, Bonanza	y	y	n
Wheat	Herbicide	2,4-D	Various	y	y	y
Wheat	Herbicide	Mecoprop	Various	y	n	y
Wheat	Herbicide	Thifensulfuron methyl	various premixes (Refine Extra, Harmony Extra)	y	y	y
Wheat	Herbicide	Aqueous extract of seaweed meal		n	y	n
Wheat	Herbicide	Furfuryladenine		n	y	n
Wheat	Herbicide	Nitrapyrin		n	y	n
Wheat	Herbicide	Colletotrichium gloeosporioides f. sp. Malvae		y	n	n
Wheat	Herbicide	Pyridazine-carboxylic acid		n	y	n
Wheat	Herbicide	Cytokinins		n	y	n
Wheat	Herbicide	Nonanoic acid		n	y	n
Wheat	Herbicide	Broxoxynil Heptanoaten		y	n	
Wheat	Herbicide	Chloropicrin		y	y	
Wheat	Herbicide	Pyriedizan Carboxylic Acid		n	y	
Wheat	Insecticide	Pirimiphos-methyl	Actellic	n	y	n

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	United States	Significant Pesticide?[2] y/n
Wheat	Insecticide	Permethrin	Ambush or Pounce	y	n	y
Wheat	Insecticide	Azadirachtin	Azatin, Margosan-O, Sofer Bicnean	n	y	n
Wheat	Insecticide	Piperonyl butoxide	Butacide	n	y	n
Wheat	Insecticide	Silicon dioxide	CAB-O-SIL, Aerosil	y	y	n
Wheat	Insecticide	Hydrocyanic acid	Cyclon	n	y	n
Wheat	Insecticide	Dimethoate	Cygon	y	y	y
Wheat	Insecticide	Deltamethrin	Decis	y	n	y
Wheat	Insecticide	Methoprene	Diacom	n	y	n
Wheat	Insecticide	Disulfoton	Di-Syston	y	y	y
Wheat	Insecticide	Methoxychlor	Drexel	y	y	n
Wheat	Insecticide	Trichlorfon	Dylox, Danex	y	n	n
Wheat	Insecticide	Carbofuran	Furadan	n	y	y
Wheat	Insecticide	Malathion	Fyfanon, Malathion	y	y	y
Wheat	Insecticide	Imidacloprid	Gaucho	n	y	y
Wheat	Insecticide	Azinphos-methyl	Guthion, Sniper	y	n	y
Wheat	Insecticide	Methomyl	Lannate	y	y	y
Wheat	Insecticide	Lindane	Lindane	y	y	y
Wheat	Insecticide	Chlorpyrifos	Lorsban, Pyrinex	y	y	y
Wheat	Insecticide	Clarified hydrophobic neem oil	Margosan-O	n	y	n
Wheat	Insecticide	Lamda-cyhalothrin	Matador, Karate, Warrier	y	y	y
Wheat	Insecticide	Metaldehyde	Meta	n	y	n
Wheat	Insecticide	Oxydemeton-methyl	Metasystox-R	y	n	y
Wheat	Insecticide	Parathion	Parathion	n	y	y
Wheat	Insecticide	Aluminum phosphide	Phostexin, Phistek, etc.	y	y	n
Wheat	Insecticide	Chlorpyrifos-methyl	Reldon	n	y	y
Wheat	Insecticide	Cypermethrin	Ripcord, Cymbush, Ammo	y	n	y
Wheat	Insecticide	Carbaryl	Sevin	y	y	y
Wheat	Insecticide	Phorate	Thimet	n	y	y
Wheat	Insecticide	Endosulfan	Thiodan	n	y	y
Wheat	Insecticide	Beauveria bassiana GHA		n	y	n
Wheat	Insecticide	Cube resins other than rotenone		n	y	n
Wheat	Insecticide	Garlic oil		n	y	n
Wheat	Insecticide	Glutamic acid		n	y	n
Wheat	Insecticide	Silica gel		y	y	n
Wheat	Insecticide	Pyrethrins		n	y	
Wheat	Fungicide	Mefenoxam	Apron XL	y	n	y
Wheat	Fungicide	Ampelomyces quisqualis M10	AQ:10	n	y	n
Wheat	Fungicide	Triadimefon	Bayleton	n	y	y
Wheat	Fungicide	Triadimenol	Baytan	y	y	y
Wheat	Fungicide	Benomyl	Benlate	n	y	n
Wheat	Fungicide	Chlorothalonil	Bravo 500	y	n	y
Wheat	Fungicide	TCMTB	Busan 30, 72	y	y	y
Wheat	Fungicide	Captan	Captan	n	y	y
Wheat	Fungicide	Copper hydroxide	Champ, Formula 2 Flowable, Kocide, etc.)	n	y	n
Wheat	Fungicide	Copper ammonium	Complex	n	y	n
Wheat	Fungicide	Dichloropropene	component of Telone and Vorlex	n	y	n
Wheat	Fungicide	Copper oxychloride	Coptox, etc.	n	y	n
Wheat	Fungicide	Copper chloride hydroxide	Coptox, Oxycop, etc.	n	y	n
Wheat	Fungicide	Mancozeb	Dithane DG, Penncozeb 75 DF,Manzate 200-DF, Manex II, Grain Guard, Spud Bark	y	y	y
Wheat	Fungicide	Difenoconazole	Dividend	y	n	y
Wheat	Fungicide	Imazalil	Double R	n	y	y
Wheat	Fungicide	Tebuconazole*	Folicur Elite	n	y	
Wheat	Fungicide	Maneb	Maneb	y	y	y
Wheat	Fungicide	Fludioxonil	Maxim	n	y	y

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	United States	Significant Pesticide?[2] y/n
Wheat	Fungicide	Thiabendazole	Mertect	n	y	y
Wheat	Fungicide	Metam-sodium	Metam 426, Vapram, etc.	n	y	y
Wheat	Fungicide	Azoxystrobin	Quadris	n	y	y
Wheat	Fungicide	Metalaxyl	Ridomil	y	y	y
Wheat	Fungicide	Metalaxyl-M	Ridomil MZ 72 WP, Ridomil Gold	n	y	y
Wheat	Fungicide	Sulfer	Sulfer, Sulfer DF, Sulfer Six	n	y	n
Wheat	Fungicide	Bacillus subtilis MBI 600	System	n	y	n
Wheat	Fungicide	Bacillus subtilis GB03	Systems	n	y	n
Wheat	Fungicide	Etridiazole	Terra-chlor	n	y	y
Wheat	Fungicide	Thiram	Thiram 75WP, Yield Shield	y	y	y
Wheat	Fungicide	Propiconazole	Tilt	y	y	y
Wheat	Fungicide	Thiophanate-methyl	Tops 2.5D	n	y	y
Wheat	Fungicide	Carbathiin, carboxin	Vitavax	y	y	y
Wheat	Fungicide	Gliocladium virens GL-21		n	y	n
Wheat	Fungicide	Burkholderia cepacia type Wisconsin		n	y	n
Wheat	Fungicide	Streptomyces gris. K61		n	y	n
Barley	Herbicide	Tralkoxydim	Achieve	y	y	y
Barley	Herbicide	Metsulfuron-methyl	Ally	y	y	y
Barley	Herbicide	Triasulfuron	Amber	y	y	y
Barley	Herbicide	Imazamethabenz	Assert	y	y	y
Barley	Herbicide	Triallate	Avadex, Far-Go	y	y	y
Barley	Herbicide	Difenzoquat methyl sulfate	Avenge 200C	y	y	y
Barley	Herbicide	Dicamba	Banvel	y	y	y
Barley	Herbicide	Diuron	Diuron, Karmex, etc.	n	y	n
Barley	Herbicide	Metolachlor	Dual, Dual II	n	y	y
Barley	Herbicide	2,4-DB	Embutox, Cobutox	y	n	n
Barley	Herbicide	2,4-DP/2,4-D	Estaprop/Turboprop 600/Dichlorprop-D	y	n	n
Barley	Herbicide	Tribenuron-methyl	Express and various premixes	y	y	y
Barley	Herbicide	Chlorsulfuron	Glean, Telar	y	y	n
Barley	Herbicide	Paraquat	Gramoxone	y	y	n
Barley	Herbicide	Diclofop-methyl	Hoegrass 284, Hoelon (diclotop)	y	y	y
Barley	Herbicide	Metribuzin	Lexone	y	y	n
Barley	Herbicide	Linuron	Linuron 480	y	y	n
Barley	Herbicide	Clopyralid	Lontrel, Stinger	y	y	y
Barley	Herbicide	MCPA	MCPA	y	y	y
Barley	Herbicide	Bromoxynil octanoate	Pardner, Varipam 700	y	y	y
Barley	Herbicide	Prosulfuron	Peak	n	y	y
Barley	Herbicide	Fenoxaprop-p-ethyl	Puma	y	y	y
Barley	Herbicide	Diquat	Reglone, Diquat	y	n	n
Barley	Herbicide	Propanil	Stampede	y	y	y
Barley	Herbicide	Fluroxypyr	Starane	y	y	y
Barley	Herbicide	TCA	TCA	y	n	n
Barley	Herbicide	Terbutryn	Terbutrex	n	y	n
Barley	Herbicide	Picloram	Tordon 22K	y	y	n
Barley	Herbicide	Trifluralin	Treflan, Rival, Bonanza, Advance, Trifluralex	y	y	y
Barley	Herbicide	MCPB + MCPA	Tropotox PLus	y	n	n
Barley	Herbicide	2,4-D	Various	y	y	y
Barley	Herbicide	Mecoprop	various	y	n	y
Barley	Herbicide	Thifensulfuron methyl	various premixes (Refine Extra, Harmony Extra)	y	y	y
Barley	Herbicide	Colletotrichium gloeosporioides f. sp. Malvae		y	n	n
Barley	Herbicide	Glyphosate		y		
Barley	Insecticide	Permethrin	Ambush or Pounce	y	n	y
Barley	Insecticide	Azadirachtin	Azatin	n	y	n
Barley	Insecticide	Silicon dioxide	CABO-SIL, Aerosil	y	y	n

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	Registered y/n[1] United States	Significant Pesticide?[2] y/n
Barley	Insecticide	Chloropicrin	Chlor-O-Pic	n	y	y
Barley	Insecticide	Deltamethrin	Decis	y	n	y
Barley	Insecticide	Disulfoton	Di-Syston	y	y	y
Barley	Insecticide	Methoxychlor	Drexel	y	y	n
Barley	Insecticide	Trichlorfon	Dylox, Danex	y	y	y
Barley	Insecticide	Carbofuran	Furadan	n	y	y
Barley	Insecticide	Imidacloprid	Gaucho	n	y	y
Barley	Insecticide	Azinphos-methyl	Guthion, Sniper	y	n	y
Barley	Insecticide	Methomyl	Lannate	y	y	y
Barley	Insecticide	Lindane*	Lindane	y	y	y
Barley	Insecticide	Chlorpyrifos	Lorsban, Pyrinex	y	n	y
Barley	Insecticide	Malathion	Malathion	y	y	y
Barley	Insecticide	Lambda-cyhalothrin	Matador, Karate, Warrier	y	y	y
Barley	Insecticide	Oxydemeton-methyl	Metasystox-R	y	n	y
Barley	Insecticide	Parathion	Parathion	n	y	y
Barley	Insecticide	Allethrin	Pgnamin	n	y	y
Barley	Insecticide	Aluminum phosphide	Phostoxim, Agtoxin, etc.	y	y	y
Barley	Insecticide	Chlorpyrifos-methyl	Reldon	n	y	y
Barley	Insecticide	Cypermethrin	Ripcord, Cymbush, Ammo	y	n	y
Barley	Insecticide	Carbaryl	Sevin	y	y	y
Barley	Insecticide	Methoprene		n	y	n
Barley	Insecticide	Allyl isothiocyanate		n	y	y
Barley	Insecticide	Hydrocyanic acid		n	y	n
Barley	Insecticide	Chitosan		n	y	n
Barley	Insecticide	Piperonyl butoxide		n	y	n
Barley	Insecticide	Silica gel		y	y	n
Barley	Insecticide	Calcium Cyanide		n	y	n
Barley	Insecticide	Pyrethrins		n	y	
Barley	Fungicide	Mefenoxam	Apron XL	y	y	y
Barley	Fungicide	Triadimefon	Bayleton	n	y	y
Barley	Fungicide	Triadimenol	Baytan	y	y	y
Barley	Fungicide	Benomyl	Benlate	n	y	y
Barley	Fungicide	TCMTB	Busan 30, 72	y	y	y
Barley	Fungicide	Mancozeb*	Dithane DG, Penncozeb 75 DF,Manzate 200-DF, Manex II, Grain Guard, Spud Bark	y	n	y
Barley	Fungicide	Imazalil	Double R	n	y	y
Barley	Fungicide	Tebuconazole	Folicur Elite	n	y	y
Barley	Fungicide	Maneb*	Maneb	y	n	y
Barley	Fungicide	Metam-sodium	Metam 426, Vapram, etc.	n	y	n
Barley	Fungicide	Oxadixyl	Recoil, etc.	n	y	n
Barley	Fungicide	Metalaxyl*	Ridomil	y	n	y
Barley	Fungicide	Bacillus subtilis MBI 600*	System	n	y	n
Barley	Fungicide	Bacillus subtilis GB03*	System	n	y	n
Barley	Fungicide	Thiram	Thiram	y	n	y
Barley	Fungicide	Propiconazole	Tilt	y	y	y
Barley	Fungicide	Carbathiin, carboxin	Vitavax	y	y	y
Barley	Fungicide	Proprionic acid		n	y	n
Canola	Herbicide	Atrazine	Aatrex, Atrazine	y	n	n
Canola	Herbicide	Imazamox	AC299,263	y	n	n
Canola	Herbicide	Quizalofop-p-ethyl	Assure II	y	y	y
Canola	Herbicide	Triallate	Avadex, MON7901	y	n	y
Canola	Herbicide	Colletotrichium gloeosporioides f. sp. Malvae	Biomal	y	n	n
Canola	Herbicide	Cyanazine	Bladex	y	n	n
Canola	Herbicide	Ethafluralin	Edge, Sonolan	y	n	y

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	United States	Significant Pesticide?[2] y/n
Canola	Herbicide	Triallate/trifluralin	Fortress, MON7985	y	n	y
Canola	Herbicide	Fluazifop butyl	Fusilade I	y	n	n
Canola	Herbicide	Fluazifop-p-butyl	Fusilade II, Venture	y	n	y
Canola	Herbicide	Fenoxaprop-p-ethy/fluazifop-p-butyll	Fusion	y	n	y
Canola	Herbicide	Diquat/paraquat	Gramoxone PDQ, Reglone	y	n	y
Canola	Herbicide	Endothall	Herbicide 273	n	n	y
Canola	Herbicide	Diclofop-methyl	Hoe-Grass, Hoelon	y	n	y
Canola	Herbicide	Glufosinate ammonium	Liberty, Harvest	y	y	y
Canola	Herbicide	Ethametsulfuron	Muster (Toss-N-Go)	y	n	y
Canola	Herbicide	Imazamox/imazathapyr	Odyssey	y	n	y
Canola	Herbicide	Sethoxydim	Poast Ultra, Poast	y	y	y
Canola	Herbicide	Imazethapyr	Pursuit	y	n	y
Canola	Herbicide	thifensulfurn methyl	Refine	y	n	
Canola	Herbicide	Diquat	Reglone, Diquat	y	n	y
Canola	Herbicide	Trifluralin	Rival, Treflan, Advance, Trifluralex, Bonanza	y	y	y
Canola	Herbicide	Glyphosate/glufosinate ammonium	Roundup Fastforward Preharvest	y	n	y
Canola	Herbicide	Glyphosate	Roundup Transorb, Touchdown, Glyphos	y	n	y
Canola	Herbicide	Clethodim	Select	y	n	y
Canola	Herbicide	Clopyralid	Stinger, Lontrel	y	n	y
Canola	Herbicide	TCA		y	n	
Canola	Herbicide	Trifluralin	Treflan	y	y	
Canola	Insecticide	Permethrin	Ambush	y	n	y
Canola	Insecticide	Terbufos	Counter	y	n	y
Canola	Insecticide	Dimethoate	Cygon, Lagon	y	n	y
Canola	Insecticide	Deltamethrin	Decis	y	n	y
Canola	Insecticide	Trichlorfon	Dylox, Danex	y	n	y
Canola	Insecticide	Carbofuran	Furadan	y	n	y
Canola	Insecticide	Malathion	Fyfanon, Malathion	y	n	y
Canola	Insecticide	Imidacloprid	Gaucho*	y	y	y
Canola	Insecticide	Azinphos methyl	Guthion, APM, Sniper	y	n	y
Canola	Insecticide	Methomyl	Lannate	y	n	y
Canola	Insecticide	Chlorpyrifos	Lorsban, Pyrinex	y	n	y
Canola	Insecticide	Cyhalothrin-lambda	Matador, Karate, Warrier	y	n	y
Canola	Insecticide	Methamidophos	Monitor	y	n	y
Canola	Insecticide	Parathion	Parathion	n	y	y
Canola	Insecticide	Cypermethrin	Ripcord, Cymbush, Ammo	y	n	y
Canola	Insecticide	Carbaryl	Sevin, Sevimol	y	n	y
Canola	Insecticide	Endosulfan	Thiodan	n	y	y
Canola	Insecticide	Methyl-prathin		n	y	
Canola	Fungicide	Metalaxyl	Apron FL*	y	n	y
Canola	Fungicide	Mefenoxam	Apron XL*	y	n	y
Canola	Fungicide	Benomyl	Benlate	y	y	y
Canola	Fungicide	Benomyl/thiram	Benlate T*	y	n	y
Canola	Fungicide	Benomyl/lindane/thiram	Benolin R*	y	n	y
Canola	Fungicide	Iprodione/lindare/thiram	Foundation*	y	n	y
Canola	Fungicide	Iprodione/thiram	Foundation Lite*	y	n	y
Canola	Fungicide	Lindane/Thiram/Thiabendazole	Premiere Plus, Sapphire*	y	n	y
Canola	Fungicide	Azoxystrobin	Quadris	n	y	y
Canola	Fungicide	Vinclozolin	Ronilan	y	n	y
Canola	Fungicide	Iprodione	Rovral FLO	y	n	y
Canola	Fungicide	Iprodione/lindare	Rovral ST*	y	n	y
Canola	Fungicide	Propiconazole	Tilt	y	n	y
Canola	Fungicide	Carbathiin/lindane/thiram	Vitavax RS, Cloak*	y	n	y
Canola	Fungicide	Pseudomonas cepacia		n	y	y

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	United States	Significant Pesticide?[2] y/n
Canola	Fungicide	Fludioxonil		n	y	
Canola	Fungicide	Thiram*		y	y	
Potato	Herbicide	Monolinuron	Afesin	y		
Potato	Herbicide	Chlorthal	Dacthal	y	n	
Potato	Herbicide	Metolachlor	Dual, Dual II	y	y	y
Potato	Herbicide	EPTC	Eptam 8E	y	y	y
Potato	Herbicide	Fluazifop-p-butyl	Fusilade II	y	n	y
Potato	Herbicide	Paraquat	Gramoxone, Gramoxone PDQ	y	y	y
Potato	Herbicide	Glufosinate Ammonium	Harvest, Ignite	y		
Potato	Herbicide	Diclofop-Methyl	Hoegrass 284	y	n	y
Potato	Herbicide	linuron	Linuron	y	y	y
Potato	Herbicide	Methoxone	MCPA	y	y	
Potato	Herbicide	Metobromuron	Patoran	y		
Potato	Herbicide	Sethoxydim	Poast Ultra, Poast	y	y	y
Potato	Herbicide	Rimsulfuron	Prism, Matrix	y	y	y
Potato	Herbicide	Pendimethalin	Prowl, Pendulum	n	y	y
Potato	Herbicide	Diquat	Reglone	y	y	
Potato	Herbicide	Glyphosate	Roundup	y		
Potato	Herbicide	Clethodim	Select	y	n	y
Potato	Herbicide	Metribuzin	Sencor, Lexone	y	y	y
Potato	Herbicide	Trifluralin	Treflan, Rival, Bonanza, Advance, Trifluralex	n	y	y
Potato	Herbicide	Fenoxaprop-P-Ethyl		y		
Potato	Insecticide	Permethrin	Ambush	y		y
Potato	Insecticide	Esfenvalerate	Asana XL	n	y	y
Potato	Insecticide	Deltamethrin	Decis	y		y
Potato	Insecticide	Disulfoton	Di-Syston	y		y
Potato	Insecticide	Fonofos	Dyfonate	y		y
Potato	Insecticide	Carbofuran	Furadan	y	y	y
Potato	Insecticide	Malathion	Fyfanon, Malathion	y		y
Potato	Insecticide	Imidacloprid	Gaucho	n	y	y
Potato	Insecticide	Cyromazin	Govenor	y		
Potato	Insecticide	Azinphos-Methyl	Guthion, Sniper	y	y	y
Potato	Insecticide	Dimethoate	Lagon, Cygon	y	y	y
Potato	Insecticide	Chlorpyrifos	Lorsban, Pyrinex	y		y
Potato	Insecticide	Lamda-Cyhalothrin	Matador, Karate, Warrier	y	y	y
Potato	Insecticide	Oxydemeton-Methyl	Metasystox-R	y		y
Potato	Insecticide	Methamidophos	Monitor	y	y	y
Potato	Insecticide	Ethyl Parathion	Parathion	n	y	y
Potato	Insecticide	Phosphamidon	Phosphamidon	n	y	y
Potato	Insecticide	Permethrin	Pounce	y		y
Potato	Insecticide	Fenvalerate	Pydrin	n	y	y
Potato	Insecticide	Cypermethrin	Ripcord, Cymbush	y		y
Potato	Insecticide	Carbaryl	Sevin	y		y
Potato	Insecticide	Phorate	Thimet	y	y	y
Potato	Insecticide	Endosulfan	Thiodan, Endosulfan	y	y	y
Potato	Insecticide	Oxamyl	Vydale	y		
Potato	Insecticide	Diazinon		y		
Potato	Insecticide	Methomyl		y		
Potato	Insecticide	Methoxychlor		y		
Potato	Insecticide	Pyrethrins		y		
Potato	Insecticide	Rotenone		y		

Crop	Pesticide Type	Active Ingredient	Trade Names	Registered y/n[1] Canada	United States	Significant Pesticide?[2] y/n
Potato	Fungicide	Dimethomorph/Mancozeb	Acrobat MZ	y		y
Potato	Fungicide	Chlorothalonil	Bravo 500	y	y	y
Potato	Fungicide	Mancozeb	Dithane DG, Penncozeb 75 DF,Manzate 200-DF, Manex II, Grain Guard, Spud Bark	y	y	y
Potato	Fungicide	Thiophanate-Methyl	Easout	y		y
Potato	Fungicide	Copper	Guardsman Copper Oxychloride 50, Clean Crop Copper Spray, Clean Crop Copper 53W, Champion WP	y		y
Potato	Fungicide	Copper Hydroxide	Kocide 101 DF	y	y	y
Potato	Fungicide	Thiabendazole	Mertect	y		y
Potato	Fungicide	Metiram	Polyram 16D	y		y
Potato	Fungicide	Metiram	Polyram 16D	y	y	y
Potato	Fungicide	Mensenoxem	Rid-o-mil	y		
Potato	Fungicide	Chlorothalonil/metalaxyl	Ridomil Gold	y	y	y
Potato	Fungicide	Metalaxyl	Ridomil MZ 72 WP, Ridomil Gold	y	y	y
Potato	Fungicide	Propamocarb HC1/Chlorothalonil	Tatto C	y	y	y
Potato	Fungicide	Captan		y	y	
Potato	Fungicide	Chloropicrin		y		
Potato	Fungicide	Zineb		y		
Potato	Fungicide	Sodium Hypochloride		y		

[1] Based on information supplied jointly from PMRA and the EPA registration status as of April 20th, 1999.

[2] Based on industry expertise a pesticide is significant if it has market share greater than zero.

APPENDIX 6

A Listing of Products, Rates, Prices and Market Shares Used to Determine Pesticide Expenditure

Trade Name	Active Ingredient		Formulation	Metric Rate/ac	Imperial Rate/ac	Metric Unit	1997 Price/ Metric Unit	1998 Price/ Metric Unit
Achieve 40DG	tralkoxydim	US	40% DG		8 oz/ac			
Achieve 80DG	tralkoxydim	Can	80% DG	0.1 kg/ac		kg	153.50	155.66
Achieve 80DG	tralkoxydim	Can	80% DG	0.1 kg/ac		kg	153.50	155.66
Achieve Extra Gold	tralkoxydim, bromoxynil,MCPA ester	Can	80% DG, 280 g/l + 280 g/l EC	0.05 case /ac		case	419.00	423.89
Assert 2.5S	imazamethabenz	US	2.5 lb/gal		1.04 pint/ac			
Assert 300-SC	imazamethabenz	Can	300 g/l SN	0.59 l/ac		L	44.97	44.97
Assure II	quizalofop-p-ethyl	US	0.88 lb/gal		0.4 pint/ac			
Avenge 200C	difenzoquat	Can	200 g/l SN	1.42 l/ac		L	10.53	11.09
Banvel	dicamba	Can	480 g/l SN	0.1 l/ac		L	28.81	32.33
Banvel	dicamba	US	4 lb/gal		0.18 pint/ac			
Bronate	bromoxynil/MCPA	US	2 lb/gal		1 pint/ac			
Bronate	bromoxynil/MCPA	US	2 lb/gal		1.0 pint/ac			
Buctril M	bromoxynil/MCPA	Can	280 g/l, 280 g/l EC	0.405 l/ac		L	14.19	14.20
Champion Plus	fenoxaprop-p-ethyl, MCPA ester, 2,4-D ester, thifensulfuron	Can	45 g/l, 210 g/l, 70 g/l EC, 75% DF	0.05 case/ac		case	205.00	202.06
Cheyenne	fenoxaprop-p-ethyl, MCPA ester, thifensulfuron methyl, tribenuron	US	0.467 lb/gal, 2.16 lb/gal EC, 50%, 25 % DF		0.025 case/ac			
Curtail M	clopyralid, MCPA ester	Can	50 g/l, 280 g/l EC	0.8 l/ac		L	13.31	13.17
Diquat	diquat	US	200 g/l SN		1.5 pint/ac			
Dithane DG	mancozeb	Can	75% DF	.5 kg/ac		kg	9.11	8.62
Dithane DG	mancozeb	US	75% DF		1.1 lb/ac			
Dual II	s-metolachlor	US	7.8 lb/gal		2.3 pint/ac			
Edge	ethafluralin	Can	60% DG	0.42 kg/ac		kg a.i.	47.41	41.41
Estaprop	dichlorprop, 2,4-D ester	Can	300 g/l, 282 g/l EC	0.71 l/ac		L	8.65	8.07
Express	tribenuron	US	75% DF		.25 oz/ac			
Furadan 480F		Can	480 g/l	0.22 l/ac		L	31.98	33.23
Furadan 480F		US	4 lb/gal		.39 pint/ac			
Gramoxone	paraquat	Can	200 g/l SN	2.2 l/ac		L	19.15	19.15
Harmony Extra	thifensulfuron methyl, tribenuron methyl	US	50%, 25% DF		0.35 oz/ac			
Horizon	clodinafop-propargyl	Can	240 g/l EC	0.095 l/ac		L	154.81	161.40
Liberty	glufosinate	Can	150 g/l SN	1.1 l/ac		L	17.06	17.05
Lontrel	clopyralid	Can	360 g/l SN	0.23 l/ac		L	129.49	129.49

Trade Name	Active Ingredient		Formulation	Metric Rate/ac	Imperial Rate/ac	Metric Unit	1997 Price/ Metric Unit	1998 Price/ Metric Unit
Lorox/Afolan	linuron	Can	50% DF/ 480 g/l F	1.74 kg/ac		kg	31.38	31.38
Matrix 25DF	rimsulfuron	US	25% DF		1.25 oz/ac			
MCPA	MCPA	Can	500 g/l EC	0.50 l/ac		L	5.96	6.13
MCPA	MCPA	Can	500 g/l EC	0.5 l/ac		L	5.96	6.13
MCPA	MCPA	US	4 lb/gal		1.0 pint/ac			
MCPA	MCPA	US	4 lb/gal		0.8 pint/ac			
Muster Gold	ehtametsulfuron-methyl/quizalofop-p-ethyl	Can	75% DF, 96 g/l EC	0.05 case/ac		case	390.00	390.00
Muster Toss-N-Go	ehtametsulfuron-methyl	Can	75% DF	8 g/ac		g	1.62	1.70
Odyssey	imazamox/imazethapyr	Can	35%, 35% DG	17 g/ac		g	1.45	1.45
Pendulum	pendimethalin	US	60% WDG		2.4 pint/ac			
Poast	sethoxydim	US	1.5 lb/gal		.6 pint/ac			
Poast Ultra	sethoxydim	Can	450 g/l EC		0.13l/ac	kg a.i.	202.25	189.42
Prism	rimsulfuron	Can	25% DF	24 g/ac		g	0.56	0.77
Puma	fenoxaprop-p-ethyl	Can	92 g/l EC	0.35 l/ac		L	37.28	37.94
Puma	fenoxaprop-p-ethyl	US	1 lb/gal		0.47pint/ac			
Pursuit	imazethapyr	Can	240 g/l SN	0.085 l/ac		L	225.18	237.12
Refine Extra Toss-N-Go	thifensulfuron methyl, tribenuron methyl	Can	50%, 25% DF	10 g/ac		g	0.65	0.65
Roundup Original	glyphosate	Can	356 g/l SN	1 l/ac		L	8.96	8.89
Roundup Original	glyphosate	Can	356 g/l SN	1.5 l/ac		L	8.96	8.89
Roundup Original	glyphosate	Can	356 g/l SN	0.5 l/ac		L	8.96	8.89
Roundup Ultra	glyphosate	US	3 lb/gal SN		2.6 pint/ac			
Select	clethodim	Can	240 g/l EC	0.08 l/ac		L	230.67	220.63
Sencor 75DF	metribuzin	Can	75% DF	0.3 kg/ac		kg	94.62	63.59
Sencor 75DF	metribuzin	US	75% DF		10.5 oz/ac			
Sonalan	ethafluralin	US	10% G		12.02 lb/ac			
Stinger	clopyralid	US	3 lb/gal SN		0.4 pint/ac			
Target	dicamba, mecoprop, MCPA amine	Can	62.5 g/l, 62.5 g/l, 275 g/l SN	0.5 l/ac		L	11.50	11.52
Treflan	trifluralin	Can	480 g/l EC	0.48 kg a.i./ac		kg a.i.	26.37	26.06
Treflan	trifluralin	US	4 lb/gal EC		1.8 pint/ac			

Trade Name	Active Ingredient		Formulation	Metric Rate/ac	Imperial Rate/ac	Metric Unit	1997 Price/ Metric Unit	1998 Price/ Metric Unit
Triumph Plus	fenoxaprop-p-ethyl, MCPA ester, thifensulfuron methyl	Can	56 g/l EC, 256 g/l EC, 75% DF	0.025 case/ac		case	399.00	404.83
various	2,4D amine	Can	500 g/l EC	0.5 l/ac		L	5.03	5.09
various	2,4D amine	US	3.8 lb/gal SN		1.0 pint/ac			

[1] Footnote: ND - 199 North Dakota Weed Control Guide; SW & MB - Guide to Crop Protection 1998; T - 1999 Thomsen Report

[2] Footnote: ND - 1999 North Dakota Weed Control Guide; SW & MB - Guide to Crop Protection 1999; T - 1999 Thomsen Report

Trade Name	Imperial Unit	1997 Imperial Price/Unit	1998 Imperial Price/Unit	1997 Price Source[1]	1998 Price Source[2]	Other Costs	1997 Wheat Acres Treated	1997 Barley Acres Treated	1997 Canola Acres Treated	1997 Potato Acres Treated	1998 Wheat Acres Treated	1998 Barley Acres Treated	1998 Canola Acres Treated	1998 Potato Acres Treated
Achieve 40DG	oz	2.52	2.49	ND	ND	$1.00/ac - Supercharge 0.5% v/v		na				na		
Achieve 80DG				SW	T	0	4	13.8			3	8.6		
Achieve 80DG				SW	T	0								
Achieve Extra Gold				SW	T	0		8.6				10.6		
Assert 2.5S	U.S. gal	163.12	188.32	ND	ND	$0.75/ac - Spray Water Adjuster	2	4			2	na		
Assert 300-SC				ND	T	$0.75/ac - Spray Water Adjuster	5	7.1			6.9	5.2		
Assure II	U.S. gal	162.47	184.38	T	T	0			3.6				3.6	
Avenge 200C				T	T	0		3				3.1		
Banvel				T	T	0	na	na			na	na		
Banvel	U.S. gal	117.17	125.79	T	T	0	28.9	7.2			28.9	7.2		
Bronate	U.S. gal	79.31	78.49	T	T	0	7.1	na			7.1	na		
Bronate	U.S. gal	79.31	78.49	T	T	0								
Buctril M				T	T	0	6	4.3			10.8	10.6		
Champion Plus				SW	T	0		10.5				7		
Cheyenne	case	1022.24	1185.35	ND	ND	0		na				na		
Curtail M				SW	T	0	3				1.4			
Diquat	U.S. gal	107.37	117.44	ND	ND	0				35.6				35.6
Dithane DG				T	T	0				37.2				37
Dithane DG	lb	5.55	5.55	T	T	0				11.9				11.9
Dual II	U.S. gal	53.86	59.17	ND	ND	0				7				7
Edge				T	T	0			11.4				6.4	
Estaprop				SW	T		9	9.4			10.2	10.3		
Express	oz	21.51	25.54	ND	ND	$0.90/ac - NIS .25% v/v	13.1	17.3			13.1	17.3		
Furadan 480F				T	T	0				11.5				8.8
Furadan 480F	U.S. gal	93.59	93.59	T	T	0				107.5				107.5
Gramoxone				SW	SW	0				12.8				13.2
Harmony Extra	oz	17.71	17.52	ND	ND	$0.72/ac - NIS .2% v/v	na	na			na	na		
Horizon				SW	T	0	8	na			12.1	na		

Trade Name	Imperial Unit	1997 Imperial Price/Unit	1998 Imperial Price/Unit	1997 Price Source[1]	1998 Price Source[2]	Other Costs	1997 Wheat Acres Treated	1997 Barley Acres Treated	1997 Canola Acres Treated	1997 Potato Acres Treated	1998 Wheat Acres Treated	1998 Barley Acres Treated	1998 Canola Acres Treated	1998 Potato Acres Treated
Liberty				SW	T	0			12.5				13.7	
Lontrel				SW	T	0			8.2				4.3	
Lorox/Afolan				SW	SW	0				13.6				13.3
Matrix 25DF	oz	23.45	17.74	ND	ND	$0.72/ac - NIS .2% v/v				13.5				13.5
MCPA				T	T	0	3	5.8				4.5		
MCPA				T	T	0					3.8			
MCPA	U.S. gal	23.92	24.39	T	T	0	15.8	22.5				22.5		
MCPA				T	T	0					15.8			
Muster Gold				SW	SW	0			0				5.6	
Muster Toss-N-Go				SW	T	$1.80/ac - Agral 90 .2l/100l			12.3				12.6	
Odyssey				SW	T	0			2.8				5.4	
Pendulum		38.15	43.11	ND	ND	0				15.4				15.4
Poast	kg a.i.	156.26	161.85	T	T	$2.90/ac - Oil 1q/acre			44.8	15.3			44.8	15.3
Poast Ultra				T	T	0			13.1	5.3			7.7	4.1
Prism				SW	SW	$1.80/ac - Agral 90 .2l/100l				5.2				8.5
Puma				SW	T	0	13	5			12.3	8.3		
Puma	U.S. gal	0.00	296.38	na	ND	0	na	na			na	na		
Pursuit				SW	T	$2.25/ac - Agral 90 .25l/100l			6.4				1.4	
Refine Extra Toss-N-Go				SW	T	$1.80/ac - Agral 90 .2l/100l	13	5.4			12.4	9.7		
Roundup Original				T	T	0	7	3.9			4.2	5.1		
Roundup Original				T	T	0				12.7				11
Roundup Original				T	T	$15.00/ac - TUA			6.1				24.3	
Roundup Ultra	U.S. gal	62.95	76.61	T	T	0				9.5				9.5
Select				SW	T	0			6.2				10.8	
Sencor 75DF				SW	SW	0				31.7				32.4
Sencor 75DF				ND	ND	0				52.52				52.52
Sonalan	lb	1.47	1.61	T	T	0			2.9				2.9	
Stinger	U.S. gal	644.22	720.99	ND	ND	0			1.6				1.6	

Trade Name	Imperial Unit	1997 Imperial Price/Unit	1998 Imperial Price/Unit	1997 Price Source[1]	1998 Price Source[2]	Other Costs	1997 Wheat Acres Treated	1997 Barley Acres Treated	1997 Canola Acres Treated	1997 Potato Acres Treated	1998 Wheat Acres Treated	1998 Barley Acres Treated	1998 Canola Acres Treated	1998 Potato Acres Treated
Target				SW	T	0	4	3.1			3.5	1.5		
Treflan				T	T	0			6				2.5	
Treflan	kg a.i.	26.06	26.09	T	T	0	7.6	6.7	34.9	6.2	7.6	6.7	34.9	6.2
Triumph Plus				SW	T	0	8				3.5			
various				T	T	0	2	3.8			1.1	3		
various	U.S. gal	19.82	23.04	T	T	0	49.8				49.8	45.3		

[1] Footnote: ND - 199 North Dakota Weed Control Guide; SW & MB - Guide to Crop Protection 1998; T - 1999 Thomsen Report

[2] Footnote: ND - 1999 North Dakota Weed Control Guide; SW & MB - Guide to Crop Protection 1999; T - 1999 Thomsen Report

APPENDIX 7

Industry Contacts

Industry Contacts

a) Canada

- Novartis
  Warren Libby, President
- Monsanto
  Mike Kinley, Executive Vice President
- Cyanamid
  Jay Bradshaw, General Manager
- Cargill
  John Simons, Marketing Manager, Crop Protection Products
- Canadian Wheat Board
  Bruce Burnett, Director Weather & Crop Surveillance
- Canola Council of Canada
  JoAnne Buth, Vice President, Crop Production
- Manitoba Agriculture
  John Gavloski, Entomologist
  Todd Andrews, Weed Specialist
  John Heard, Soil Fertility Specialist
- Kroeker Farms Limited
  Wayne Rempel, Farm Manager, Winkler Manitoba
- Thomas Menold, Grain Farmer, Carmon, Manitoba
- Crop Protection Institute
  Charlie Milne, Vice President Government Affairs

b) United States

- North Dakota Grain Growers Association
  Lance Gaebe, General Manager
- Northern Canola Growers Association
  Barry Coleman, Executive Director
- North Dakota State Agriculture
  Gerald Thompson, Program Manager, Plant Industries
- North Dakota State University
  Denise McWilliams, Weed Specialist
  Richard Zollinger, Weed Specialist
  Alan Dexter, Weed Specialist
- Louis Kuster, Grain Farmer, North Dakota
- University of Minnesota

Duane Preston, Area Extension Agent for Potatoes
Gene Krause, Extension Service

- Minnesota Canola Foundation
  Beth Nelson

APPENDIX 8

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