DIRECT SEEDING IN ALBERTA - MAKING IT WORK

Part B by Ron Heller *(For Introduction and Part A See Page 124) - Don Wentz*

Now that a large percentage of Alberta farmers are seeding in a manner that retains the majority of crop residues on the soil surface[1], the threat of soil erosion has been significantly reduced. Reduced *tillage* has become the fundamental practice change behind it, often described in terms such as *min-till, zero-till, no-till, or one-pass seeding*. However, the focus of *direct* seeding (DS) is less on tillage and more on *cropping* systems tailored to variable (but specific) circumstances unique to soil zone, crop rotation and grower preference. Chapter 1 of my DS *handbook* explains five **Key Principles**.

1.1 Standing stubble: When crops are harvested in a manner which leaves the stubble anchored and the soil undisturbed, the results are significantly rewarding for both the soil and steward of the land (a.k.a. farmer / rancher / next generation).

Table 1. Stubble height effects on microclimate (Adapted from SPARC[2] 1997)

REDUCTION from cultivated	Short (16 cm)	Tall (37cm)
Wind Speed (ground level)	15%	70%
Evaporation	5%	25%

In this study (Table 1), data analysis averaged over the growing season indicates that soil moisture evaporation rates were reduced by 25% in tall stubble and by 5% in short stubble, compared to cultivated stubble. The report states that a major yield component in spring wheat, *increased kernel number*, was directly attributable to taller stubble treatments. This points out the value of standing stubble for early plant development, chiefly related to superior water use efficiency in dry, windy climates.

- Standing stubble promotes healthy emergence and protects seedlings.
- Canola (a major high-value crop in Alberta) is now grown almost exclusively on cereal stubble, replacing the intense tillage methods of the past.
- Annual forage crops cut for feed may reduce the total amount of field residue, therefore minimizing soil disturbance is critical in order to gain the maximum benefit.
- Soil temperature (i.e. too cold?) - Studies under DS conclude soil temperature impacts are less important than seeding early and shallow into firm moist soil.[3]
- Muddy fields (i.e. too wet?) - Undisturbed soil provides superior traffic-ability, improved infiltration, with a quicker start-up window for field operations than most tilled-soils.
- Learn to make crop stubble a friend, not a foe (this leads to the next key principle).

1.2 Residue management: Crop residues left in the field will be either an obstruction or a boon for the subsequent crop. Crop residue conserves soil moisture and builds organic matter. Sometimes this may compliment or compete with livestock feeding.

- Surface mulch impedes seed germination and seedling emergence, insulates the soil, and improves soil moisture. Good or bad? (think weeds too!)
- Uniform distribution of straw and chaff aides the performance of any DS implement.
- Chaff spreaders do a better job than harrows.
- Chaff collection is also an option for some enterprises.
- Straw handling alternatives: chop as short as possible; spread evenly; or remove.
- Baling is an option.
- NO BURNING ALLOWED!
- Heavy harrows have their place in some operations.
  [More about this key DS principle will be discussed in machinery features.]

1.3 Herbicide use: DS teams up with herbicide to beat a grain grower's toughest competitor - weeds! (Obviously tillage is not really an option in DS for weed control.)

- Spraying herbicide replaces tillage, avoids soil erosion, and reduces equipment costs, while providing superior weed control.
- Most cropping enterprises rely on in-crop herbicide. DS therefore does not necessarily increase the use of herbicide, however it can demand timeliness.
- Traditional tillage, including extreme summerfallow, never really stopped weeds.
- **Thank whomever you wish for Roundup™ and its' glyphosate[4] cousins, for with out it DS would not have evolved past our grandfathers' dreams!**


HIGH PRAIRIE
CKVH
SLAVE LAKE
CKWA
ATHABASCA
CKBA
WESTLOCK
CFOK
St. PAUL
CHLW
WETASKIWIN
CJOR
WAINWRIGHT
KEY 83
STETTLER
Q14
DRUMHELLER
Q91
BROOKS
Q13
BLAIRMORE
CAT COUNTRY
Radio Network
Athabasca 850 CKBA
Blairmore CJPR
Brooks Q13
Drumheller Q91
High Prairie 1020 CKVH
Slave Lake 1210 CKWA
St. Paul 1310 CHLW
Stettler Q14
Wainwright KEY 83
Westlock 1370 CFOK
Wetaskiwin 1440 KJR
We're all over Alberta
For all your agricultural advertising needs call
1-877-707-2346

1.3.1 Fundamentally, DS relies upon herbicide for:

- Cheap and simple pre-seed burnoff[5].
- Useful pre-harvest[6] options.
- Chem-fallow[7]
- Sod-seeding[8]

1.3.2 Herbicide methods compliment the principles of residue management.

1.3.3 Zero-till[9] (ZT) is on the leading edge with this key DS principle.

1.4 Fertilizer placement: This principle implies that fertility should favour the crop and not weeds. Another implication is whether or not we fertilize the *soil* or the *crop*?

- My interaction with farmers confirms that soil fertility is of keen interest to them.
- There are many ways and means of supplying nutrients for our crops (not just N).
- Optimal application should be near the location and time that a crop is growing.
- Farmers need more knowledge about fertilizer efficiency (timing, rates, placement, source, etc.).
- Can we trust soil nutrient testing procedures that evolved under cropping practices that predate DS?
- What is the value/risk of fall-application, or other separate-pass operations?

We have very good DS systems that target crop fertility, but I think more efficiency is required. The discussion may involve rates, timing and placement of inorganic (purchased) forms; N-fixation (i.e. pulse crops in rotation); using organic forms (i.e. manures); or new technology (i.e. Agrotain™). However, with more questions than answers, the challenge is to our industry stakeholders for continued research, support and direction in this field of discovery. **After all, fertilizer is a major expenditure, especially for cropping enterprises with top-yield production goals.**

Some ongoing soil fertility research is now discovering a beneficial contribution from long-term DS[10]. Three years ago at *FarmTech Conference 2003*, a DS research pioneer, Dr. Guy Lafond, presented views on soil nutrient cycling. With respect to fertilizer-N (nitrogen), he reminded us that *climatic* along with *agronomic* conditions must merge to optimize crop nutrient uptake, stating "Important differences in nitrogen management between clay and fine sandy loam [soils] were observed. …Temperature and moisture are very important drivers of nitrogen cycling in the soil… Crops behave somewhat differently [and] the results are not conclusive as to the *preferred placement*, and consequently more research is needed".[11]

1.5 Low soil disturbance: Most of the practice change (and DS engineering) that has occurred in the last 25 years has been driven by the innovation and persistence of farmers seeking to reduce the amount and intensity of tillage to both save soil and lower costs.

- From tillage experience we know that the *first* field pass is always the easiest.
- Disturbed soil mixed with crop residue compromises the full benefit of DS.
- Reduced tillage and DS may also lead to less weed pressures.[12]

Perennial forage qualifies as *no-till* (Alberta farms and ranches are increasing hayland and pasture by almost 200,000 acres a year[13]). This is a good thing for soil quality.

This is also perhaps the best place to mention "summerfallow". In my opinion, rainfall, risk, and rotation are the only factors that should determine the frequency of a fallow-year. Drought might preclude seeding a crop (pray for rain). A cash flow squeeze in annual cropping may push growers to fallow for survival on equity rather than risk falling into debt (today's #1 problem for production agriculture). Crop-choice often follows a regional inclination for stubble crops or fallow (does not have to be bare soil).

I see little reason to make tillage-fallow a part of any cropping plan. For me it's just old-fashioned, detrimental and no longer qualifies as *acceptable* agricultural practice in Alberta. The alternatives start with chem-fallow and/or more diversity in crop rotations (i.e. pulse or winter cereals). **Prairie soil needs more stubble, not more tillage!**

Full circle, I believe these 5 key principles (1.1-1.5) outline DS for most Alberta farmers. Beginners, young or old, need not question *why* DS, but rather they should find out how and when to make it work on their farm. Much of the discovery is in the doing!

So, while the first chapter of my *DS handbook* may still face revision in that the era of cropping without tillage on the prairies is still young compared to tradition, I also acknowledge that each farm faces different management challenges and not every grower has the same opportunity or production goals. Therefore another way to understand DS is simply to study Chapter 2 - **Machinery Features**. Of course, the primary implement is the seeder (a.k.a. drill, airseeder, airdrill, etc.), and its' function within DS goes beyond just planting seed in the ground.

[Examples will be discussed in more detail during the conference presentation]

2.1 Seeding Implements: Everything from openers[14] for seed and fertilizer placement, seed spread and row spacing, soil displacement, furrow closure and packing, to residue clearance and field finish, must be looked upon as only one part or function of a good DS implement.

- For the DS novice, it should come as no surprise that the first question to be answered is "which opener works best… for me"?
- The use of terms like shank, hoe, and disc must be qualified with more explicit provisions such as single or double-shoot, knife, angle-disc, spoon, or spreader tip - stipulations that help classify the level of soil disturbance and stubble knock-down to be expected for the seedbed.
- In turn, many of these specifications get matched with various options of carbide, scrapers, boots, and tubes that further define their performance in certain soil types (ie: heavy clay, gumbo, abrasive, etc.).
- My best advice is to begin by *doing your homework*.

NOTE: The task does not have to be daunting, because I'm certain there are nearby experienced DS farmers willing to answer any questions. Also, RTL operates a DS network with a large database of owner/operators for just about any type of seeder anywhere in the province. Myself, or another RTL agronomist would be pleased to assist in matching inquiries, farmer to farmer. Additionally, I have provided a list of current DS machinery Internet websites with these proceedings.[15]

It is important to understand the following machinery-related issues. In the short time I have for this conference presentation, I can only identify what I think are the main matters a farmer must settle BEFORE selecting a DS implement. [Examples will be discussed, so readers may also have to be in attendance to gain full benefit].

2.1.1 What are my fertility goals and what is my fertilizer choice?

The primary decision a grower must make about DS openers and implements includes the type of fertilizer (F) to be used. That will depend on cost ($), logistics (L), and somewhat on target yields (Y). Soil-type (S) can be a factor, and crop-type (C) should also be considered, although both these alone are not significant reasons for selecting an opener to match a chosen fertilizer source. Fertilizer also involves decisions about single or double-shoot systems, which extends or limits the full machinery choices.

The common fertilizer sources can be described as dry granular blends (DGB), liquid solutions (LQS), or gaseous (NH3, anhydrous ammonia - strictly a nitrogen source). **Each has unique characteristics that influence a grower's preference, and will ultimately determine the DS features required for his cropping system.**

Thus, the selection order is: F>$>L>Y. In other words if you want a worthwhile crop (Y) you must plan for the soil to have the right nutrient balance at the time the crop requires it (L) and, in order to achieve that consistently and economically ($), you must understand how your fertility (F) program works. Separate-pass fall NH3 is different than NH3 double-shoot. Not all fields require high levels of seed-placed nutrients.

[Fertility & Machinery will be discussed more in the conference presentation]

2.1.2 How much and what kind of crop residue do I normally produce?

As mentioned, the key DS principle of residue management must be addressed in an equipment line-up. Most of the popular DS implements used in Alberta today are designed for residue clearance to some degree. Each may have its own set of compromises amongst a range of users and their reasons for choosing such - for some it's the colour:. Major problems can be avoided with experience (management trumps use).

Initially, nothing is more evident in DS than the efficiencies gained with wider row spacing (RS)[16] - less plugging, bunching and dragging occurs; less openers in the ground means more acres with a wider implement and the same tractor; one-pass side banding of fertilizer is possible; standing stubble and heavy residue are suddenly no longer a seeding barrier. The industry standard is around 9-12 inch RS. (Is that because of grower-comfort, or because it's only what the manufacturer's offer? - a few DS growers I know are wondering now if even wider RS will work in certain crops for specific reasons, one example being canola @ 18"RS to reduce disease within the canopy?).

Farmers will want to have confidence their DS implement-of-choice has enough residue clearance to handle the entire crop residue that accompanies bumper crops. Designs that feature wide RS and narrow seed spread provide the best residue clearance and the lowest soil disturbance. Contrary to some misinformation, swathed crops are not necessarily at risk with wide RS, nor are fields always smoother with narrow RS.

The same factors considered in fertilizer placement can apply to residue management, however the priority will further influence a grower's choice of seeding implement. Yield potential (Y) and cost differences ($) between design features are usually not significant. In my opinion, the selection order becomes: C>F>S>L. In other words, crop rotation (L) may determine if a design feature works for your soil type (S), using your fertility program (F) for the crop you wish to seed in the stubble you have (C). Using sweeps to seed HRS wheat into pea stubble for protein is different in sticky clays than sandy soil. Malt barley may require earlier seeding and a different nutrient package than silage or feed barley.

[Crop Rotation & Machinery will be discussed in the conference presentation]

2.1.3 What's my budget?

Farmers always inquire, "What DS implement will work best"? *Best* is not an easy thing to qualify without one-on-one consultation! However, I believe one-pass low disturbance DS is possible for most crops anywhere - with the right attitude and seeding implement.

Regardless of crop, climate or location, DS is working for Alberta farmers to the same degree as conventional cropping ever has. Thus, when things turn tough (ie: drought, rising fuel costs, limited labour, machinery breakdown, etc.), then bragging rights still favour the average DS operation, plus risk mitigation due to moisture conservation. Tillage does nothing but waste valuable resources when already scarce or expensive!

Even when current income deems DS un-affordable, farmers should be looking at where expenses can be cut, what can be saved over time, or gained by future investment in a DS cropping system. On the expense side one cannot discount rising fuel prices, shrinking farm labour resources, and never ending equipment allowances. These are real costs. Can DS significantly offset them?

It is interesting to note the range in costs associated with the machinery line up used in a comparison between DS and conventional cropping (Column 2, Table 2) . The calculations show that both machinery operating and ownership costs are reduced with DS, especially when the same tractor is used. Adding fuel, labour, and equipment savings amounts to a fair offset for annual payments on DS machinery purchases. As the cost of fuel goes up, savings further increase in favour of DS (not shown).

Table 2. SAVINGS - seeding system annual cost comparison: Direct Seeding (DS) vs Conventional (CV)

		Reduction with DS	
	COST $/acre*	1200 acres	2500 acres
Fuel @ $.75 / Litre	$3.24 - $4.50	$1,356	$2,700
Labour @ $15 / hr.	$1.80 - $3.75	$2,232	$1,500
Equipment @ 3% + lube	$3.26 - $6.47	$228	$1,075
Total Machinery [OP] ^	$8.30 - $14.77	$3588	$5,275
Total Machinery [OW] ^^	$9.86 - $22.13	$1,896	$3,325

*AAFRD machinery cost calculator as per: DS = 275hp 4WD + 30' airdrill (1200a & 2500a)
CV = 180hp 2WD + 30' airseeder + HP (1200a) or
275hp 4WD + 40' airseeder + HP (2500a)
^Operating Costs
^^Ownership Cost

Budget issues are a personal affair, so, as with fertilizer and crop, novice DS farmers are best advised to select their DS implement requirements using a pre-determined list of the important factors. Improving yield (C&Y) shouldn't be an immediate priority, rather the selection order might be S>F>L>$. In other words, equipment need not be new or fancy so shop second-hand, remembering that trade-in value for *tillage* implements continues to drop. Also, retro-fitting could be an option ($). Adjustments in your cropping system must be well understood (L) to make that implement work best, including an appropriate fertility program (F) for your soil zone (S). Start with something similar to what a DS neighbour has, or hire an experienced custom direct-seeder for one field, or one crop. Can you see the difference? Do you like it?

2.2 Air Carts / Fertilizer Tanks Opener designs mainly depend on product handling of fertilizer (i.e. DGB, LQS, NH3) plus seed placement (single or double-shoot). Many DS implements are air seeders. The toolbar DS features must be integrated with capacity, metering, flow, and air velocity adjustments of the air cart or tank.

- Unquestionably, the size and price of air carts affects the cost of a DS implement.
- Matching brands makes sense, but is not always necessary.
- Air-seeding cultivators are not air-drills, which are not box-drills.

2.3 Tractors Power, traction, and hydraulics can be very important considerations when switching from conventional (tillage) to DS.

- The features selected for the DS implement determine the tractor "options".
- Large-size carts can improve efficiency. WATCH OUT for floatation and traction!
- What do we really know about tires, tow-behind / between, etc.? (not enough)

2.4 Other Equipment Upgrading may be desirable in some cases, however additional machinery beyond seeding and specialized attachments for the combine is normally not required for DS.

- Residue management: Straw choppers, chaff spreaders, heavy harrows, balers, etc.
- Sprayers: DS requirements (for timely application in pre-seed burn off, and perhaps pre-harvest management) lead the way in new herbicide application technology.

[DS Machinery Do's & Don'ts will be discussed in the conference presentation]

Like machinery decisions described in Chapter 2, the *art & science* of crop rotations under DS also involves a personal list of the farmer's pre-determined priorities. The dynamics of growing different DS crops can be complex but at the same time rewarding. Crop selections must be constantly sequenced according to fertility and yield targets, residue management, weed control strategies, as well as quality expectations (including seed and volunteers). A certified seed-grower may have unique expectations or goals quite different from those of a feed & fodder cattleman. Therefore, Chapter 3 of the DS *handbook* - **Farming Enterprise** has a significant influence on the manner in which farmers will consider direct seeding.

[DS Machinery by Operational Diversity is part of my presentation]

3.1 RTL Focus Groups - To address specific DS issues or concerns, RTL has met with farmers to discuss their experience and opinions. Farmer-based solutions and advice can then be passed along to other farmers and stakeholders (i.e. industry goods & services reps).

3.1.1 Seed Growers and Direct Seeding (1998-99) - What is the *risk & reward*?

- Early seeding
- Even maturity
- Less volunteer
- Pulse as "break" crops (i.e. replace fallow)
- Unable to use glyphosate herbicides for pre-harvest

3.1.2 Sod Seeding (2004) - What works, or not?

- Pre-harvest / fall-spraying (herbicide) is better than spring glyphosate
- Fertility is important (double-shoot placement)
- Equipment experience is helpful (seed placement below thatch)
- Moisture and time savings are obvious
- Decision to terminate active forage in advance is difficult (season before)

3.1.3 RTL Website (2000) - What do farmers want/need for DS on-line?

- Clear, current, concise information *(Knowledge Tidbits)*
- Quick browsing (compatible with rural phone lines and basic computer)
- RT Library (topical index) with associated links
- www.reducedtillage.ca - *your source for direct seeding information* (try it)

3.2 RTL Feature Farmer - Our website Home Page has a direct link to farmer stories (operational profiles) that provide DS insight for a wide range of farming practice and location (i.e. soil zone, chem-fallow, irrigation, fall-seeding, seeder modification, etc.) For a complete list and access to the full feature articles, readers are encouraged to go to:

http://www.reducedtillage.ca/farmerlink.htm

3.3 RTL On-farm Demonstration Program - DS is the fundamental cropping practice upon which RTL builds an extension program for reduced tillage. Our partnership funding (extensive but not huge) is flexible enough to target a broad audience, and yet specific in terms of assisting farmers in the adoption of sustainable agriculture. Conducting on-farm trials is becoming an RTL specialty to help farmers find solutions for barriers to reduced tillage.

WANTED (alive): All Non-Direct Seeders!

3.4 RTL *Farmer to Farmer* DS Network - Several hundred Alberta farmers have given RTL permission to share their own DS experience with other farmers who wish to learn or exchange ideas. Contact an RTL agronomist if you wish to participate. It's simple, private, and the best way for first-hand honest information about how to make DS work on your farm - anywhere in Alberta.

Appendix A. Internet Bookmarks for DS Equipment (Manufacturing Companies)

AIRDRILLS & AIRSEEDERS

http://www.bourgault.com

http://www.caseih.com

http://conservapak.com

http://www.deere.com

http://www.ezeeon.com/main.html

http://www.flexicoil.com

http://www.greatplainsmfg.com/index.html

http://www.morris-industries.com/index.php

http://www.newholland.com/h4/products

http://www.seedhawk.com

http://www.strawtrack.ca

OPENERS & RETRO-FIT

http://www.dutchind.com

http://www.farmlandspecialty.com/frproduct.htm

http://www.harvestechnologies.com/harvest.php

http://www.khartindustries.com

http://www.gaber.com/gaberdst/nichols.html

http://www.technotill.com

http://www.liquidsystems.net/bins/index.asp

CHAFF & STRAW

http://www.agritechmanufacturing.com

http://www.crary.com

http://www.redekopmfg.com

http://www.mandakoagri.com/mandako

http://www.thespreader.com/chaff_spreader.htm

http://www.vittetoe.com/chaff1.htm

FARM EQUIPMENT LISTING (AAFRD - July 2005)

http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng9837

EQUIPMENT REPORTS / TESTING

http://www.pami.ca

Harmon International Industries Inc.
Saskatoon, SK. S7K 2Y4
(306) 931-1161

Valley Packing Systems
Wadena, Saskatchewan, S0A4J0
Ph: (306) 338-2718

Crawford's West Inc.
Straw Storm
Alberta Dealer: Camrose, Alberta T4V0J9
Ph: (780) 672-2471

Rodono Industries Ltd.
Clive, AB. T0C 0Y0
Ph: (403) 784-3864

Appendix B. Comparison List of Machinery Used for DS vs Conventional (Table 2)

	Tractor	Seeder	Other	Farm Size	System
#1)	4WD 275hp	30' airdrill	n/a	1200 ac.	DS
#2)	FWA 180hp	30' airseeder*	60' HP^	1200 ac.	CV
#3)	4WD 275hp	30' airdrill	n/a	2500 ac.	DS
#4)	4WD 275hp	40' airseeder*	60' HP^	2500 ac.	CV

*High-disturbance (sweeps / no on-row packing)
^Harrow-packing draw bar / separate operation

On-line link for AAFRD Machinery Calculator *(Ropin' the Web)*
http://www.agric.gov.ab.ca/app24/costcalculators/machinery/getmachimpls.jsp

[1] 2001 Canadian Agricultural Census

[2] *Stubble height effects on microclimate, yield and water use efficiency of spring wheat grown in a semiarid climate on the Canadian prairies* - H.W. Cutforth and B.G. McConkey, SPARC March 1997

[3] See: *Soil Temperature and Direct Seeding* - Agdex 590-2, 1999 (AAFRD DS Factsheet series)

[4] *Glyphosate* is the chemical name for the active ingredient used in several non-selective herbicides

[5] *Pre-seed burnoff* refers to the common DS practice of spraying herbicide on early emerging weeds prior to seeding the crop.

[6] *Pre-harvest* is the term commonly used for a non-selective, in-crop herbicide application before harvest -often used in DS for perennial weed control and to enhance crop maturity.

[7] *Chem-fallow* implies that weed control is achieved with herbicides rather than tillage.

[8] *Sod-seeding* in Alberta is becoming a popular method of terminating a perennial forage crop with herbicide and reseeding for annual cropping without any tillage (i.e. to avoid plowing or discing).

[9] *Zero-till* referred to here means a DS practice whereby any tillage operation (soil disturbance) only occurs at seeding (one-pass for seed & fertilizer, <40% stubble knock-down), thus excludes high disturbance, and any fall tillage, pre-seed tillage, etc.

[10] *Evaluation of Long-term No-till Effects on Soil Fertility* - Project Leader: Guy Lafond, AAFC Indian Head, SK.

[11] Farm Tech 2003 Proceedings: *Direct Seeding & Nitrogen Fertilizer: The Past, the Present and the Future*...[p 82-116] - Guy P. Lafond et al (AAFC; PPIC).

[12] Author's background & personal experience with DS cropping systems

[13] 1996-2001 *Canadian Ag. Census* comparison

[14] *Openers* as used here refer to the ground-engaging components of a DS implement.

[15] See Appendix A. for *Internet* website listing of DS Equipment manufacturing companies.

[16] *Row spacing* is often used to determine acceptable performance parameters for DS implements, including crop agronomy (emergence, maturity, etc.) and operational efficiencies (machinery draft, price, etc.).

[17] See Appendix B. for a summarized comparison list of each machinery scenario used in Table 2.

[18] *Retro-fit* DS equipment is usually only a short-term solution for mitigating equipment costs