CROP RESIDUE CONSERVATION DURING FALLOW AND EROSION RISK IN WEST CENTRAL SASKATCHEWAN

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INTRODUCTION

Summerfallow is considered to be a necessary practise to replenish soil moisture reserves in much of west central Saskatchewan. Unfortunately, this practise has been largely responsible for severe erosion in the past.

Recently many farmers have attempted to keep more crop residue on the soil surface, by using herbicides and wide blade cultivators to control weeds during the fallow period. Much of the increase in these practises has been due to assistance programs provided by PFRA, Saskatchewan Agriculture (eg. Save Our Soils (SOS) program), Ducks Unlimited and other organizations.

This paper looks at the effectiveness of these projects in maintaining crop residue to minimize erosion. Included are evaluations of weed control, costs, subsequent crop yields and farmer perceptions.

Results of a crop residue survey are also presented. This survey provides a good comparison with the project fields. It also enables one to forecast erosion potential for the following winter, spring, and summer seasons. While the paper focuses mainly on 1988 activities, it should be noted that similar work was done in 1986 - 87.

METHODS

Crop residue measurements for project fields and the crop residue survey were made by PFRA staff in the fall of 88. Staff were trained using the rope method to estimate percent ground cover. After becoming competent they used photographs with known amounts of residue as a basis for making quick estimates.

Fields measured in the crop residue survey were assumed to have been fallowed by tillage primarily. This assumption provides the basis for comparing. If any fields in the survey appeared to have managed differently, they were deleted from the comparison. It would have been preferable to have side by side comparisons for all sites but this wasn't possible. Some of the difficulties in this type of comparison are discussed in the results. Nevertheless, with the large number of fields involved making comparisons of averages is valid.

All other data such as weed control, costs, and farmer perceptions were provided by the farmer's themselves. This also poses some problems in consistency and accuracy. For example, two farmers may have different definitions of weed control and suppression. However, here again the results presented are averages of a large number of projects and therefore quite valid. Also, these data describe how things happen in the real world of farmers on a field scale. This is valuable information for other farmers who may want to consider these practises.

RESULTS

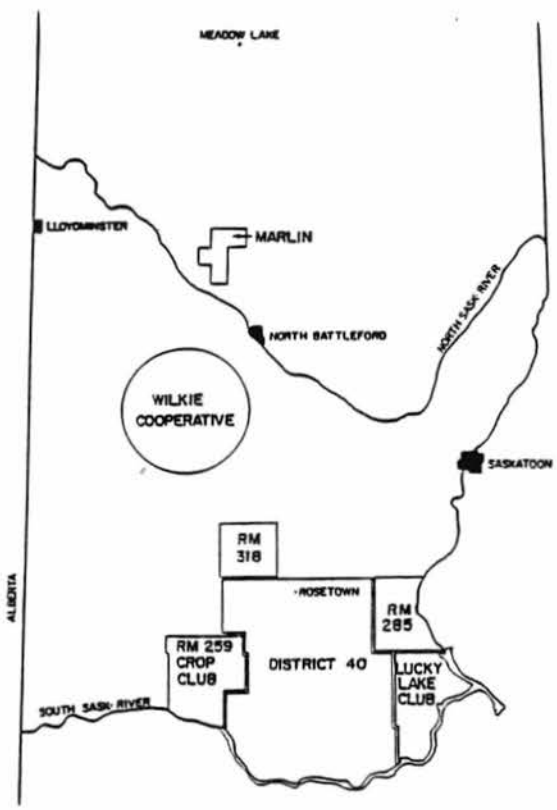
A. Herbicide Projects

In 1988 almost 130 herbicide projects were carried out through five soil conservation farmer groups (see Figure I and Table I). Four of the groups were located in the same general area, in the brown or on the southern edge of the dark brown soil zone. The fifth group, Wilkie Soil Conservation Cooperative (WSCC), was somewhat removed from the rest, being on the northern edge of the dark brown soil zone. Fallow management is quite different between Wilkie and the other areas. Therefore, these areas are separated in some of the data analysis.

TABLE I NUMBER OF PROJECTS
(Use Of Herbicides During Fallow)

GROUP	YEAR		
	1986	1987	1988
Wilkie Soil Conservation Coop.	14	32	46
District 40	37	25	24
RM 318	30	19	35
RM 259 Crop Club		8	10
Lucky Lake Soil Conservation Club		15	12
	81	99	127

FIGURE I



1. Residue

In the Wilkie area most farmers apply trifluralin herbicide in the fallow year for weed control in the subsequent canola crop. Since this herbicide requires at least two incorporations it becomes difficult to minimize tillage during the fallow year. Farmers with projects have been using herbicides like 2,4-D and Roundup to control weeds until July. After that trifluralin is applied and incorporated. Figure II shows how much residue is left for projects involving 2 to 4 tillages, compared to 5.5 tillages for conventional fallow. Even for projects with two tillages there wasn't much more residue.

(The number of tillage operations for conventional fallow was estimated by asking project farmers how many times they needed to till other fields where no herbicides were applied).

For the other groups, the same trend occurs (see Figure III). Projects with only one tillage had marginally more residue than conventionally fallow fields tilled an average of 3.6 times. Only fields that were not tilled at all had significantly more residue than those conventionally fallowed.

The rapid disappearance of residue could be because the straw and stubble has weakened from weathering and is easily broken down during the first tillage operation in mid summer. It should be noted that primary tillage for most of these projects was a heavy duty cultivator.

A second reason could be that project fields could have had less erosion to start with than those surveyed as conventional fallow. This is because many farmers choose fields that are most susceptible to erosion, for using herbicides. Thirdly, some of the fields that were assumed to have been conventionally fallowed may have in fact had some herbicides applied to them. Nevertheless, the first explanation is true and at least partly responsible.

Similar results are shown for other years in Figure IV. The year 1986 shows some exception as projects with 1 and 2 tillage still have quite a bit more residue than conventional fallow. The reason for this exception is not known.

FIGURE II

CROP RESIDUE FROM HERBICIDE PROJECTS. FALL 88
(WILKIE)

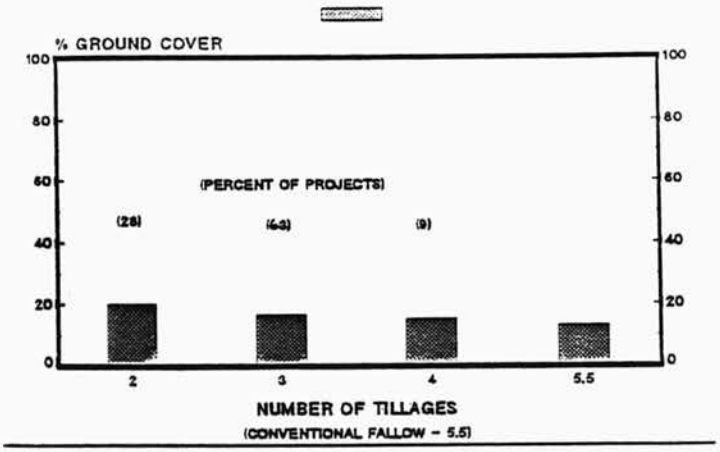


FIGURE III

CROP RESIDUE FROM HERBICIDE PROJECTS, FALL 88
(ALL GROUPS EXCEPT WILKIE)

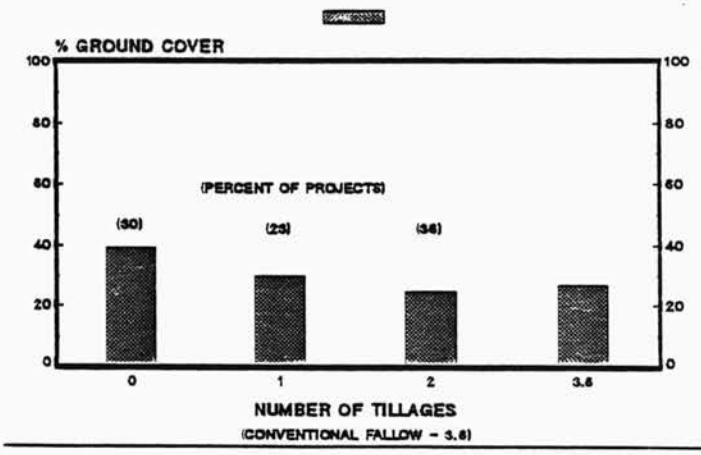
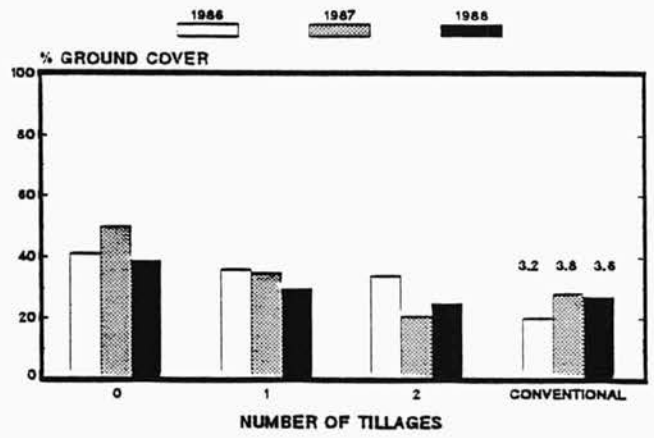


FIGURE IV

AVERAGE CROP RESIDUE FROM HERBICIDE PROJECTS
(ALL GROUPS EXCEPT WILKIE)



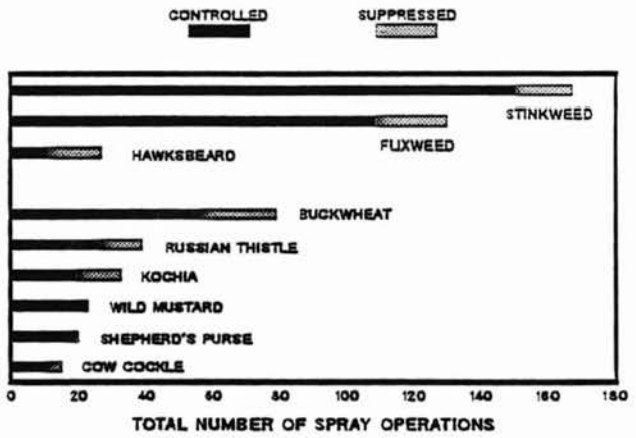
2. Weed Control

Farmers were asked to record all herbicide and tillage operations, noting which weeds were present and whether or not they were controlled or suppressed. The results of this are shown in Figures V to VIII and include projects from Wilkie.

The most common broadleaf weeds were the winter annuals stinkweed and flixweed, but they were among the easiest to control. Other broadleafs such as buckwheat, russian thistle, and kochia were not controlled as often. Narrow-leaved hawks' beard appeared primarily in Wilkie and was especially hard to control. In 1988 there was a proportionate increase in the incidence of russian thistle and kochia weeds.

FIGURE V

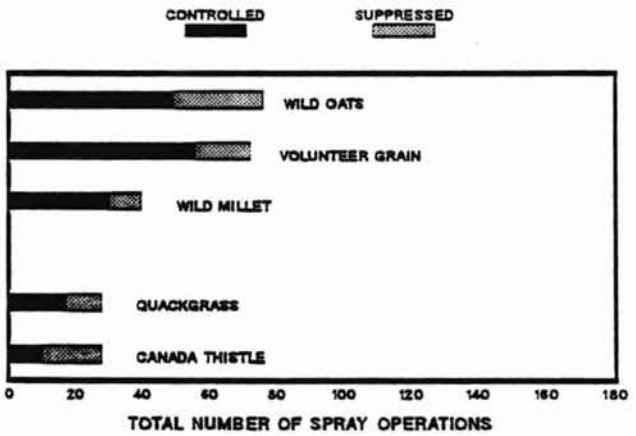
FREQUENCY AND CONTROL OF BROADLEAF WEEDS
(HERBICIDE PROJECTS, 1988)



The most common annual grassy weeds were wild oats and volunteer grain, with wild oats being more difficult to kill. Perennial grasses, which occurred mostly in Wilkie, were controlled only about half the time.

FIGURE VI

FREQUENCY AND CONTROL OF GRASSY WEEDS
(HERBICIDE PROJECTS, 1988)



When spraying winter annuals with 2.4-D, time of spraying had little effect on control. The only exception was that fall spraying had some advantage over spraying in spring. Banvel was used extensively for summer annuals. Rustler, 2,4-D, and often mixtures were used as well. Glean was only used by a small number of farmers.

FIGURE VII

USE & EFFECT OF HERBICIDES FOR BROADLEAF WEEDS
(HERBICIDE PROJECTS, 1988)

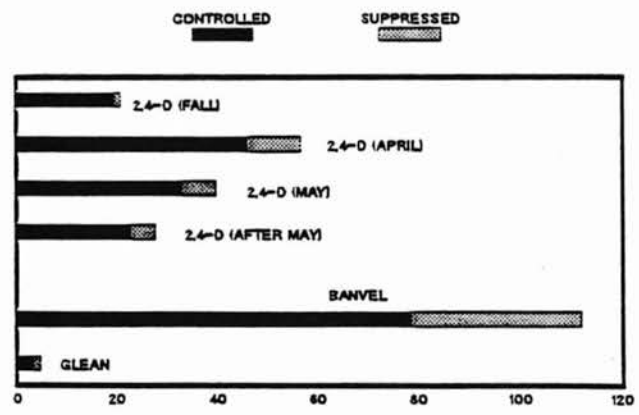
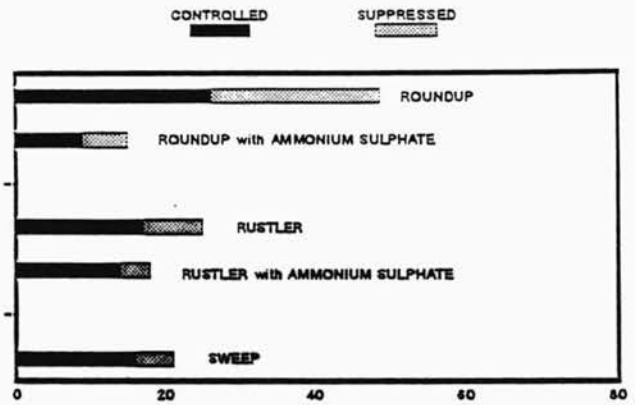


FIGURE VIII

USE & EFFECT OF HERBICIDES FOR GRASSY WEEDS
(HERBICIDE PROJECTS, 1988)



Roundup, Rustler, and Sweep were used to spray grassy weeds. In Wilkie, Roundup was used extensively to spray perennials such as quackgrass. This accounts for the somewhat poorer control with Roundup. Adding ammonium sulphate marginally improved the performance of Roundup and Rustler. Many herbicides (like Rustler) performed better in Wilkie than areas further south. This is because weeds in Wilkie were not as drought stressed.

When farmers were asked to give an overall assessment of weed control using herbicides compared to tillage, there was some preference for using herbicides (see Figure IX). There was some indication that while tillage possibly provided more immediate effect in controlling weeds, this tillage caused more weed seeds to germinate resulting in more problems in the future.

A final observation on weed control practises showed that only 6% of spray operations were considered spot spraying. Spot spraying was defined as spraying less than half the field.

WEED CONTROL USING HERBICIDES, 1988
(COMPARED TO TILLAGE)

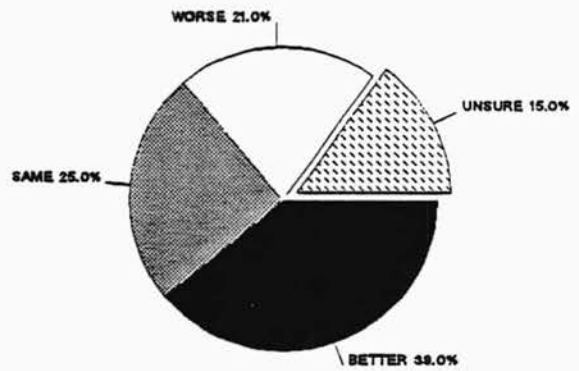


FIGURE IX

3. Farmer Perceptions

Two questions were asked of project participants. First, would they do this practise again without financial assistance. As indicated in Figure X, 46% said yes, while only 13% said no. The rest were undecided.

The second question asked what they would do different if they did this project again. Figure XI shows that many would change the timing of herbicide applications. Other changes included the type and rate of herbicide, as well as the desire to spray more often. About 19% were completely satisfied with their project and wouldn't change anything.

DO AGAIN WITHOUT ASSISTANCE?
(HERBICIDE PROJECTS, 1988)

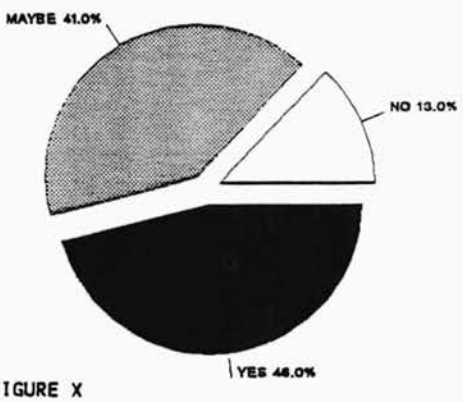


FIGURE X

DO DIFFERENT?
(HERBICIDE PROJECTS,1988)

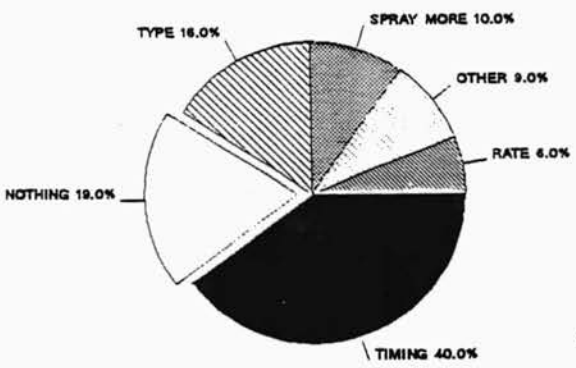


FIGURE XI

4. Costs

Table II shows average costs of fallowing for various spray and tillage combinations, for all groups except Wilkie. There were a variety of combinations used, with a range in cost for each from $11.58 to $27.53.

These combinations are further summarized in Table III into two categories; projects where only herbicides were used and ones utilizing both herbicides and tillage. In both categories the average cost is between $19 and $20, compared to only $8.82 for tillage alone fallow. The big difference in these two categories is the percent of fields protected from severe erosion (>25% ground cover). In fact more conventional fallow fields were protected than those where a combination of herbicides and tillage were used. This again supports the idea that residue disappears quickly when tilling after herbicide use. All tillage costs are calculated using custom rate guides.

TABLE II

COST OF HERBICIDE PROJECTS, 1988
(sorted by spray/till combinations)

# SPRAYINGS	# TILLAGES	COST ($)	# PROJECTS
2	0	14.94	10
3	0	20.31	8
4	0	27.83	3
1	1	13.67	3
2	1	19.13	9
3	1	26.88	3
1	2	11.58	7
2	2	17.64	5
3	2	25.21	7
1	3	14.84	3
2	3	19.18	1

TABLE III

SUMMARY OF COSTS AND CROP RESIDUE
(Herbicide Projects, 1988)

	SPRAYINGS Average #	TILLAGES Average #	COST ($)	FIELDS* PROTECTED
HERBICIDES Alone	2.7	0	19.23	67
HERBICIDES & TILLAGE**	2.1	1.7	19.89	28
TILLAGE** Alone	0	3.6	8.82	42

* percent of fields with >25% ground cover
** with conventional implements

5. Subsequent Crop Yields

It has been difficult to assess the effect of this practise on subsequent crop yields because of the lack of side by side comparisions. In past years questionaires have been sent to former project participants asking them to estimate what effect they have seen. About half the respondents have indicated no difference in yield, while the other half estimate a 1-5 bu/ac increase after using herbicides. At a few side by side comparison sites, measurements with a weigh wagon have given similar results. Therefore, most of these projects have not recovered extra costs of using herbicides in increased yields.

B. WIDE BLADE CULTIVATOR DEMONSTRATIONS

Interest in wide blade cultivators has mushroomed throughout the brown and dark brown soil zones in Saskatchewan in the last two years. In the west central region almost 200 farmers participated in field scale demonstrations in 1988 (see Table IV).

Since November 1987 implement dealers in the region have sold about 35 wide blade cultivators. Previous to that virtually none were sold. Some farmers are buying wide blade standards and blades, and mounting them to their heavy duty cultivators. Assistance programs have provided the needed incentive for many farmers. However, high erosion risk associated with several drought years has also been a contributing factor.

TABLE IV

WIDE BLADE DEMONSTRATIONS, 1988
(West-Central Saskatchewan)

AREA	# FARMERS	# ACRES
Elrose, Kyle	65	6000
Rosetown	42	3960
Kindersley	27	5655
Herschel	25	2010
Lucky Lake, Beechy	24	2350
Biggar	9	1450
TOTAL	192	21425

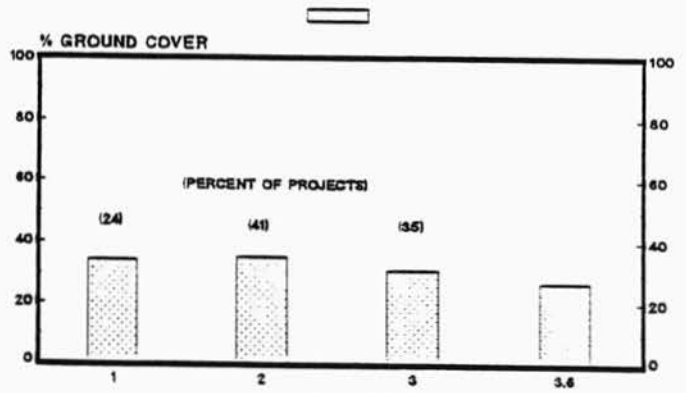
1. Residue

An evaluation of crop residue was made in the same way as the herbicide projects. Wide blade projects included in this evaluation featured a variety of management techniques. A few farmers used only the wide blade to control weeds, but many also used herbicides and/or rodweeders.

A comparison of Figure XII with Figure III, shows that projects using a wide blade cultivator had more residue than those using conventional tillage equipment with herbicides. In fact wide blade projects tilled once or twice had almost as much residue as herbicide projects that weren't tilled at all. It should again be noted that although these are not side by side comparisons, there is a sufficient number of projects to make comparisons of averages valid.

FIGURE XII

CROP RESIDUE FROM WIDE BLADE PROJECTS, FALL 88



2. Farmer Perceptions

In an evaluation questionnaire farmers were asked to rate the wide blade cultivator in several ways. For ability to clear trash and weeds, a majority rated it as good, while most of the rest said it did very good to excellent (see Figure XIII).

For ability to penetrate most rated it as good, with some giving it a higher and some a lower rating (see Figure XIV). In some of the lower ratings penetration could have been improved with better setting up of the implement. In some cases adding weight could have helped. In field comparisons with a heavy duty cultivator the wide blade has generally had better penetration and trash clearance.

Farmers were asked to compare the wide blade with the primary tillage implement they normally used. For weed control, most felt they performed the same. About 19% felt that the wide blade controlled weeds better, while 15% thought it was poorer (see Figure XV).

For ease of operation a majority again felt there was no difference from their normal tillage implement. About 23% felt the wide blade worked better, while 15% thought it was poorer (see Figure XVI). Ease of operation included transport, setting up for field work, and general performance in the field.

FIGURE XIII

ABILITY TO CLEAR TRASH & WEEDS
(WIDE BLADE PROJECTS, 1988)

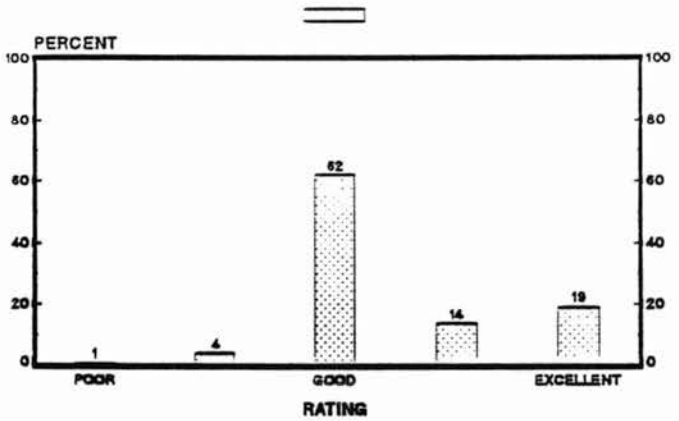


FIGURE XIV

ABILITY TO PENETRATE
(WIDE BLADE PROJECTS, 1988)

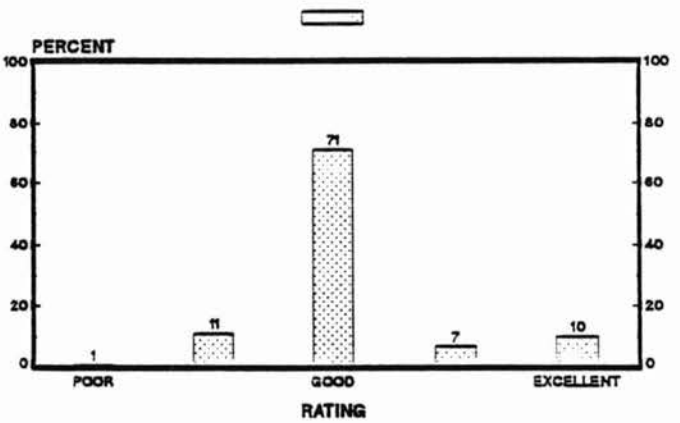


FIGURE XVI

EASE OF OPERATION COMPARED TO CULTIVATOR
(WIDE BLADE PROJECTS, 1988)

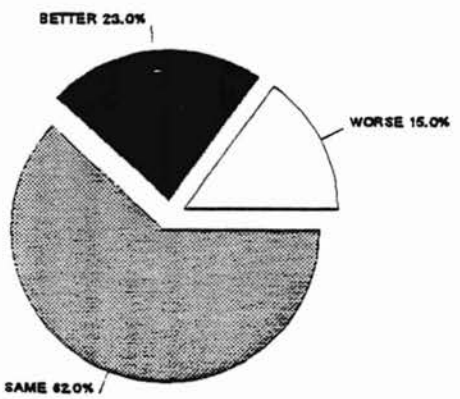
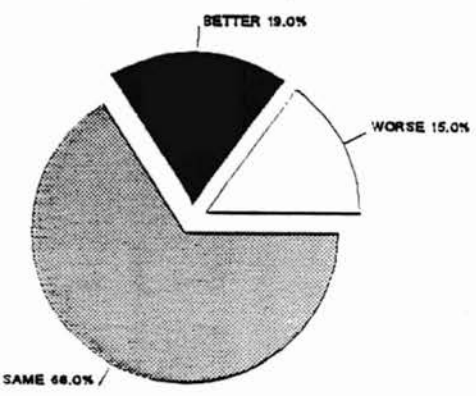


FIGURE XV

WEED CONTROL COMPARED TO REGULAR TILLAGE
(WIDE BLADE PROJECTS, 1988)



3. Costs

Average cost of wide blade projects, as shown in Table V, include two categories; projects using tillage alone and projects using both tillage and herbicides. Comparing this data with Table III shows that wide blade projects cost less than herbicide projects and were more effective in keeping fields protected from erosion. In fact projects involving wide blade cultivators with or without rodweeders cost less than conventional fallow. All tillage costs, including the wide blade, are calculated using a custom rate guide.

TABLE V

SUMMARY OF COSTS AND CROP RESIDUE
(Wide Blade Projects, 1988)

	SPRAYINGS Average #	TILLAGES Average #	COST ($)	FIELDS* PROTECTED
WIDE BLADE Alone**	0	2.5	6.86	61
WIDE BLADE** & HERBICIDES	1.4	1.8	14.06	65
TILLAGE*** Alone	0	3.6	8.82	42

* percent of fields with >25% ground cover
** may include rodweeders
*** with conventional implements

4. Summary of Herbicide & Wide Blade Projects

The two main factors in evaluating these projects are cost and residue conservation. On this basis one could group these projects into four categories with the following order of preference: wide blade w/wo rodweeders, wide blade & herbicides w/wo rodweeders, herbicides, and herbicides & conventional tillage. For each category one would recommend the use of 2,4-D to control winter annuals (see Table VI).

These projects show that wide blade cultivation is preferable to using herbicides mainly because of cost. However, this advantage may be somewhat less because of the high initial capital expense involved with the wide blade. Also, with future anticipated price reductions of herbicides, these may become more economical.

One should also not forget the benefit of establishing wind barriers like shelterbelts and flax strips, or farming narrower fields. These practises may be even more cost effective in reducing wind erosion.

TABLE VI

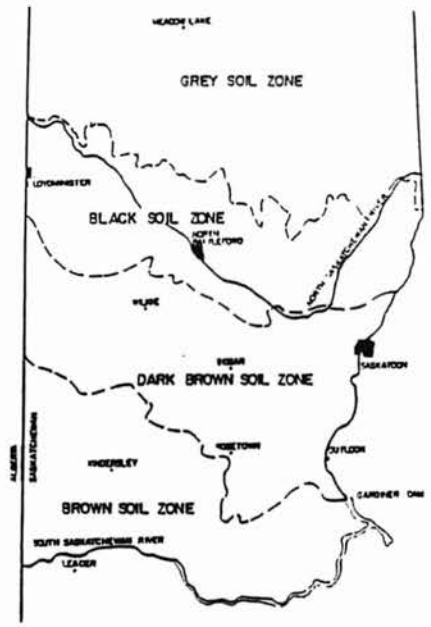
FALLOW OPTIONS
(in order of preference)

1.	2,4-D	Wide Blade	Wide Blade or Rod	>>
2.	2,4-D	Rustler	Wide Blade	Wide Blade or Rod
3.	2,4-D	Rustler	Rustler	2,4-D
4.	2,4-D	Rustler	Tillage	>>
5.	2,4-D	Tillage	>>	>>

C. CROP RESIDUE SURVEY

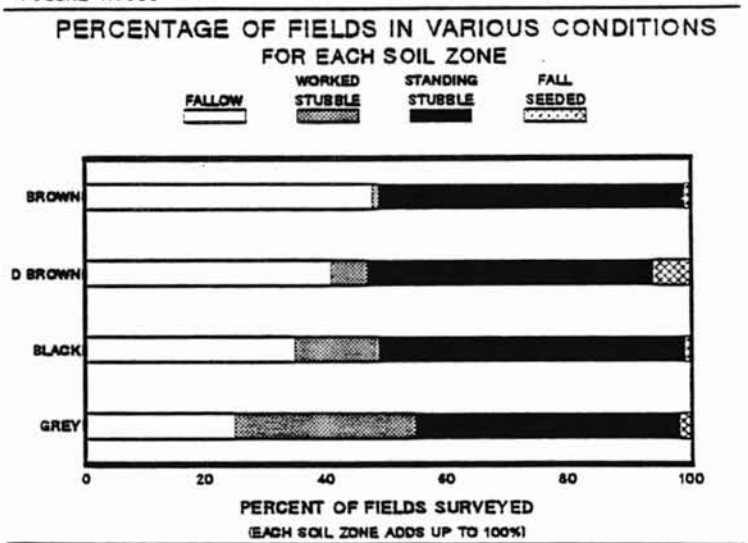
Since 1986 PFRA has conducted prairie wide crop residue surveys in late October. In the Rosetown region over 500 fields have been surveyed each year. This paper shows results from 1988, for each soil zone. The soil zone boundaries are shown in Figure XVII. The number of fields surveyed in each soil zone are as follows: brown - 140, dark brown - 278, black - 66, grey - 56.

FIGURE XVII



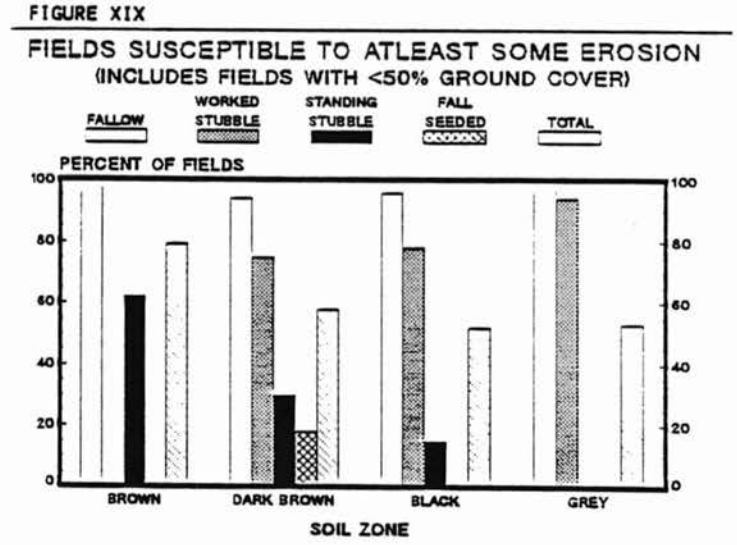
As seen in Figure XVIII, the percentage of fallow fields is greatest for the brown soil zone and decreases as one moves north. Conversely, the number of worked stubble fields is the least for the brown zone and increases as one moves north. Fallow fields included those that were seeded in spring 88, but worked down in summer because of crop failure.

FIGURE XVIII



The percentage of fields in each soil zone and field condition susceptible to at least some erosion is given in Figure XIX. Virtually all fallow fields and most worked stubble fields are susceptible. More than half of the standing stubble fields in the brown soil zone are susceptible. This is not surprising when considering the very poor yields in 1988. In the dark brown and black soil zones, the percentage of susceptible standing stubble fields is much less. Overall more than half of all fields in every soil zone are susceptible to some erosion.

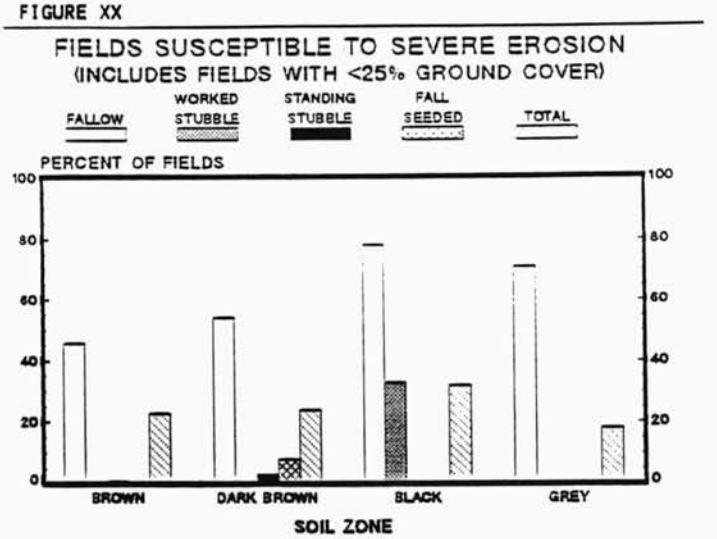
FIGURE XIX



In Figure XX the percentage of fields have been reduced to include only those susceptible to severe erosion (<25% ground cover). As expected the majority of fields in this category are fallow. Interestingly, there is a greater percentage in the black and grey zoil zones. This is because greater weed growth in the these zones requires more tillage operations during fallow.

Virtually, no standing stubble fields are seriously susceptible. However, over one third of worked stubble fields in the black zone are. Overall, it is somewhat surprising that the greatest percentage of seriously susceptible fields are in the black soil zone.

FIGURE XX



The previous results have considered erosion risk from October 1988 to seeding in 1989. Figure XXI now looks at serious erosion risk of seeded fields right after seeding in 89. Typical seeding practises are used for each soil zone. As expected most previous fallow fields will be susceptible to severe erosion. About three quarters of previous worked stubble fields will be susceptible. A large number of standing stubble fields in the brown soil zone will also be susceptible. Therefore, there may be an increase in the amount of reseeding required in 89.

FIGURE XXI

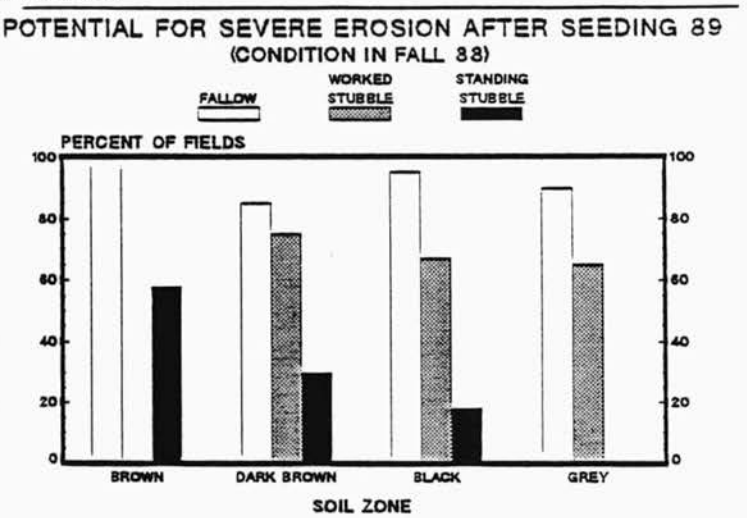
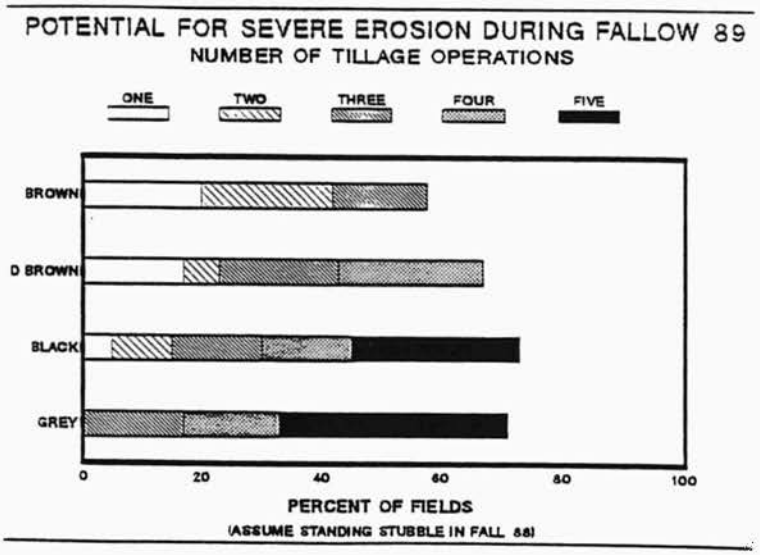


Figure XXII considers the threat of serious erosion for fields fallowed in 89, after various numbers of tillage operations. The fields included were all standing stubble in 88. The percentage of fields susceptible increases most quickly for the brown soil zone. However, the more northern zones usually require more tillage operations. As a result the percentage of fields susceptible to serious erosion will be well over half for all soil zones by the end of the fallow period. This emphasizes the need for farmers to implement soil conservation practises in 89.

FIGURE XXII



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Sapsford, K., Beaulieu, K. Save Our Soils program: Wide blade use near Biggar.

Rapp, B., Schweitzer, G. Save Our Soils program: Wide blade use near Kindersley.

Kohle, D. Coop Implements, Statistics on wide blade sales.