NB 3.1.3 Innovative People
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Topic: The Development of Better Farming Practices in Saskatchewan
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1. Beginning of Summerfallow

Professor John Macoun's optimistic reports of the agricultural potential of the southern area of Saskatchewan, known as Palliser's Triangle, and the decision to build the trans-continental railway through this region encouraged settlement by immigrants from the United States, Eastern Canada and Europe. In many cases, the new settlers were inexperienced with dryland farming techniques necessary to grow successful crops in this area characterized by low precipitation, high evaporation rates and recurrent periods of drought. C.H. Anderson wrote that "these settlers had come from areas having high rainfall and they had learned to farm with moldboard plows, disks, and harrows in an environment where there was no rush to plant seed early in order to benefit from spring rains" ("Settlement").

The "discovery" and promotion of summerfallowing by Angus MacKay of Indian Head was an important development for these early farmers trying to grow crops under conditions of inadequate precipitation. In the following excerpt, from a 1938 document entitled "Doctor Angus MacKay," the University of Saskatchewan's Dean of Agriculture, Dr. Lawrence E. Kirk, described the history of summerfallow in Western Canada beginning in the mid-1880s:

> Drought in '86 was just as spectacular and just as devastating to struggling farmers in the far-flung prairie settlements as frost had been two years before. But in that year Angus MacKay made a momentous discovery a discovery that was destined to make wheat farming a success throughout the three prairie provinces. It happened in this way: but to make a connected story we must begin with the previous year.
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> Before field work commenced in '85, the Riel Rebellion had broken out far to the north-west. Teams were required to transport equipment and supplies to forces operating in the neighbourhood of Battleford and Prince Albert. Money was scarce and the opportunity to earn ten dollars a day for a man and team was so attractive that all thought of farming was abandoned by most people for the time being. Before the outfits left, however, the new breaking was seeded, but the 400 acres that had produced a frozen crop the previous year could not be prepared or sown that spring. Eventually this land also was plowed and Mackay using a couple of horses that were not fit to take the trail, harrowed the field periodically

> to keep down weeds. Unwittingly he was preparing the first "summerfallow" in Western Canada.
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> The following year, that of '86, was memorable for the severity of the drought which visited the country. Thirsty fields were mocked by a leaden sky and hot winds seared the grain. Crops were ruined - all except Mackay's summerfallow which, like an oasis in a vast desert, flaunted a waving field of golden grain - grain which yielded 35 bushels per acre.
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> And this is where Mackay was able to make one of his greatest contributions to Western agriculture. Always quick to discern the significance of a new discovery and to recognize the magnitude of its practical value he at once announced the principle that drought must be conquered by conserving a portion of the rainfall each season for the use of crops the next year. This he said can be done by leaving a part of the land without a crop; and forthwith he set about finding out all there was to learn about a "summerfallow method" of grain farming. (2-3)

Angus Mackay was appointed first Superintendent of the Experimental Farm for the North-West Territories at Indian Head, when it was established in 1886. Mackay was a staunch advocate of summerfallow, and promoted its virtues whenever he could. The following quote from MacKay's 1889 report, "Experimental Farm for the North-West Territories," speaks to his faith in summerfallow: "Our seasons point to only one way in which we can in all years expect to reap something. It is quite within the bounds of probabilities that some other and perhaps more successful method may be found, but at present I submit that fallowing the land is the best preparation to ensure a crop"(in *Experimental Farms Reports 1887-8-9*, 133).

2. Soil Erosion Factors

Several factors contributed to the development of the "dustbowl" in the southern regions of the Prairies in the 1930s. Spurred by a high world demand for bread wheats, an astonishing bumper crop of 10 million metric tons in 1915, high grain prices due to rising demands brought on by the First World War and the advent of mechanization, huge tracts of land were broken for growing crops. Much of this land was flat, open prairie which could easily be brought into cultivation. In *A History of Soil Erosion by Wind*, C.H Anderson explained that "thousands of hectares of submarginal land were plowed up and cultivated. Consequently, this area of low precipitation, comprising 20 million hectares of grassland that had supported buffalo herds for centuries, was suddenly exposed to the full force of the prairie winds" ("Agricultural Development").

Summerfallow was carried out in the early part of the twentieth century as a means to conserve moisture, to control weeds and to get an early jump on seeding. Soil drifting was observed far earlier than the 1930s, when the startling images of black blizzards, drifts and destitution enter our collective conscience. However, the practice continued as there were significant advantages in yield where crops were grown on summerfallowed land (Johnson and Smith, "Early Years in the Province, 1906 to 1920"). Central to the soil drifting problems on summerfallowed land was the practice of "black" or "bare" summerfallow, which was promoted by agricultural experts of the day. *In Men Against the Desert*, James H. Gray described the science behind the experts' promotion of this practice:

> By capillary action, moisture was drawn to the surface and when the surface of the soil was cultivated it broke up this capillary action movement. It followed, therefore, that scientific summerfallowing required that a fine, dry dust mulch be maintained on the surface and that the land be plowed after every rain to prevent surface caking and clods from developing. (81)

In a cruel twist of fate, the farmers who followed this scientific advice to the letter were the first to see their topsoil blow away. Of the factors contributing to the "dirty thirties," Gray wrote, "It is one of the ironies of Canadian history that the worst damage to the soils of the Palliser Triangle was done by the best farmers. ... It was those who followed the best scientific methods, those who plowed and manicured their summerfallow with infinite care and patience, who were the primary fashioners of the disaster" (18-19).

Soil drifting in the prairies was already being questioned by the 1920s . The following excerpt from the 1920 *Royal Commission into Farming Conditions in Saskatchewan* foreshadowed the disaster that would come:

> For over thirty years, the summerfallow once in three years has been the practice upon which successful grain growing has been carried on in Eastern and Central Saskatchewan. Until this plan of storing moisture was devised, crop failure was as frequent and just as serious in the eastern part of the province as it is now in the southwest. But while it stabilized grain growing it was learned that when the root fibres of the native prairie plants had been worked out or destroyed by plowing and cultivating, the land developed a tendency to drift, and this has been the history of most open plains districts where grain growing has been carried on for a dozen years or so, while some have reached this stage much sooner. The southwest being more recently settled than any other part of Saskatchewan should not yet experience soil drifting... ...Soil drifting is one of the most serious conditions in connection with grain growing on the lighter soils in Saskatchewan and calls for immediate action.(as quoted in Gray 24-25)

What the cure will be is not fully apparent...

The practice of black summerfallow was not the only contributing factor to the devastating soil drifting that marked the “dirty thirties,” but the effects were exacerbated by several auxiliary circumstances. In *A History of Soil Erosion by Wind*, Anderson wrote, “The main reason for the severe soil drifting that occurred on the prairies was that a cultural system was introduced that was not adapted to the ecological environment. The introduction was very rapid, on a large scale, and it coincided with periods of low precipitation, high winds, insect and disease outbreaks, and economic distress” (“Summary”).

The gravity of the soil drifting situation, is put into perspective from statistics quoted in the 1937 Department of Agriculture’s publication 568, *Soil Drifting Control in the Prairie Provinces.* The publication reports: “One inch of surface soil blown from a single section of land means the movement of approximately 100,000 tons of soil” (Hopkins, Palmer and Chepil, 6). Estimates made in 1934 at th Regina Sub-station are startling. Over the course of the season, soil movement from a quarter section of summerfallow to an area of stubble “was equivalent to a loss of almost 1.25 inches of topsoil from the whole quarter section or approximately 195 tons per acre” (Hopkins et al., 6). The drifting was a serious problem in the fields, but its effects were more far-reaching than the farmstead. “During the 1930's, the wind moved millions of metric tons of soil from fields, burying fences lines and blocking district roads. The drifts choked out shelterbelts and gardens, reached the roofs of outbuildings, and seeped in the cracks around farmhouse windows and under doors,” wrote Anderson. (“Soil Drifting”). In addition, the drifting soil was a menace to “railway right of ways” and to life in the adjacent settlements. During wind storms, the blowing soil became a dangerous hazard to drivers. Driving became hazardous in some. Hopkins et al. wrote, “This [the dust] has been so bad in some prairie towns that traffic on the streets has had to be abandoned during a wind storm. Driving under such conditions has caused accidents on town and country roads. Even in cities it has been necessary to use lights during the day, as is sometimes required in a dense fog” (8).

3. Cooperative Effort

The drought and the winds were of Mother Nature’s making. The collapse of world markets was beyond the control of the farmer. In the face of these stark challenges, provincial and federal governments, research stations and universities, in concert with farmers on the front lines, launched a cooperative effort to fight the desertification of the Palliser Triangle by reclaiming the ravaged lands, and developing more sustainable agricultural practices (Regehr, 64). When we think of the Great Depression we think of dust, destitution and despair. However, an important legacy came from these hard times. A legacy of endurance, strength, ingenuity and innovation was born of this period. In a quote from Barry Broadfoot’s *Ten Lost Years*, an anonymous survivor of this time recalled, "Remember in some ways it was a tremendously exciting time. People found strengths they did not know they had. They learned they could endure, and endure and endure and endure some more" (17).

In *Men Against the Desert*, James H. Gray speaks passionately of the collective effort:

> ...the discoveries they made and the methods they devised will pay dividends in increased food production in the semi-arid areas of the world for generations to come. Who were the people who did all this, and what did they do? "They " were the 50,000 bankrupt farmers who lived on relief throughout the "Dirty Thirties inside the famous Triangle that Captain John Palliser said should never be settled; who fought the scorching wind, the blowing dust, the drouth, hail, frost, grasshoppers and rust from one crop to another, and never gave up. "They" were the dedicated legion from the Dominion Experimental Farms who provided not only the leadership but the muscle and equipment that was required to mount the campaign against the desert. "They" were the agricultural engineers, and the university researchers, the soil scientists, entomologists, plant breeders and animal husbandmen who often worked around the clock with the farmers in the fields. "They" were the people who brought the Prairie Farm Rehabilitation Administration into existence - more, the people who fought it into existence. (1-2)

4. Early Developments

Soil drifting began to raise concerns in the 1920s, and farm abandonment began to rise. In response, the Royal Commission into Farming Conditions in Saskatchewan was established in 1920 to investigate dryland farming. The Commission recommended that a new Experimental Station be set up at Swift Current, specifically to study and find solutions to dryland farming problems. James H. Gray touted this recommendation as "the suggestion which history will probably judge one of the most important ever to come out of a Royal Commission" (23). However, the idea of a research station to study dryland farming was not a new one. The Hon. W.R. Motherwell, Saskatchewan Minister of Agriculture, wrote letters in 1910 and 1911 to his federal colleague, the Hon. Sydney A. Fisher regarding provisions for a research station in Saskatchewan's dry southwest (Campbell, 13). Farmers were also thirsty for scientific answers to their problems as expressed in an article entitled "Another Government Experimental Farm Wanted" which appeared in the Vol. 10, April 1920 edition of the *Saskatchewan Farmer Magazine*. According to the article, "For several years farmers in the southwestern part of the Province of Saskatchewan that is in what is called the dry district, have been clamoring for an Experimental Farm" (as quoted in Campbell, 13).

A second important early development came out of the Better Farming Conference held in July of 1920, which was sponsored by the Saskatchewan Department of Agriculture. A lack of a soil survey was an impedance to developing better farming methods. Work began to survey the soils in the agricultural regions in the province in 1921 as a result of the Conference. Work was begun by the University of Saskatchewan's Department of Soil Science. Soils Report 10 was completed by 1936, and encompassed most of the areas under cultivation. By 1950, Soils Report 13 completed the survey of the soils within Saskatchewan's Agricultural regions. According to the University of Saskatchewan's Department of Soil Science, "Saskatchewan, unlike other provinces, had comprehensive coverage of all agricultural lands, leading to improved application of soils research to specific soil characteristics and problems" (University of Saskatchewan College of Agriculture website "1921-1950: Soil Survey"). The Soil Surveys were an important tool for researchers and farmers - one that the early settlers did not have the benefit of in selecting their lands.

5. Important Contributions of the Dominion Experimental Stations

Many of the measures developed to stop soil erosion were not Saskatchewan innovations. However, Experimental Station and University staff were very involved in the research and refinement of new cultural practices and machinery that were being used to beat back the desert. Farmers were also busy during this time doing experimentation of their own. The innovation here lies in the momentous, wide-scale effort to search out, refine and apply the most scientifically sound and proven methods and equipment like strip farming, trash farming and the Noble blade. It lies in the cooperation between governments, universities and farmers searching for solutions to common problems. It lies in the endurance of all involved, as the solutions were developed and applied over the course of years. The truly amazing thing here is that eventually the desert was beaten back; the degraded soils were stabilized, some restored to crop land, while submarginal lands were regrassed and developed into important community pastures; a move towards more sustainable farming practices began; small and large scale water projects and shelterbelts were developed by the P.F.R.A; and the Palliser's Triangle once again became a successful grain growing and grazing region. To put the gravity of the effort into perspective, it was estimated that at the height of the disaster, one-quarter of Canada's arable land was affected (Gray, 11). Likewise, the Rt. Hon. J.G. Gardiner admitted that a total evacuation of farmers in Saskatchewan's southwest had been considered by government during the 1930s, when he addressed a meeting in Gull Lake in 1940 (PFRA "PFRA and Irrigation in Southwest Saskatchewan").

Although the Swift Current Research Station was dedicated to finding solutions to dryland farming problems, all of the stations in the prairie region acted in concert. During the dust bowl, the Experimental Farms and Stations at Swift Current, Indian Head, Scott, Rosthern and Lethbridge were all involved, and according to Gray, "the other stations kept each other advised of the results and directed questions germane to their specialties to the other stations" (81). Gray provides a sketch of the work undertaken by the Experimental Farms in *Men Against the Desert*:

> They went everywhere the dust blew, made speeches, organized listing bees, set up seed depots, supervised the mixing of grasshopper bait, and helped convert and repair farm equipment. They ate when they could, slept where they could and when they could. They choked in the dust with the farmers on the land, sharing each problem as they became part of the solution.
>
> And, retrospectively at least, they loved every minute of it, remembering it with relish as long as they lived. (95)

It is hard to give any one person credit for developments which occurred, because many parties had a hand in what was going on including the farmers themselves. Dr. Archibald, Director of the Experimental Farms Service at the time, recalled the role of the farmer:

> It was really the farmers themselves who got the job done. I never ceased to be amazed at the wonderful co-operation we got from western farmers in those years. All we had to do was ask and they would come from miles around to help. And it wasn't always simply a matter of us telling them what to do. They had ideas of their own, and they thought nothing of driving 15 or 20 miles to Swift Current or Lethbridge... ...Of course they had confidence in our people. The farmers knew that they were working as hard as it was humanly possible to solve their problems. But without the marvellous co-operation of the farmers everywhere we could have accomplished very little. (Archibald as quoted in Gray, 124)

6. The Adoption of Trash Farming

Trash farming was one of the most significant developments in the search for answers of how to save the soil and restore its productivity. Trash farming or ploughless fallow, whereby crop stubble and other plant material is preserved, rather than being buried, was heavily promoted as an effective measure to decrease soil erosion during the 1930s. However, the idea of trash farming was discovered some years earlier by a Sibbald, Alberta area farmer named J.H. Bohanon. The advantages to not burning crop stubble prior to summerfallowing were also recognized by Asael Palmer of the Lethbridge Research Station by the early 1920s (Gray, 86-87). It had been drilled into the psyches of farmers that a bare, finely pulverized "dust mulch" summerfallow was the sign of a good farmer. These practices were difficult to unlearn, and the following story by the Swift Current Experimental Farm's Grant Denike, explains both the common thinking of the day and the reason why it had to change:

> A farm a few miles south of Swift Current, on which the dry mulch-fallow method was practiced, was selected as an example of what could be achieved by good farming methods. The farm operator was awarded a Better Farming Certificate by a local service club. There were no weeds, no stones, no trash, and no cultivator furrows anywhere on his half section. Its surface was as smooth as a billiard table. But the day after the farm was so singularly honored, the *west wind* started to blow. It blew for three days, at a velocity as high as 35 miles an hour. When the wind abated, the soil had been swept away to the depth of cultivation. (Denike as quoted In Campbell, 29)

Soil scientist Sydney Barnes of the Swift Current Research Station was instrumental in laying the scientific groundwork for change. Barnes' research "exploded" the traditional theory of capillary action, upon which black summerfallow was based. He determined that it was in fact the control of weeds that was the true moisture conserver versus the practice of a dry mulch-fallow (Gray, 82). The whole practice of summerfallow as it had been traditionally carried out had to be un-learned by prairie farmers. It was now recognized that tillage should be kept to a bare minimum, and that land should only be worked to control weeds. As well, the preservation of surface trash and a cloddy soil surface were important to prevent soil drifting (Gray, 83). Barnes was also instrumental in proving the important theory, that "Evaporation of the moisture could be substantially reduced by insulating the surface of the soil from the turbulence of the hot winds" (Gray, 250). Of the discoveries made at Swift Current, Gray wrote, "In a real sense, the discoveries...had the same effect as if rainfall within the Triangle had been increased by an inch or two" (250).

The timeliness and importance of Barnes' research is outlined in the "Division of Field Husbandry Progress Report for the Years 1931 to 1935" (38-40) in the Dominion of Canada's *Experimental Farms Reports: 1930-1938*:

> The amount of soil moisture present in the soil is the most important single factor affecting crop production in the semi-arid areas of the Prairie Provinces. This fact has been demonstrated in a striking manner during recent years of severe drought. For this reason the results of soil moisture experiments which have been conducted under the supervision of the late Sydney Barnes on the Dominion Experimental Station at Swift Current, Sask., since 1922 have an important and timely bearing on dry land agricultural practices. (38)

The following excerpt from the *Report* explains the interesting methodology that Barnes contrived to conduct his soil moisture experiments:

> In these experiments crops are grown in soil contained in cylindrical water tight

> tanks, 15 inches in diameter by 5 feet deep. These tanks are placed in small pits of sufficient depth that the surface of the contained soil is ta the same level as the surface of the surrounding land. Arrangements have been made whereby these tanks may be conveniently weighed, and any increase or reduction of spoil moisture in the tanks is readily determined. The soil in the tanks may be exposed to natural precipitation or sheltered therefrom at will, so that the amount of moisture in the soil may be controlled. With this equipment the effect of varying amounts of soil moisture on plant growth can be accurately determined.(38)

Through his soil moisture experiments, Barnes was also able to determine what plants could be grown in the Palliser Triangle, and he determined the upper and lower limits of moisture for plants growing in the Triangle (Gray, 82).

W.S. Chepil, who took over the Soils Laboratory in 1935 after Barnes'death, gained an international reputation for his soil and wind research as well. Notably, Chepil devised an indoor wind tunnel for use in his experiments. Chepil's "pioneering work" was instrumental in the development of the "first mathematical model used to predict wind erosion" (Ellert and Padbury, *The Health of Our Soils*, "Modelling Erosion").

Sidney Barnes and W.S. Chepil, in collaboration with Lethbridge's Asael Palmer and E.S. Hopkins of Ottawa, were involved in producing the pamphlet entitled, *Soil Drifting Control in the Prairie Provinces*. The pamphlet was developed to put the know-how of how to stop the drifting, garnered by the Experimental Farms' staff, into the hands of the people on the front lines. Barnes and Chepil provided much of the scientific material for the pamphlet; Palmer was the primary writer; while Hopkins was involved in the editorial aspects. So successful was the pamphlet, that it was printed in large quantity four times between 1935 and 1946 (Gray, 91-92).

7. Strip Farming

Strip farming was first developed by the Koole brothers in southern Alberta in 1917, where significant soil drifting had already become a problem. The observations which led to the development of strip farming are explained in *Soil Drifting Control in the Prairie Provinces*:

> Some farmers near Monarch, in southern Alberta, noticed that the last place to drift was on the west part of their fields and that the prevailing winds were generally from a westerly direction. They noticed also that frequently the west ten or twenty rods of the field did not drift at all if drifting conditions were not too severe. These observations soon led to a division of the fields into alternate strips of fallow and grain, a practice which has been so helpful that it has now been widely adopted... ...They have been able

> by this means, along with proper cultural practices, to practically prevent drifting on their farms, although unstripped fields in the same vicinity have drifted nearly every year. (Hopkins et al., 9-10)

Strip farming on its own was not the savior of the soil. Farmers were cautioned in *Soil Drifting Control in the Prairie Provinces* that "stripping is only an aid," and that "the best cultural methods be adopted for summer-fallow strips, in order to secure as much trash cover as possible, or to maintain the soil in a lumpy condition" (Hopkins et al., 10).

In Saskatchewan, strip farming was most extensively adopted in the southwest, with good results in severely drifting areas (Archibald, 166). In a 1940 *Canadian Geographical Journal* article entitled "Prairie Farm Rehabilitation," E.S. Archibald, of the Dominion Experimental Farms Service wrote, "it was only by the adoption of the same practices found at Monarch that any reasonable control was established [in areas like Shaunovan and Gull Lake]" (166). Much of the strip farming activity involved the organization of strip farming associations. Groups of farmers at Rosetown, Shaunovan, Gull Lake, Aneroid and Limerick were among those noted to have adopted the practice. Farmers were keen and took it upon themselves to promote strip farming within their districts. The following excerpts from A.E. Palmer's "Organized Methods of Soil Drifting Control" article in the *C.S.T.A Review*, identify several successful examples:

> "A group of farmers from Rosetown, Saskatchewan, hearing of the Nobleford experience, visited that locality in the early thirties and many of them adopted strip farming"(35).
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> "The Limerick Strip Farming Association succeeded in getting a large majority to adopt the strip farming method. Good results were obtained and the system has been adopted by practically all farmers in the district" (35).
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> "At Shaunovan, Saskatchewan, a large percentage of farmers voluntarily adopted strip farming and the highest type of cooperation was shown. Difficulties arose in 1937 when the crop failed to grow but emergency measures were used in which listed strips replaced the stubble strips and the 1938 crop was well protected" (35).

There were several problems related to the practice of strip farming. Among them, grasshopper, wheat-stem sawfly and weed infestations, ridging and drifting summerfallow strips where inappropriate cultural methods were practiced. Due to these problems, many farmers turned their attention to trash cover farming for a longer-term solution (Hopkins et al., 9-12, Gray, 89 and 239).

8. The Search For Implements

Implements like the moldboard and disc plow, utilized by the early prairie settlers on the fertile, virgin prairie, were no longer suitable as the practice of black summerfallow was abandoned in favour of more sustainable methods, which emphasized the importance of preserving trash cover, shallower cultivation and fewer tillage operations. A new generation of implements were necessary to aid in the control of drifting soils and to carry out the new cultural methods that had been proven successful by the Experimental Farms and Universities. A combination of weed control and trash conservation were desired attributes (Wetherell and Corbet, 119-125).

The Experimental Farms, particularly at Swift Current, and the University of Saskatchewan were heavily involved in investigating and evaluating new equipment, modifying existing equipment to meet new demands, consulting with farmer-inventors and conducting extension services to educate the public. Researchers like Grant Denike and H.J. "Shorty" Kemp of the Swift Current Research Station were dedicated to finding implements which preserved a cloddy soil structure (Gray, 83).

Farmers worked tirelessly in their efforts to find suitable equipment, both on their own farms and in consultation with Experimental Station and University staff. Of this drive to develop better equipment, Gray wrote:

> The most intriguing aspect of the whole saga of the struggle against the desert in the Palliser Triangle must surely be this: At a time when nature was going the worst, and a consensus grew that Palliser had indeed been right, the farmers themselves were engaged individually and collectively in a personal search for farm implements to unlock the secrets of successful dry-land farming. (238)

Although the incubation time between idea, construction, testing, refinement and production of suitable implements could take years, the pace of those involved was frantic as the threat of the desert was ever-present. Due to high demand, the University of Saskatchewan put on 120 machinery field days over the course of the summer of 1937, compared to just seven a decade earlier (Gray, 239). Staff at the Swift Current Research Station often faced 16 hour days to accommodate the flow of requests and farmer visits (Gray, 124).

8.1 Trash Farming Implements

Out of the evaluation process, duckfoot cultivators, one-way discs, rod weeders and Noble blades showed promise. The following paragraphs provide descriptions of these implements and the issues surrounding their applications and disadvantages.

8.1.2 DuckFoot Cultivator

Duckfoot cultivators became popular by the 1920s to control weeds, but were prone to clogging and proved to be "too light for primary tillage" (Wetherell and Corbet, 120). In *Soil Drifting Control in the Prairie Provinces*, the applications of duckfoot cultivators were described: "Where soil drifting may occur, the duck-foot cultivator performs several very useful functions. It may be used to prepare the soil instead of ploughing. It is very effective in destroying weeds. It does not unduly disturb the surface soil and it leaves stubble and trash at the surface as a protection against drifting" (Hopkins et al., 23).

8.1.3 One-Way Disc

The heavier one-way disc was an important development in the move towards trash farming in the 1930s. However, the reviews of the one-way were mixed. The authors of *Soil Drifting Control in the Prairie Provinces* provided this description of the one-way disc: "The one-way disk can be used in many cases to displace the plough. It is useful in heavy stubble as much of the stubble is left partially buried at the surface where protection against soil drifting is provided. In short stubble the use of a duck-foot cultivator is preferable as the one-way disk may bury the stubble completely" (Hopkins et al., 24). H.A. Lewis of the University of Saskatchewan described the one-way as "cantankerous" (Lewis as quoted in Gray, 243). The one-way was plagued with hitching and side draught problems, and required extra weight in hard and heavy soils (Wetherell and Corbet, 122 and Gray, 243). The University of Saskatchewan had to set up field days just to teach farmers how to operate them (Wetherell and Corbet, 122). On short stubble or land with little or no trash cover, the one-way was a dangerous implement. In the "Division of Field Husbandry Progress Report For the Years 1931 to 1935, Part II," the Swift Current Station cautioned that the one-way "has a pulverizing effect on the soil, while the cultivator leaves the land in ridges that are much less subject to soil drifting. As the use of the cultivator is also cheaper, it is to be recommended for the preparation of summer-fallowed land for grain" (Hopkins,33).

8.1.4 Noble Blade

The Noble Blade, designed in 1936 by Charles S. Noble of Alberta, was one of the first breakthroughs in being able to put the new cultural methods into practice. Noble's design, inspired by a sugar beet digger he had observed on a farm in California, incorporated a large straight blade, which was later changed to a v-shape. In *Breaking New Ground*, Wetherell and Corbet explain the premise for Noble's invention: "He saw that if the weeds were cut below the surface without turning the soil, the weeds and stubble left anchored in the soil would provide protection from wind erosion and evaporation" (124). Noble sought out the assistance of Swift Current and Lethbridge Experimental Station staff to help make modifications, and the

Experimental Farms Service began recommending its use (Gray, 89). The Noble blade couldn't be used to perform pre-seeding tillage operations to ready land for planting, and farmers often found the one-way disc to be more adaptable (Wetherell, 124). Although popular in Alberta, the attention of Saskatchewan farmers was more focused on the development of disc-type implements (Friesen, 390).

8.1.5 Rod Weeder

The rod weeder was another important implement which had applications for trash cover farming. In *Soil Drifting Control in the Prairie Provinces*, the virtues and limitations of the rod weeder were outlined:

> The rod weeder is an effective weeding implement where soil drifting is feared and where conditions are satisfactory for its operation such as level fields, friable soil and relative freedom from stones, as it leaves the surface of the soil undisturbed. This implement is used chiefly on summerfallow after the cultivator or one-way disk. The use of the cultivator and rod weeder forms a very satisfactory practice for destroying weeds and maintaining a protective covering of trash on the surface of the soil. The rod weeder does not create a lumpy surface, it merely preserves an existing condition of the surface of the soil if run about three inches deep. (Hopkins et al., 24).

According to Wetherell and Corbet, "The use of rod weeders was initially limited by the fact that the rod either broke or was thrown out of the soil when it hit a stone" (132). George Morris, an implement dealer from Bangor, Saskatchewan, provided the solution to this problem. Morris' foray into implement design and manufacturing was an early example of how Saskatchewan innovation has responded to meet local needs. In this case, large full line manufacturers of the day were not offering suitable equipment to meet the needs of farmers working stony land on the prairies. The following excerpt from *The Morris Story* by describes the chain of events in the development of the Morris Rod Weeder:

> In 1927, as George was repairing his neighbour's broken implement, he began to see the need to develop a trip mechanism that would allow the rod to momentarily lift out of the ground and clear an obstruction when it encountered strong resistance. By 1929, he had patented his new over centre trip design and was producing the first horse-drawn, eight-foot Morris Rod Weeder.
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> The idea of the rod weeder with a protective trip mechanism caught on quickly. Because the demand for the new machine soon exceeded the production capacities of the small shop, some phases of manufacturing were handled by a

production firm in Portage La Prairie, Manitoba [in 1935] (DeRyk, 3).

8.1.6 Post Depression Era Implements for Trash Farming

Innovation and invention in equipment for trash farming and reducing tillage continued beyond the depression era. The development of the discer with an attached seed box in the late 1940s was an early move toward direct seeding, whereby tillage and seeding were accomplished in one-pass, directly into stubble. The discer was a Saskatchewan innovation which left more trash on the surface than its predecessor the one-way, and were larger in size due to reduced draught - a timely development due to increasing farm size at the time (Wetherell and Corbet, 122-123). Saskatchewan inventors and manufacturers also made important contributions to the development of the heavy duty cultivator, which is also known as a chisel plow. Heavy duty cultivators featured higher trash clearance, and preserved more surface trash than disc type implements.

The development of the coil land packer by Asquith, Saskatchewan area farmer Emerson Summach, was another important development for trash cover farming. The Summach design "consisted of a single steel coil about 18 inches in diameter. The coil had no spokes and was simply a continuous piece of coiled steel" (Wetherell and Corbet, 135). In *Breaking New Ground*, Wetherell and Corbet describe the Summach Packer: "The coil packer was a simple but ingenious design with significant advantages over existing types. It followed the contours of the land, it worked well in stony land, and it did not pulverize the soil" (135). In addition, the herringbone pattern produced by the coil packer helped to prevent erosion (*Saskatoon Star-Phoenix*, Flexi-Coil, G5). Emerson Summach moved to Saskatoon and set up a small company called Flexi-Coil to manufacture and distribute his packer. 4000 packers had been produced by 1957. The company was taken over by Emerson Summach's son Terry following his death in 1964. Flexi-Coil expanded to produce harrow packer draw bars, tillage, air seeding and spraying equipment, with a continuous commitment to research and development that has established them as an industry leader.

9. Emergency Measures

Although soil drifting and erosion were serious problems in many areas across the prairies during the1930s, there were regions where the blowing had reached such proportions that emergency measures had to be instituted. Often, farms in these areas were simply abandoned, which was cause for concern for adjacent farms and the municipalities in which they were located. The Experimental Farms, working through the P.F.R.A., undertook the monumental task of tying down the soil and reclaiming these disaster areas which became known as Reclamation Stations. Experimental Farms personnel were successful in gathering firsthand information for farmers as to what worked and what didn't. The work on the Reclamation Stations was pivotal, because if the worst areas could be brought under control, there was hope for the rest of the affected farms. In the article "Soil Erosion Control" in the 1939 *C.S.T.A Review*, W. Gibson and P.J. Janzen summarized the work on the Reclamation Stations:

> In some of the most severe drifting areas, such as Cadillac, Estevan, Aylesbury and Kisbey in Saskatchewan, the Dominion Experimental Farms through the Prairie Farm Rehabilitation Act have acquired a number of drifting tracts for the purpose of obtaining information on the best methods of control and permanently tying down the soil with a grass cover. Already sufficient information has been obtained on the various projects to enable a definite statement that the drifting soil can be controlled. (68)

Emergency measures imply a quick fix to the problem at hand. However, the work on the Reclamation Stations was laborious and success was measured in small strides. Setbacks were common, and were not always of mother nature's making according to Gray who wrote,"The soil on the Mortlach project was sufficiently controlled in the fall of 1936 that a good catch of fall rye was obtained. Several hundred acres of greenery were too much of a temptation for the farmers in the district. They opened their gates and turned their famished cattle into the fields, nullifying the year's work" (140-141). The steady but slow progress of the Swift Current Experimental Station is explained by Campbell:

> Four of the worst in southwestern Saskatchewan were at Mortlach, Meyronne, Vanguard and Cadillac. These lands were rife with conditions of desert intensity. Their reclamation was assigned to the Swift Current Station, and after three summers of work all areas were completely stabilized. Transformation was slow and often discouraging, particularly when two months' work could be lost by a one-day windstorm. (34)

Anderson outlined the basic procedure for stabilizing drifting fields in *A History of Soil Erosion by Wind*:

> First, the soil movement was stopped by means of listing and ridging the fields in order to trap the moving soil. As soon as the drifting was stopped, these areas were seeded to a cover crop of winter rye, which had been found to establish readily. Grass was seeded into the stubble the following year, after the rye was harvested. The rye stubble shaded the grass seedlings and trapped snow, which provided additional moisture for growth next spring. This technique for seeding grass was used successfully to return large areas of badly eroded land to grass.

In addition to the emergency measures undertaken on the abandoned land of the Reclamation Stations, there were also vulnerable areas on farms under cultivation. Hopkins et al.explained, “It may be necessary sometimes to supplement a permanent control practice with emergency measures. In principle these emergency measures closely resemble the permanent practices in that they aim to place obstructions in the path of moving soil in order to check drifting before it can assume appreciable proportions” (19). The following list from page 20 of the same publication outlines the suggested emergency measures to treat drifting areas:

1. Listing summer-fallow fields in the fall.
2. Ploughing furrows one rod apart through the field.
3. Ridging by means of the duck-foot cultivator.
4. Application of straw or manure.
5. Disking during winter months.
6. Reploughing deeply.

10. Prairie Farm Rehabilitation Administration

In “Prairie Farm Rehabilitation,” in the Canadian Geographical Journal, Dr. E.S. Archibald, Director of the Experimental Farms Service, described the conditions leading up to the Prairie Farm Rehabilitation Act in 1935:

> Shrinkage of income rendered many farmers incapable of dealing with the soil drifting menace, or even of continuing normal farming operations. In whole municipalities the capital value of the community farm enterprise declined to less than its mortgaged indebtedness. Large governmental expenditures for relief, and to enable farmers to continue operations, became necessary. Under such circumstances the economic structure of the region was subjected to severe strain, and social services were threatened with disruption.
>
> The nation-wide repercussion of the drought crisis led the Dominion Government to introduce various measures for the alleviation of distress and the reorganization of agricultural economy in the affected region. One of these measures was the rehabilitation programme initiated in 1935 by the Prairie Farm Rehabilitation Act (P.F.R.A.). (161)

The Prairie Farm Rehabilitation Act was initially brought forward by the Hon. Robert Weir who was the Minister of Agriculture under R.B. Bennett, but was not implemented when Bennett’s Conservatives were defeated. It was implemented under the new Rt. Hon. William Lyon McKenzie King’s Liberal government. Of Mckenzie King’s choice for Minister of Agriculture, Campbell wrote: “Fortunately for Canada, the Triangle, and the farmers, Mr. King chose the Rt.

Hon. J.G. Gardiner as Minister of Agriculture" (29). As the former Premier of Saskatchewan and a farmer from the Melville district, Gardiner grasped the gravity of the situation very well (Campbell, 29). Gardiner selected John Vallance of the Kindersley area as the first Director of Rehabilitation, who was able to get the organization up and running. Gardiner took a hands-on approach, and according to Gray, "Mr. Gardiner, during the next year, spent almost as much time in Saskatchewan as he did in Ottawa, and was in fact on a tour of the dust bowl in July 1936 when the heat wave was at its worst" (118-119). Interestingly, the PFRA's boundaries roughly trace those of the famous Palliser Triangle (PFRA, "PFRA: A Brief History").

The following paragraphs explain the multi-faceted role of the PFRA, its contribution to the rehabilitation of the drought areas of the southern prairies and the legacy of the program today.

10.1 Experimental Substations

Provisions were made for the establishment of District Experimental Substations. In *A History of Soil Erosion by Wind,* Anderson summarizes the important role of the substations:

> The substations became centers for the development of the most effective soil conservation practices within their districts, covering a wide range of soil conditions and climate. Each substation served its district as a test center from which recommendations were made on the cultural practices and crop varieties best suited to those districts. As soil drifting was controlled on the substations neighboring farmers copied the methods, and their successes were, in turn, noted and used by others. ("Creation of Substations")

10.2 Agricultural Improvement Associations

The formation of Agricultural Improvement Associations (AIAs) was an important aspect of the PFRA program in the 1930s. The AIAs were coordinated by the Dominion Experimental Station in their area, and supported by cash grants from the PFRA to cover administration costs. Cliff Shirriff, AIA Supervisor at the Swift Current Experimental Station, explained that "It was fully realized that no matter what recommendations were made, the organization of the farmers themselves was prerequisite to the adoption of any change in farm practice" (*C.S.T.A. Review*, 32). Soil degredation and drifting was a community problem, and a community effort was necessary to rectify the situation (Palmer, 35). "Their purpose was to bring farmers together in organized groups to exchange ideas, inform PFRA and provincial agencies of conditions needing attention, and act as an exchange through which special activities could function and assistance be given." wrote Anderson ("Agricultural Improvement Associations"). Through the AIAs, activities such as the distribution of lister shovels, crested wheat grass seed and trees for planting shelterbelts were undertaken. The listing bees organized by the AIAs were invaluable tools to stabilize the drifting soils across the prairies. In 1940, Dominion Experimental Farms Director E.S. Archibald recalled, “The very considerable improvement in farm practices which have been effected on the prairies in recent years is largely attributable to the co-operative and educational activities of the A.I.A.’s” (in *Canadian Geographical Journal*, 163).

Farmers embraced the AIAs, and by 1939 there were 192 Associations organized, comprised of some 30,000 members. The farmers’ thirst for information is illustrated by a story of Cliff Shirriff’s, Swift Current’s AIA organizer, in Gray’s *Men Against the Desert*. A farmer at a field day in Cabri reportedly said:

> ‘Cliff Sherriff (sic),’ he said, ‘I’d like to say something to you before we start. We aren’t here today for social talk and we didn’t come here just to visit with you. We’re here to learn how to control soil drifting. We’ve got a problem and we want you to tell us how to fix it. If you can’t do that, tell us right now and we’ll go home. But if you’ve got any answers for us, if you can tell us anything that will help, we will stay with you till the cows come home!’. (123-124)

The following excerpts from the article “Soil Drifting Control” by A.E. Palmer in the 1939 *C.S.T.A Review*, speak to the palpable improvements made possible through the tenacious and cooperative spirit of AIA members:

“The Swift Current Station reports practically no damage from soil drifting in areas where Agricultural Improvement Associations are established under their direction” (36).

“The farmers displayed a fine spirit of cooperation in the face of great difficulties. At Tompkins, Saskatchewan, for example, the first attempt to work the whole area of 30,000 acres failed due to heavy winds coming up before sufficient work had been done to hold the soil. The work was started the second time and then the third time before being completed. A good crop was finally established and the whole area controlled” (36).

10.3 Community Pastures

An important legacy of the PFRA’s work during the 1930s was the establishment of the community pastures program in 1937. Methods of how to stop the drifting soils were known, what was uncertain however, was what to do with the land once it had been stabilized. All across the Palliser Triangle there were large tracts of land that never should have been broken by the plow. In the early days of settlement, submarginal lands had been cultivated during a period of sufficient precipitation and in response to a high world demand for bread wheats. By the 1930s, much of this land was abandoned and blowing out of control, and essentially unfarmable by any families who remained in these areas. The community pastures program was the answer. The areas were taken out of cultivation permanently and the soil drifting was controlled. These areas were then regrassed with a drought resistant, perennial grass sown directly into the weed cover. The benefits of the community pastures were many-fold, not the least of which were the permanent removal of submarginal lands from cultivation and the economic benefits of providing neighboring farmers with good pasture land for raising livestock.

The governments of Saskatchewan and Manitoba showed a great commitment to the development of community pastures. In the online document *Prairie Land and Water Resources - the past 100 years*, the political process which facilitated the formation of community pastures is explained:

> The provinces of Saskatchewan and Manitoba, passed enabling legislation to permit lands unsuitable for cereal crop production to be transferred to the federal government for development by Prairie Farm Rehabilitation Administration (PFRA) into community pastures. The province concerned selected the area and obtained control of the land, which was then leased to the Government of Canada for PFRA to construct, maintain and operate the required community pasture facilities. (PFRA, "Community Pastures")

One of the first steps in building the community pasture system was to fence off the land. An added benefit to their development was the provision of much needed relief work to farmers during the very grim year of 1937. It is estimated that in Saskatchewan during 1937, 120,000 post holes were dug, 600,000 staples were used and an astounding 5,000 miles of barbed wire were strung (Gray, 168). In *Men Against the Desert*, Gray wrote about how desperate people were for the relief work:

> . . . money was once again circulating in Kerrobert, Yellow Grass, Ormiston, Watrous, Dundurn, Radville, Hardy, Hitchcock and Bienfait. The fence-building farmers were paid 35 cents an hour, worked a 10-hour day and were so starved for work that they provided PFRA with its first public relations problem. A demand arose from those who were not hired that the work be spread around, that a limit be placed on the length of time any one man could hold a job. Except for a few key men needed as straw bosses, the work was indeed rationed and after a couple of weeks, crews were laid off and new crews hired. (168)

Crested wheat grass played an important role in the establishment of the community pastures. In the words of Gray, "few Canadians have ever played so large a role in changing the face of the earth as Dr. Lawrence E. Kirk, and few seeds of grass have ever been so face-changing as the crested wheat grass he developed at the University of Saskatchewan" (96). A strong statement, nevertheless, the impact of crested wheat grass in reclaiming abandoned fields and depleted pastures in the drought scourged prairies of the Dirty Thirties, and in other semi-arid areas around the world, can't be overstated. "When drought conditions struck [in the 1930s] and vast areas of cultivated native rangelands began to blow, crested wheat grass was a solution to a virtual ecological disaster," explained Bruynooghe et al.("Yearlings and Crested Wheatgrass: Performance and Productivity"). Crested wheat grass was a savior to abandoned fields and exhausted pastures on the prairies during the 1930s and beyond (Stevenson et al., 12). Over 300,000 acres of abandoned lands were sown to crested wheat grass by farmers under the auspices of the Saskatchewan Experimental Farms in the PFRA's community pastures (Campbell, 33).

In *Men Against the Desert*, Gray asserts "There can be little doubt that the whole Community Pastures program was made possible by the ability of crested wheat grass to take root and prosper on abandoned land once the soil blowing was stopped" (105). Crested wheat grass is a nutritious pasture grass which is amenable to the palates of livestock. Importantly, it does well under grazing pressure and provides "pasture available at both ends of the season [summer] when it is needed most" (Kirk, 12). An article, which appeared in the August 12, 1939 edition of the *Regina Leader Post*, sang the praises of what crested wheat grass had done for depleted lands in the Battleford area:

> There is a project undertaken by the P.F.R.A. that is attracting much attention these days, because of the success of the venture. It has renewed hope in the hearts of thousands of that section of Saskatchewan, that within a short time, man will be able to produce his sustenance, establish a home, and make for permanence in an area, that a few short years ago was turning to wind-blown sand dunes. ...The desert blooms, and this is literal, for where not even pasture grass could be found for livestock, there is now being harvested crested wheat grass that will give a ton to the acre, that will bring back humus and fibre to the soil, and make it possible for ranchers to again grow good cattle. (*Saskatchewan News Index*)

In a 1952 report entitled "Government of Canada Community Pastures," P.F.R.A. Superintendent of Pastures Raymond Youngman, wrote of the instrumental role that crested wheat grass played in the community pasture program:

> In accordance with recommendations following surveys by the technical staff of the Swift Current Experimental Station, an intensive regrassing program has been carried out throughout the years and we are now regrassing approximately 15,000 acres per year. As a result, our carrying capacity has been practically tripled. Crested wheatgrass has been used almost exclusively in our regrassing operations

> and has undoubtedly been a major factor in the successful operation of our pastures as it is suited to our climate, stands exceptionally heavy grazing in the early Spring, and is the main source of hay requirements for our pastures. (384)

Today, the legacy of the community pastures program continues. Currently, the PFRA operates 62 pastures in Saskatchewan, 24 in Manitoba and one in Alberta (Cook, "Summary"). Hugh Cook of the PFRA summarizes the legacy in his article "PFRA Community Pastures - the Canadian communal grazing experience and multiple values of public grasslands":

> This marginal, severely eroded land was taken out of cultivation, restored to permanent cover and has been providing grazing for livestock as well as wildlife habitat for the past 40 to 50 years. The initiative stopped the spread of soil degredation to adjacent lands and th soils were brought back into production as a livestock grazing and wildlife resource. This land has remained productive through subsequent drought. Provision of grazing has had a stabilizing effect on the livestock industry on the prairies. This in turn has helped to stabilize farm incomes and subsequently improved the living standards of the prairie farmer and rancher.

10.4 Water Projects

Obtaining a dependable water supply has been one of the utmost concerns of prairie farmers and governments since the area was settled. The area is characterized by periods of low rainfall, which is "generally insufficient to maintain flowing streams, natural lakes, springs and shallow wells" (PFRA, *Prairie Land and Water Resources*, "Water Development"). In addition, fast flowing rivers filled by Rocky Mountain run-off are few, and widely dispersed across the large prairie region (PFRA, *Prairie Land and Water Resources*, "Water Development"). Since 1935, the PFRA has supported the development of small scale, community and major water development projects (PFRA, *Prairie Land and Water Resources*, "Water Development"). The *Prairie Land and Water Resources* website reports that the PFRA has assisted in the development of 148,417 dugouts, 111,552 wells, 14,839 stock-watering dams, 10,723 irrigation projects, 847 medium and large dams, and 711 water pipelines between 1935 and 2000 ("Water Development").

The development of small scale water projects like dugouts and stockwatering dams provide important sources of water for livestock, feed growing and domestic use for farm gardens and yards. In 1939, W.L Jacobson, Secretary of the PFRA's Water Development Branch wrote: "Small water developments are important nevertheless as a means of conserving and utilizing at least a portion of the run-off water that is now going to waste, in order to give a greater degree of stability to farming and ranching on the open plains during periods of low rainfall" (in *C.S.T.A Review*, 58-59). The initial provisions were $50 per dugout, $150 per stockwatering dam or flood irrigation project and $350 for irrigation dams. Presently, the PFRA has expanded to provide assistance for the development of wells and rural pipelines (PFRA, *Prairie Land and Water Resources,* "Rural Water Development Program (RWDP)").

Gray furnishes an interesting quote about the importance of dugouts to prairie farmers in *Men Against the Desert*: "The dugouts were as inelegant a collection of holes in the ground as ever devised by man. They did nothing aesthetically for the landscape. They were utilitarian in the extreme. Yet, if acceptance is a measure of worth, few more valuable projects were ever devised" (193).

In addition to on-farm water development projects, the PFRA has been involved in developing projects on the community scale ranging from damming streams, coulees and ravines to build-up surplus run-off to supplementing and improving natural bodies of water with additional drainage. The benefits of these community projects, which number greater than 100 since 1935, are felt by livestock producers and smaller communities. The *Prairie Land and Water Resources* website states:

> Of particular significance has been the benefit to the livestock industry, through the creation or improvement of water facilities in farms, pastures and feedlots, and through the production of reserve supplies of forage grown under irrigation for the winter maintenance of livestock. . . .they could be used to supply nearby towns and villages as well. Many prairie communities continue to take their water supplies from reservoirs built by the PFRA ("Community Projects").

Major water projects constructed by the PFRA provide more consistent supplies of water. A greater population and area are served by the PFRA's major water projects, which are concentrated on primary tributaries. The large storage reservoirs created by these projects continue to provide a reliable source of water for irrigation, domestic and urban water supplies and recreation (PFRA, *Prairie Land and Water Resources*, "Major Water Projects"). The water projects of the PFRA were, and continue to be very important to southwestern Saskatchewan which is the "driest part of the semi-arid plains" (PFRA, "PFRA and Irrigation").

10.5 Shelterbelts

The Dominion Government first established a Tree Nursery at Indian Head in 1902 to supply hardy trees and shrubs to the new settlers. Due to high demand, the nursery at Sutherland in Saskatoon was opened in 1913. Prior to the dust bowl conditions of the 1930s, shelterbelts were mainly planted to protect buildings and livestock on prairie farms. A renewed interest in shelterbelts was spurred in the 1930s to protect the soil and crops from the ravages of the winds. The tree nurseries were very involved with the PFRA's projects during the 1930s as described on the PFRA website:

> During the severe drought of the 1930's Shelterbelt Centre staff worked with the newly formed PFRA to plant field shelterbelts and demonstrate their use for soil conservation. Major plantings were established at this time at Lyleton, Manitoba; Porter Lake, Alberta; Aneroid, Saskatchewan and Conquest, Saskatchewan. Over 2,000 km of shelterbelts were planted, many of them still present today. ("History of the Shelterbelt Centre")

In 1939, Norman Ross, Superintendent of the Forestry Station at Indian Head reported on some of the benefits observed by planting shelterbelts:

> The most striking benefits have been obtained by farmers during these dry years in producing vegetables and fruits where their gardens have been sheltered by well established tree belts even in districts where there have been complete crop failures. In many cases too, yields from forage and grain crops have been noticeably increased where protection has been afforded by tree shelters. (in *C.S.T.A Review,* 93)

Support for the programs was strong. As cited by Norman Ross, members of the Agricultural Improvement Associations were furnished with free trees and prepaid shipping charges for planting home shelterbelts, of which 1700 farmers took advantage, totaling 1,277,000 trees distributed in 1939 alone (93). The importance of trees to the prairie population was expressed by E.S. Archibald, Director of the Dominion Experimental Farms who wrote: "In the final analysis, the permanency of western agriculture will depend essentially on a programme of developing permanent rural homes, and because of the high wind and consequent high evaporation of soil moisture, even without spoil drifting, trees become indispensable (170).

The Shelterbelt Centre at Indian Head became a part of the PFRA in 1963. The Sutherland operation closed in 1965. According to the PFRA website, "Today the Shelterbelt Centre is 640 acres (265 ha) in size and produces 29 hardy tree and shrub species. Annually the Centre distributes over 5 million trees and shrubs to 10,000 prairie clients" (PFRA, PFRA website, "PFRA Shelterbelt Centre"). The Centre continues to promote the establishment of farm and field shelterbelts to reduce soil erosion by wind, to trap snow, protect livestock and farm buildings, and to beautify yards and provide valuable wildlife habitat. Today, the Centre is also interested in promoting agroforestry in the province, and the role of agroforestry and shelterbelts in reducing greenhouse gas emissions in the atmosphere (PFRA, PFRA website, "PFRA Shelterbelt Centre"). According to the PFRA, the Shelterbelt Centre at Indian Head has grown and distributed enough trees to circle the planet Earth - an astounding 570,000,000 of them (PFRA website, "PFRA Shelterbelt Centre").

11. Lessons Born of Hard Times

As bad as the 1930s were on the prairies, there were lessons learned from the blowing soil and crop failures. Trash conservation, reducing tillage, re-grassing marginal lands and utilizing more soil-friendly implements were all part of the legacy of those hard times. After the experience of the dirty thirties one would have expected that soil conservation issues would have been paramount to ensure such a disaster would never happen again. This was not so, as explained by Robert Wettlaufer and Paula Brand of the PFRA: "Over the next 40 years, public visibility and efforts for soil conservation waned due to generally benign weather, reasonable commodity prices and rapidly developing technology which masked degradation effects" ("Adoption of Soil Conservation Practices on the Canadian Prairies"). Several factors came into play in the 1980s which once again brought the issue of soil degradation to the forefront, including: widespread drought, a 1983 PFRA Soil and Water Conservation Branch assessment which cited excessive tillage and marginal land cultivation as major problems, and the 1984 report chaired by the Honourable Herb Sparrow, entitled *Soil at Risk - Canada's Eroding Future*, which warned that the future of the Canadian farm was at risk from soil degradation (Wettlaufer and Brand, "Adoption of Soil Conservation Practices").

"Blowing in the Wind" and "Soil drifting in southwest area severe" were headlines from Saskatchewan newspapers in the 1980s. The articles reported that the conditions had old-timers comparing the drifting soil to their experience in the 1930s. Soil degradation, exacerbated by the drought, could no longer be ignored. In 1986, the Science Council of Canada pegged annual losses due to soil degradation in Saskatchewan at $560 million (as quoted in Zakreski, "Soil loss costs $1 billion: report"). In a 1987 *Western Producer* article, reporter Bob Jamieson reported that "summerfallowing is now considered to be the single largest cause of soil degradation" (B1). The University of Saskatchewan's Don Rennie took a controversial stand against the practice of summerfallowing in the 1970s, and continued his crusade into the 1980s (Saskatchewan Centre for Soil Research). The negative long-term effects of summerfallow, including increased risks for wind and water erosion, soil salinity problems and the loss of organic matter, were coming to the forefront (University of Saskatchewan, *Saskatchewan Interactive,* "Agriculture: Crops: Management: Traditional").

In 1988, Lorne Hehn, then vice-president of Soil Conservation Canada, explained that "Summerfallow has been practiced for generations and in many areas, 'how well you farm is still measured by how black your summerfallow is (the more a fallow field is tilled, the darker is the soil).'"(Hehn as cited in Knycha). Farmers maintained that summerfallowing, the practice of leaving a field idle every other year and tilling to prevent weed growth as a means of recharging soil moisture, was the only way to grow a crop, especially in the very dry southwest of the province. Old practices and habits would be hard to break, but the reality of the situation dictated that some combination of economic benefit and stewardship of the land would have to be found In 1988, Senator Herb Sparrow, chairman of the Senate's 1984 *Soil at Risk* report, delivered this terse warning in the September 9 issue of the *Western Producer*: "We're still on a terrible downward slide, he says. We have turned it a little but not enough. We probably have 10 years to level that off. If not, we will have lost so much land that the base will not lend itself to healthy agriculture." (Sparrow as quoted in Wilson). An excerpt from the article "Blowing in the Wind," from the November 9, 1989 edition of the *Saskatoon Star-Phoenix*, illustrates the crossroads that many farmers in the 1980s and beyond faced:

> Farming seemed a lot simpler 15 years ago when [Marcel] Jalbert took over the family farm from his father. You planted a crop in the spring, harvested in the fall and summerfallowed the following year. Grain prices were good, the land fertile. But this all changed. Three brutal droughts and an international grain price war this decade altered the rules of the game. Chilling images of barren fields and sand dunes forced a re-evaluation of traditional farming systems. Finding a way to preserve the health of the land, and make a decent living, has emerged as *the* issue facing farmers in the last decade of this century. (Zakreski,10)

Just as the reclamation of the desert in the 1930s required the cooperative effort of governments, research personnel and farmers, efforts to remedy soil degradation since the 1980s have required similar cooperation. The health of the agricultural economy is reliant on the health of the soil, and with 40% of Canada's agricultural land, the sustainability of farming in Saskatchewan is a serious concern for all levels of government, farmers and the general population (University of Saskatchewan, *Saskatchewan Interactive*, "Agriculture: Facts & Figures: Agri-Food" and *Land For The Future*, 1). A federal-provincial initiative named the Canada-Saskatchewan Soil Conservation Agreement was unveiled in the summer of 1989, which made $54 million of resources available to finance on-farm programs, establishing permanent cover on marginal lands, soil conservation awareness, research and soil surveys (Zakreski, "Blowing in the Wind," 10). The development of Regional Conservation Teams as part of the Agreement was a first in Canada, and provided "a co-operative, multidisciplinary approach to land management at the local level" (*Land For The Future,* 2). The following excerpt from the newspaper supplement *Land For The Future*, explains the relationship between the cooperating groups:

> Getting local producers involved in program development and delivery is a major objective of the Agreement. The key to achieving this is working with the Agriculture, Development and Diversification (ADD) Boards. Each of Saskatchewan's 43 Agricultural Districts has its own ADD Board, and each ADD Board works with a RCT and producers in its district to develop and implement a

local conservation plan. (2)

An important education and extension activity of the Saskatchewan government in the 1980s was the Save Our Soils program. In an effort reminiscent of the 1930s experience, Save Our Soils coordinator Jim Moen explained, "The whole idea of the project was to get farmers working together and in cooperation with the universities and research stations for the benefit of the land" (Saskatchewan Agriculture, *ADF News*, 1). Through the program, funds were allocated for on-farm demonstrations to promote soil conservation practices, to hire district conservationists, for research and to raise awareness through education programs (Saskatchewan Agriculture, *ADF News*, 1).

Soil conservation has to start at the grassroots level, and the old motto from the Save Our Soils program says it all: Soil Conservation...it's in our hands (Polegi, "What's Happened to the Spring Dust Storms?"). The 1980s saw the formation of soil conservation clubs around the province. One such example is the Wheatland Conservation Area (WCA), formed in 1983 by farmers in southwestern Saskatchewan. In 1987, the WCA had 250 farmers in its membership, and was the largest of 25 conservation groups who were organized in Saskatchewan at that time (Jamieson, B1). The group formed initially over concerns about alkali conditions on their farms, but expanded to include promoting soil conservation awareness and practices, and the purchase and subsidized rental of more soil friendly equipment like a wide-blade cultivator and a grass seeder. The efforts of the WCA were evident in the area, according to farmer-member Dean Smith from Success, Saskatchewan in the July 28, 1988 edition of the *Western Producer*. Smith said, "I'm amazed at the number of people doing chemical fallow. A few years ago, they would have been over their summerfallow two or three times by now. This year, they're just working it for the first time" (Smith as quoted in Sproat, 20).

The formation of the Saskatchewan Soil Conservation Association (SSCA) in 1987, was an important development in the province, which today continues to promote and provide technical assistance to further the development of sustainable farming practices. The SSCA defines itself as "a non-profit, producer-based organization whose mission is to 'promote conservation production systems that improve the land for future generations'" (SSCA Website). Over the years, the SSCA has participated in a wide range of extension activities including: tradeshows, field days, publications like the *Direct Seeding Manual* and the *Prairie Steward* newsletter, information videos, the Save Our Soils program, the Conservation Learning Centre, and the development of educational materials and presentations for k-12 students (Polegi, "SSCA: 10 Terrific Years"). Farmer support and interest in the organization is strong. A 1993 field day held in Moose Jaw attracted upwards of 4000 interested people (Giles). The SSCA also maintains a valuable Conservation Farmers Helping Farmers Directory, which puts experienced farmers in contact with other farmers seeking answers to questions about conservation practices (Saskatchewan Soil Conservation Association, *Prairie Steward* Issue 20).

The soil conservation movement continued to gain momentum in the 1990s. SSCA representative Ray Kettenbach was quoted in a 1993 *Moose Jaw Times Herald* article as saying: "People who fail to get involved in this trend towards soil conservation and direct seeding are going to be left in the dust. Soil conservation is what the 90s are all about" (as quoted in Giles). In their 1998 article "The Adoption of Direct Seeding Technology in Saskatchewan," authors Wall, Zentner and McKell reported: "The 1990's have witnessed a substantial growth in the use of conservation tillage practices in Saskatchewan". Producers have continued this trend, as more and more producers adopt conservation tillage practices and work to reduce summerfallow acres each year. At present, according to the Government of Saskatchewan, "We are first in the world with farming practices and equipment that minimize soil disturbance and conserve the land" (*Saskatchewan - Our Future Is Wide Open,* "Celebrate Success - Saskatchewan Firsts," "Agriculture"). Saskatchewan leads Canada in the adoption of no-till or zero-till seeding (Statistics Canada, *2001 Census of Agriculture,* "Agriculture in Saskatchewan").

Hand-in-hand with the adoption of conservation tillage and the reduction of summerfallow to protect the soil is the inclusion of flexible, extended and diversified crop rotations beyond the traditionally grown cereal crops to include pulses, oilseeds, forages, green manure and cover crops, the planting of shelterbelts, establishing permanent cover on marginal lands and grassing waterways, as well as practicing rotational grazing on pasture lands (PFRA, "Healthy Soils"). Compared to 1996, the number of farms reporting the use of permanent grass cover in the 2001 Census of Agriculture increased from 12128 to 13824, representing a 14 percent increase (Statistics Canada). The Saskatchewan Government launched a four- year, $26 million Conservation Cover Program in 2001 to assist farmers in converting marginal crop lands to permanent perennial cover (Saskatchewan Agriculture, Food and Rural Revitalization, 2002 Conservation Cover Brochure). In the first two years of the program, over 17,000 farmers participated, and over 800,000 acres were converted to perennial cover. The benefits of permanent cover go beyond soil conservation to include: increased pasture land and feed for livestock, conserving biodiversity, reducing greenhouse gas emissions and protecting water resources (Saskatchewan Agriculture, Food and Rural Revitalization, News Release, April 17, 2003). In addition, winter cover crops were planted on 1181 farms in 2001 compared to 613 in 1996, which represented a 92 percent increase (Statistics Canada). Cover crops protect the soil from erosion and help to trap winter snowfall (PFRA, "Healthy Soils").

The acreage under summerfallow is declining in Saskatchewan. Farmers are recognizing the negative effects of this practice including wind and water erosion, loss of organic matter through increased soil mineralization and soil salinity problems. Summerfallow acreage declined by half between 1990 and 2002, from 14.5 to 7.4 million acres (Government of Saskatchewan, *Saskatchewan - Our Future Is Wide Open,* "Celebrate Success - Saskatchewan Firsts," "Agriculture"). In an online article entitled "GoodBye Tillage," professional agrologist Kevin Hursh wrote, "While Saskatchewan continues to have more summerfallow than neighbouring provinces, even here it has declined to about 20 % of the cultivated acreage and rather than tillage to control weeds on those summerfallow acres, chem fallow has become increasingly prevalent" (aginfonet.com).

The number of farmers adopting conservation farming practices is steadily increasing. Kulshreshtha and Storey provide the following general definition of conservation tillage in the 1999 *Atlas of Saskatchewan*:

> This [conservation tillage] generally refers to reduced tillage systems, defined as any system that leaves at least 30 percent of the previous crop residue on the soil surface after planting. This tillage systems can be classified into three types: (1) Conventional tillage; (2) Minimum tillage; and (3) No or Zero tillage. The last two systems are generally classed as "conservation" tillage systems. Conventional tillage incorporates most crop residues into the soil. Under minimum tillage, most of the crop residues are left on the surface, while under zero till there are no tillage operations before seeding (239).

In the online article"GoodBye Tillage" by Kevin Hursh, several factors are cited which support the adoption of conservation tillage practices. Hursh wrote:

> There are a number of reasons for the mass conversion to reduced and minimum tillage. Diesel fuel and iron prices have continued to become more expensive, while non-selective herbicides like Round-up have dropped in price. Airseeder technology, much of it developed in Western Canada, has made direct seeding fast and economical for large operations.
>
> Soil conservation is also a driving force. After the serious soil erosion of the late 1980s, producers were anxious to adopt farming practices which retained residue and conserved soil moisture. (aginfonet.com)

The benefits and limitations of conservation tillage are summarized by Kulshreshtha and Storey in the 1999 *Atlas of Saskatchewan* as follows:

> Such methods require fewer field operations, and thus offer potential energy savings to producers. In addition, use of fossil fuels - the major source of energy inputs - is linked to emissions of carbon dioxide. Thus savings in energy lead to benefits through reduced emissions of greenhouse gases. Associated with these are also some other economic benefits of conservation tillage. Under these systems, less power for plowing is required due to better soil structure. As well, less labour and farm machinery are required. However, the downside of such systems is that more herbicides are needed for weed control, there is a higher

> incidence of insects and pathogens, more fertilizer is required, and seeding rates are higher and require special equipment. (240)

As previously mentioned, Saskatchewan leads the country in the adoption of zero tillage direct seeding. The PFRA defines zero tillage as "a one pass operation which places seed and fertilizer into an undisturbed seedbed, packs the furrow and retains adequate surface residues to prevent soil erosion" (PFRA, "Healthy Soils"). Statistics Canada reported that zero till was used on one-third of Saskatchewan's seeded acres, according to the 2001 Census of Agriculture (Statistics Canada). Reduced tillage and traditional tillage are each practiced on one third of Saskatchewan's remaining seeded acres according to the Saskatchewan Soil Conservation Association's Executive Director, Blair McClinton (McClinton as quoted in Hursh, aginfonet.com). The adoption of zero tillage increased five-fold between 1991 and 1996, with a jump of 1.3 to 6.7 million hectares (Kulshreshtha and Storey, 240). Land under zero tillage benefits from increased preservation of surface residues, corresponding to reduced moisture losses, improved soil condition and organic nitrogen availability, and protection from wind and water erosion (PFRA, "Healthy Soils").

The SSCA has profiled several successful direct seeding farmers in the province. Farmers on the land who have adopted direct seeding are the best promoters of the practice. Larry Scott who farms near Marsden, Saskatchewan said, "I'm conserving moisture, using less manpower, and lowering my fuel costs"(Saskatchewan Soil Conservation Association, "Profiles"). Barry Gwillim from Strasbourg, Saskatchewan reports: "I haven't been direct seeding for that many years yet I can already see the soil mellowing. When we used to summerfallow, we had to go out really early in the spring and break up the soil crust otherwise the surface would bake like cement" (Saskatchewan Soil Conservation Association, "Profiles"). Alan Moskal of Star City, Saskatchewan said, " I would hate to have to go back to the old way" (Saskatchewan Soil Conservation Association, "Profiles").

In tandem with the adoption of conservation tillage practices, Saskatchewan farm implement manufacturers have become leaders in the development, manufacture and export of equipment like air seeders, straw choppers and spreaders which "protect the soil" (Government of Saskatchewan, News Release, April 11, 2000). Saskatchewan manufacturers, many located in smaller rural centres, provide valuable employment at their production facilities. According to the Government of Saskatchewan, "In just a few years, what could have been a serious environmental problem has been turned into a major opportunity - as we conserve our soil and ship our equipment and expertise around the globe" (*Saskatchewan - Our Future Is Wide Open*, "Celebrate Success - Saskatchewan Firsts," "Agriculture"). A description of the development and production of air seeders and equipment related to direct seeding will be provided in Appendix A.

Times truly are changing for the better. The adoption of conservation tillage makes environmental and economic sense. New and seasoned farmers are adopting better farming practices across the province. Although Saskatchewan farmers are leaders in soil conservation practices, there is still a long way to go. Saskatchewan is a province with variations in soil and climate across its agricultural regions, and not all conservation practices are applicable to all areas. Considerable research, innovation and foresight are required on the part of farmers who make the move away from conventional agriculture, from choosing the conservation practices best suited to their areas to adapting or purchasing new farm machinery for direct seeding. Drought conditions and high winds will always be factors to contend with on the prairies, but adopting minimum and zero till methods help farmers to buffer these climatic effects. A veteran farmer from northeastern Saskatchewan, who was planting his 75th crop in 2000, was disgusted at the blowing dust he witnessed on the very dry and windy May long-weekend. The farmer said: "In the 30's everyone farmed like that. The sky was black no matter which way you turned. We didn't know what else to do. Today we know better" (as quoted in Tim Nerbas). The lack of dust in the air in the spring of 2000 versus that of 1988 was a testament to the value of conservation tillage in conserving Saskatchewan's soil - our most valuable resource. University of Saskatchewan Soil Science Professor Fran Walley was quoted as saying, "It's easy to make an argument for conservation tillage especially in dry springs. Not all of Saskatchewan was blowing and conservation tillage played a big role in keeping soil in the field and out of the ditch" (as quoted in Polegi, "What's Happened to the Spring Dust Storms?").

Appendix A:

Saskatchewan Contributions to Direct Seeding Technology and Manufacturing

***Please Note: The manufacturers included in Appendix A were accurate as of 2004 when the original research document was completed. Inevitably, due to product development and the sale or dissolution of companies, current information may differ. We apologize for any errors or omissions.**

Seeding using forced air was a significant development in seeding technology after the Second World War, and has become an important tool in the practice of direct seeding. Saskatchewan inventors and manufacturers have contributed to the advancement of this technology, and have become leaders in the production of world class air seeders, which have been exported around the globe (Government of Saskatchewan, "Industry and Resources"). The University of Saskatchewan provides the following general description of the air seeder:

> Uses air pressure to distribute seed through hoses from a central tank to the furrow openers on cultivators or seed drills. It is also used to place fertilizer and pesticides. A double-shoot system has two hoppers and two separate air lines to place seed and a fertilizer. A triple-shoot system can place seed, fertilizer and herbicide from three separate hoppers. An air seeder has an advantage over a normal seeder of reducing the time to seed a crop. It can drill seed directly into stubble without first cultivating. It also has good depth control and accurate fertilizer placement (Saskatchewan Interactive, "Agriculture: Crops: Management: Machines").

The following outline provides a brief overview of Saskatchewan people and companies involved in the development of air seeder technology. The idea of using forced air to seed was not born on the prairies, and had been utilized in countries like Germany and Australia, but never before in North America before prairie inventors and manufacturers took on the task.

Bechard and Bourgault:
Jerome Bechard, an innovative farmer from Lajord, Saskatchewan was likely the first in Western Canada to develop a seeding system utilizing forced air. Bechard debuted his combined cultivator and seeder in the spring of 1969, and garnered significant attention from other farmers, researchers, manufacturers and the media. The wet spring of 1952 planted the seed for Bechard's air seeder design. "We were cultivating," he said, "trying to dry the land up enough to seed it. I was adjusting the cultivator in the field when I happened to look down at the soil around the shovels. 'This is crazy' I thought. 'If I [c]an get out on the land at all, I should be seeding'" (as

quoted in Gayton, 14). In the May 13, 1969 edition of the *Leader Post*, agriculture reporter Gerry Wade wrote, "It looks like nothing else that has been seen on the Western Canadian prairies. ...it resembles a travelling milking machine more than anything else". Advantages to Bechard's air seeder were uniform depth of seeding, longer times between refilling, faster cleanout, and gentle handling of the seed (Lyster, 15), in addition to incorporating several field operations into one pass. The University of Saskatchewan's Bill Reed foreshadowed the future in a 1975 *Country Guide* article when he said "it offers possibilities for a system that might someday be widely used on Prairie farms" (as quoted in Lyster, 15). Bechard obtained a Canadian patent numbered 1060720. The patent abstract describes Bechard's invention as follows:

> The system is designed to be used in conjunction with conventional tillage equipment such as one-way discers, deep tillage chisel ploughs, field cultivators and the like and can be utilized to plant seed and/or apply fertilizer, herbicides or both. It consists of a separate wheeled trailer carrying the weight of the seed, fertilizer, herbicides and the like thereby eliminating any weight change from the seeding machine. The seed or granular chemicals are entrained in air stream and conveyed by headers and conduits to the seeding boots or spouts. (Canadian Patents Database)

Frank Bourgault of F.P Bourgault Industries Limited in St. Brieux, Saskatchewan acquired the rights to Jerome Bechard's Bechard Seeding System in 1978. When Frank Bourgault spoke about building on Bechard's design, he said, "There's no use inventing the wheel when we already have one" (as quoted in Froehlich, A30). The following excerpts from the Prairie Farm Machinery Manufacturers: Diversification of Farming website: <http://collections.ic.gc.ca/machiner/index-f.htm> (July 2004), provide a brief overview of Bourgeault's contributions to air seeder technology:

> ...after two years of further development, production began. The first air seeder manufactured was the Model 138. It was the first tow behind the cultivator unit which gave the operator an unobstructed view of all cultivator shanks and trash flow. The three large floatation tires meant that the seeder applied no more pressure to seeded soil than would a man walking across the field. The Bourgault Air Seeder was quickly disconnected, freeing the cultivator for other work. This unit has since served as the model for virtually all the air seeders currently being produced in North America.
>
> Bourgault Industries has been responsible for creating the first dual purpose cultivator, the first tow behind air seeder, the first air seeder capable of accurately distributing all seeds and fertilizer with an acceptable c.v. (coefficient of variation), the first loading and unloading auger system for air seeders, the first

> auto-fold sprayer with break-away booms and half width capabilities, the modern wing packer for air seeders, and the first granular herbicide attachment for air seeders.

Pride Industries
Saskatchewan farmers Preston Davy and Duncan Elliott, in tandem with Richard Evanson of Virden, Manitoba, marketed a Super Seed Air Seeder in the late 1970s under the company name Pride Industries (Wetherell, 145-146). The Super Seed Air Seeder could handle both granular and liquid fertilizer. The company was acquired by Prasco Inc. of Winnipeg (*Farm Show*, 1978).

Leon's Manufactruing and Friggstad Manufacturing
Several other prairie manufacturers became interested in producing air seeders in the 1980s. Leon's Manufacturing of Yorkton and Friggstad Manufacturing of Frontier were two Saskatchewan firms which purchased air seeder designs in the 1980s. Friggstad's design was of German origin (Wetherell, 147). Friggstad Manufacturing was purchased by Flexi-Coil in 1984. Leon's Manufacturing purchased an Australian design, which they further modified. Leon's produced their first air seeders around 1980, and discontinued production in the early 1990s (Henry Malin, Leon's Manufacturing Ltd., personal communication).

Flexi-Coil
Flexi-Coil began its endeavor into air seeders in 1980 with an Australian design, upon which their research and development team built upon (Wetherell, 147 Star Phoenix, G5). The following summary was prepared by Darrel Schindel, Brand Communications Manager, Case New Holland (CNH) in August, 2004, and describes innovations in Flexi-Coil's line of air seeding equipment:

> Flexi-Coil pioneered the development of accurate air delivery with the introduction in 1981 with the model AFS 1000. These first air carts freed farmers from the limitations of ancient gravity-fed technology.
>
> A series of precision air carts opened up a world of possibilities for more efficient seeding and fertilizing.
>
> - 1986 - Introduction of the 1100 air cart provided farmers with the ability to double-shoot fertilizer and seed.
> - 1987 - Model 1600 air cart provided increased product capacity to 160 bushels.
> - 1990 - The 2320 and 1720 air cart created a new generation of air seeding technology with parallel flow metering for precised (sic) air delivery, air velocity sensors and advanced monitoring and control.

- 1990 - Flexi-Coil came full circle when the advantages of packing were applied to new flexible tillage in a precise, on-row design in the 5000 air drill. This combined with air delivery for a way of seeding to which all others are now compared.
- 1996 - Flexi-Coil introduces the most advanced air delivery technology available with the 50 series air cart. These air carts designed for growers who need large capacity of 340 bushels and diverse metering capabilities. The precision technology delivered three integrated tanks to apply several products separately, blend on-the-go or use full capacity with a single product. This innovative design could be equipped with variable rate or mechanical drive metering. FlexControl made it very easy to operate with in-cab rate control.
- 1998- Introduction of the 40 Series air carts in choices of 170 or 230 bushel capacity provided leading technology to medium sized farms.
- 2003 - Flexi-Coil responded to the requirements of growing sized farms with the introduction of the 4350 air cart wit a carrying capacity of 430 bushels for single-, double-, or triple-shoot applications. More options for applying seed, fertilizer or granular products in a single pass.

Morris Industries Ltd.

Morris Industries Ltd. ventured into air seeding with an Australian design called the Napier in 1979-1980. Morris' research and development team built on the design, and the Genesis 100 and Genesis 170 were released in 1985. These models incorporated Morris' patented Flat Fan Divider Head, patent number 1287275, formally known as an "Horizontally Disposed Apparatus for the Random Distribution of Seeds and Granular Materials" (Jack Lesanko, Morris Industries Ltd. Research & Development, personal communication, and Canadian Intellectual Property Office, <u>Canadian Patents Database</u>, "Patent CA 1287275"). Morris continues to incorporate the Flat Fan Divider Head, which "eliminates abrupt flow changes of conventional vertical divider heads," into its current air seeding technology (Morris Industries Ltd., *Maxim II Air Drill System*). Today, Morris is an industry leader in air seeding technology. Current models have the potential for "triple shooting," whereby two types of product can be put down in tandem with the seed. There is also the capacity to blend two products into one air stream (Jack Lesanko, Morris Industries Ltd. Research & Development, personal communication).

Conserva Pak

The origins of the successful Conserva Pak Seeding Systems goes back to the late 1970s. Indian Head farmer Jim Halford believed in the practice of direct seeding, but the implements available to him at the time, including the disk drill he was using, were limiting and needed to be improved upon (Conserva Pak website). In 1983, Halford went about developing his own one-pass, low soil disturbance system. Halford holds Canadian Patents 1239835 and 1263060 for his

Seed/Fertilizer Placement System for Minimum Tillage Application and his Packer Wheel Arrangement respectively. In the December 30, 1997 *agWorld* article "Breaking new ground - Halford honored for direct-seeding approach" by Pat Rediger, Halford's design is described as a "patented seeding system, which uses a narrow knife double opener system to place the seed and all the fertilizer in one pass, with a minimum of soil and residue disturbance. Only the soil in the fertilizer/seed row is broken and exposed." A packer wheel on the opener "runs in the furrow to press down soil over the seed and fertilizer" (Canadian Intellectual Property Office Canadian Patents Database). After the development of a frame and two years of testing, Halford began producing complete seeders by 1989. Halford's early foray into manufacturing was on an order basis out of his quonset (Rediger, *agWorld*). Today, Conserva Pak is still operated on the Halford farm near Indian Head, but today produces around 60 air seeders per year in 16,000 square foot facility. Halford kept his business on the farm after consulting with his customers, who were interested to witness the "positive impact zero till had on his land," wrote Pat Rediger for *agWorld* (December 30, 1997). The award winning Conserva Pak seeding systems have been exported around the world. In 2003, it was estimated that more than 400 Conserva Pak systems were in operation (Conserva Pak website).

Seed Hawk Inc.

Seed Hawk Inc. is a company located in Langbank, Saskatchewan which has been producing air seeders since the winter of 1992/1993. Seed Hawk has developed its own one pass seeding system, that provides accurate seeding depth, fertilizer placement and packing for use in minimum and zero tillage operations, featuring a hydraulic opener (patent pending). From the first six seeders built and sold in 1992/1993, the company has grown to 39,000 square feet of production space, and an estimated 900 air seeders have been produced to date (Seed Hawk website).

Straw Track Manufacturing Inc.

Straw Track Manufacturing Inc. located in Emerald Park, Saskatchewan produces direct seeding equipment, incorporating leading-edge technology patented by company president Norbert Beaujot. According to the company's website, "Our patented products include the Seed Master™ zero-till seeder, Smart Mark™ field marker arm, Smart Hitch™ guidance system and the Heads Up™ combine header-height control device" (Straw Track Manufacturing Inc. website).

Residue Management Equipment

Several other types of implements are being produced to support the demand for direct seeding equipment in the province. Residue management is an important aspect of direct seeding to avoid problems with heavy trash cover (University of Saskatchewan Saskatchewan Interactive). Properly managed residue can help protect soil against erosion, capture and hold more snow, protect winter crops and improve soil quality (SSCA Residue Management Section). In contrast, improperly managed residue, whereby the straw and chaff is poorly spread, can "plug seeding equipment, and cause uneven soil fertility, moisture and temperature across fields," according to Saskatchewan Agriculture (July 2000 Farm and Food Report). Several Saskatchewan firms are producing straw choppers, chaff spreaders and chaff collectors to enable better residue management during harvesting operations. After-market straw choppers can be added to combines to increase the width that the straw is spread so that it matches the width of the cut. Chaff spreaders can also be added to combines to spread the chaff beyond the width of the combine. An alternative to spreading chaff is to collect it for use as a livestock feed by employing the use of a chaff collection system (SSCA Residue Management Section).

Redekop Manufacturing Co. in Saskatoon produces residue management equipment including straw choppers and rotors and chaff collection systems. The National Research Council of Canada describes Redekop's products as "home-grown hardware on the cutting edge of agricultural technology" (Industrial Research Assistance Program). President Leo Redekop reports that the business grew out of equipment they began building for their own mixed farm, and snowballed from there. The farm was sold in 1984, and the family focused on developing equipment. Redekop was given assistance from the National Research Council's Industrial Research Assistance Program to refine a chopper/blower which, by 1991, could "optimize the capture of residue for any crop or harvest conditions." According to 2002 figures, the company was producing 2500 units per year, with sales in the millions (National Research Council Industrial Research Assistance Program).

Rem Manufacturing Ltd. of Swift Current, Saskatchewan produces a Pneumatic Chaff Spreader which delivers up to a 40 foot spread (REM Manufacturing Ltd. website). Dutch Industries in Pilot Butte is another manufacturer of chaff and straw spreaders, with a reported spread of up to 40 to 50 feet, depending on model type and conditions (Dutch Industries Ltd. website).

The University of Saskatchewan Agricultural Engineering Department also developed a design for a straw chopper fin modification to increase the spread of straw in the late 1970s, which is still pertinent today. Measurements and instructions were made available for farmers to construct the straw chopper fin modification themselves (Saskatchewan Agriculture and Food, July 2000 Farm and Food Report).

Openers and Packers

Several other Saskatchewan companies manufacture after-market openers and packers for use in direct seeding (minimum and zero-till operations) to fit a variety of factory-made, brand-name equipment. Alberta Agriculture, Food and Rural Development defines an opener as "the part of a planter that penetrates the soil to place seed and fertilizer. It has a soil-breaking wear point, a soil dividing body, and delivery tubes to place seed and fertilizer. It often also has deflecting surfaces to guide the soil back over the fertilizer and seed furrows" (Alberta Agriculture, Food and Rural Development website)". Opener types include narrow sweeps, knives and discs, with the amount of soil disturbance generally increasing from sweep to knife to disc type openers (SSCA SSCA website). Packers are also an important aspect of a direct seeding operation to cover the seed with soil, and ensure contact between the moist soil and the seed to aid in germination. Packing is accomplished either by on-row packing utilizing a packer wheel to pack the width of the seed row or random packing with a pull-behind coil type packer. Most direct seeding systems employ on-row packing, as random packing between the seed rows can promote weed seed germination as well as crop germination (SSCA SSCA website).

Bourgault Tillage Tools in St. Brieux, Saskatchewan are a leader in the research, design and manufacturing of innovative tillage tools, seed openers and boots, including low soil disturbance openers (Bourgault Tillage Tools website). Bourgault Tillage Tools were the first to feature parallel wing sweeps, whereby "the ends of the wings are cut parallel to each other so the sweep maintains its width as it wears"(Bourgault Tillage Tools 2002 Product Catalogue, 4). The parallel wing sweep design has become an industry standard. Bourgault Tillage Tools' products are available across North America, Australia and Europe (Bourgault Tillage Tools website).

Froc Industries Ltd. of Melfort, Saskatchewan designs and produces a line of air seeder boots to fit a wide range of air seeder brands and models (Froc Industries Ltd.).

Dutch Industries of Pilot Butte, Saskatchewan also designs and manufacturers a range of openers, boots and packers. Dutch Industries has utilized the facilities and expertise at the University of Saskatchewan in their research and development process. Dutch Industries products are sold to customers in 11 countries on six continents (Dutch Industries website).

K-Hart Industries of Elrose, Saskatchewan has been designing and producing direct seeding equipment since 1988. The K-Hart line includes coulters, disk openers, mounted air seeder packers, disk air drills, residue managers and soil furrow closers. This small town company markets their products across Canada, the United States, Australia, New Zealand and Europe (K-Hart Industries).

Valley Packing Systems is another Saskatchewan manufacturer of packers for air seeders and air drills. The company is located in Wadena, Saskatchewan.

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