Evaluating Tillage Options for Your Farm

GHG Taking Charge Team Factsheet

Your tillage system is important to the long-term sustainability of the farm enterprise. Matching a crop tillage system that is suited to your farm resources can provide both economic and environmental benefits. It is important to evaluate your land and determine what options would be appropriate.

Several questions have arisen regarding new approaches or options in tillage systems compared to a conventional system. The following fact sheet will look at some alternatives to conventional tillage and evaluate the advantages and disadvantages associated with each as they apply to field crops in New Brunswick. The economics of each tillage approach is closely tied to matching the specific soil, climate, and topography of the production field with the appropriate crop management requirements.

What are the options?

Tillage options range from no-till, with minimal soil disturbance through to conventional plowing, disking, cultivating, and planting. Conservation tillage is a reduced tillage system that reduces the number of land preparation passes, and increases surface residues to greater than 30% after planting, to protect soil and conserve water losses. There are many combinations and variations between conventional and no-till.

Generally if the soil and its water management properties including topography are suited, reduced tillage can save time, save fuel, reduce soil loss, improve soil structure and water retention compared to a conventional system. However it can present challenges if careful attention is not given to residue management, proper seeding, crop rotation, weed control, fertility, and pH management. Poorly drained or compacted soils are limiting factors in applying no-till or reduced tillage options. Implementing reduced or no-till will often require a transitional period, starting with your best fields first will allow producers to gain experience in dealing with surface residue levels.

A healthy soil improves yields

What are the advantages and disadvantages of reduced tillage?

Advantages

- ✓ Potentially higher profits primarily from reduced inputs including fuel, machinery and labour costs.
- ✓ Reduction in land degradation, reduced erosion and runoff.
- ✓ Improvements to soil (structure, organic matter), improved moisture retention and sustainable yields, particularly in dry years.
- ✓ Less leaching of nutrients and chemicals.
- ✓ Comparable yields over time, 2-3 years, but equal or more $/acre.
- ✓ Improved harvest conditions as a result of increased load bearing capacity of soil.

Disadvantages

- ✓ Not suited to poorly drained land.
- ✓ Initial investment of equipment, particularly if no-till approach used.
- ✓ Will require increased weed control management and herbicide use.

What are the key elements to evaluate when considering reduced tillage options?

Each of the following elements are important in a conventional tillage system, however introducing a reduced tillage system requires particularly good

suitability information and subsequent management:

- Land suitability (including an assessment of fields to determine their suitability for reduced tillage.)
- Soil type, Drainage, Compaction, Erosion potential
- Crop Selection
- Crop Rotation
- Residue management
- Weed management
- Nutrient management
- Insects and Disease

Land Suitability

Soil type is very important to the success of reduced and no-till management. It is particularly important under our New Brunswick climatic conditions where abundant rainfall and cool temperatures in the spring and early season can impact field operations, germination and plant establishment. The following provides general information on the suitability of reduced tillage systems for various soil textures. It is strongly recommended that producers evaluate each field for its specific suitability.

Coarse textured soils

Sandy and sandy loam soils are characterized as droughty and are susceptible to erosion. They do dry quickly in the spring and will be earlier to plant. Moisture retention is a concern with these soils, as a result, these soils can benefit from reduced tillage. Leaving plant residue can reduce runoff, improve infiltration and reduce evaporation. No-till and reduced tillage are expected to equal or improve yield potential compared to conventional tillage on these excessively drained soils.

Medium textured soils

Medium textured soils under reduced tillage tend to provide increased yields compared to both no-till and conventional tillage. Special attention is needed in the spring to confirm that soils are ready for tillage. Digging down to the depth of tillage and seeing if the soil is friable enough to work is very important. In general no-till may be able to be done 2-3 days before plowing as it is done at a shallow depth. Earlier planting may provide a slight yield advantage under no-till. Soil temperatures of 10^{o} C or better would still be needed for corn production.

Fine textured soils

Reduced tillage may be successful on only the well-drained clay loams of these fine textured soils. Yield potential can equal that of conventional tillage, but the improved soil erosion control would favor reduced tillage. No-till systems would require tillage coulters. A deep-rooted crop rotation is important on all these soils.

Note: On some of the heavier dykeland soils no-till has been successful with small grains. No-till under these circumstances avoids bringing saline subsoil to the surface for mixing with topsoil. As well, it helps retain the form of dales reducing maintenance cost to re-shape them. (Rodd et al.)

Very fine textured soils

These soils are susceptible to compaction and late to warm up. Reduced tillage and no-tillage may not be suited to imperfectly drained soils. Fall plowing may be the only alternative open to producers. This presents some risk of erosion but if done on the contour and leaving 4-6 " ridge heights, this risk can be reduced.

Crop Selection

Crops selected for reduced or no-till systems must first have an adequate length of growing season to reach economic yields, therefore proper hybrid and variety selection for our climate is important. Field preparation, residue management, planting and nutrient supply must ensure good germination and growth. Weed, insect and disease management must be understood and prepared for. Reduced tillage systems rely on optimum crop rotation and crop selection must account for this.

Crop Rotation

Crop rotation is one of the keys to sustainable production and is very important in a reduced tillage system. Rotations improve the soil structure, organic matter and drainage. They maximize moisture availability, reduce erosion, help control weeds and provide less dependence on herbicides, help control insects and disease and enhance the nutrients status. Crop rotation can store carbon and reduce CO_2 emissions. In addition to these many agronomic and environmental benefits, good rotation can provide varying sources of income and help with time management by distributing the workload.

Residue management

Conventional tillage in large part is used to reduce residue and prepare the field for planting. However, the

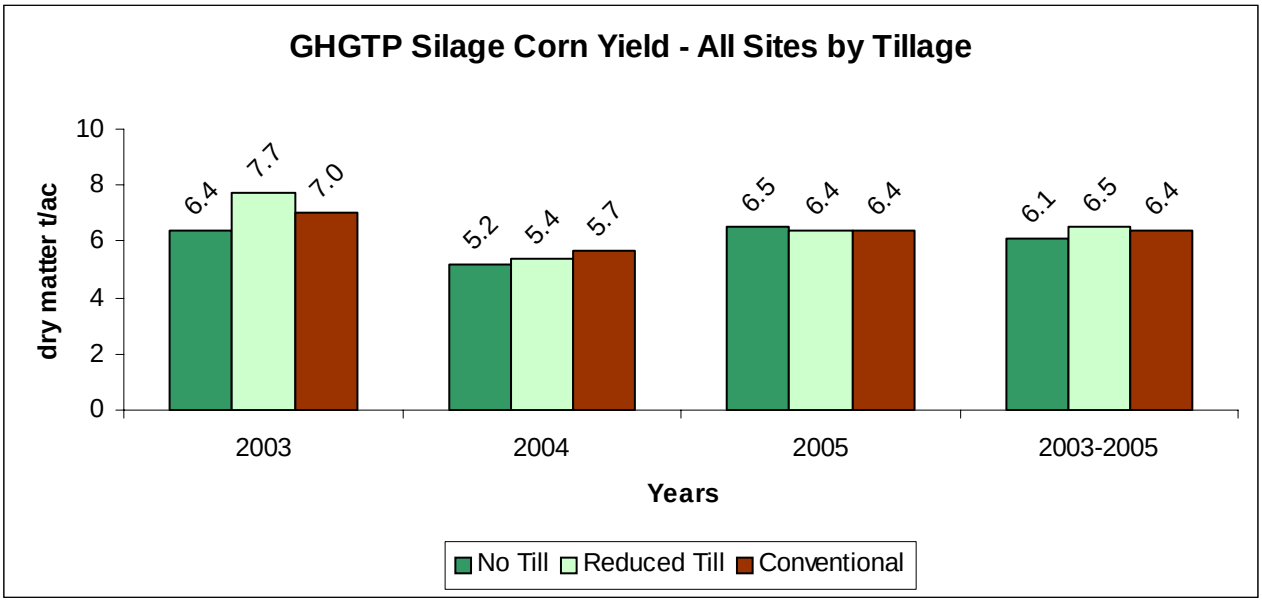

Figure 1. Tillage System Yield Comparisons

long term impacts of this activity can result in significant annual soil losses, especially if done up and down slope in the fall. Previous studies in New Brunswick indicate a major impact of reducing soil loss as a result of residue cover. These studies further demonstrated that no-till and less disturbance types of tillage such as, chisel plow, are cutting soil losses dramatically compared to conventional mouldboard plowing. At harvest, especially in small grains, even distribution of straw and chaff across the full width of the combine is essential in no-till.

Weed management

A weed management plan should be in place specifically tailored to the crop selection, the land suitability and tillage option chosen. An integrated approach to weed management and crop rotation is essential. In no-till we see a shift in weed types from annuals to perennials. Therefore, herbicide tolerant crop varieties are encouraged to allow for post emergent herbicides.

Insect and disease

Just as in conventional tillage, an integrated pest management system includes good choices on variety and hybrid selection as well as a crop rotation and scouting strategy to interrupt disease and insect population cycles. In reduced tillage with less cultivation it is even more important to obtain good control particularly in the early stages of establishing a conservation tillage program.

Nutrient management

Manure still works well with no-till, especially if injected, which would cut down on ammonia losses. Under no-till, infiltration usually increases. Manure is trapped in place by surface residue, this will infiltrate into the root zone. On the other hand, no-till may present some risk with regard to manure entering soil macropores and making its way to tile lines. A consideration in environmental farm planning, and or outlet design and location.

Less runoff and more consistent supply of nutrients to the crop can result from improved soil quality. Some nutrients may accumulate at the soil surface with no-till over time. As well, New Brunswick soils being acidic in nature and with ammonia-based fertilizers will re-acidify, over time. Therefore, conventional tillage may be required every 3-4 years to incorporate lime and re-distribute fertility within the root zone. As well, it may break up weed patterns. Example: If a dairy producer is growing corn for 3 years on the same land and wants to move to alfalfa, he could utilize conventional tillage to incorporate lime and surface accumulated nutrients such as phosphorous. The legume crop will fix it's own nitrogen and be less inclined to the acidifying affects of ammonia based fertilizers.

Costs and Benefits:

Recent results (from the Greenhouse Gas Tillage Project in New Brunswick, GHGTP) across several sites and conditions have indicated that in general, yields between the two systems have been comparable, (see figure 1.) and that there are some costs savings in

favour of a reduced tillage system (see figure 2.) The differences in crop production costs between tillage methods are given in Figure 2. The fuel savings are roughly equal to the increased herbicide costs. The major advantage of no-till is decreased labour in the spring and decreased capital outlay for equipment.

Although the benefits above are more short term, successful reduced tillage can provide a more sustainable future for the agricultural industry. Proper site selection and planning are important. For more information, please contact your local Crop Development Officer (1-888-NBAGRIC or 1-888-622-4742) or Soil Specialist (1-506-453-2109) with the New Brunswick Department of Agriculture, Fisheries, and Aquaculture, or contact your agri-environmental club coordinator.

Difference In Crop Production Costs/ac 2005 Guideline

	Estimate NB Conv Feed Barley	Estimate NB Notill Feed Barley	Estimate NB Conv Silage Corn	Estimate NB Notill Silage Corn
Diff in Operating Costs				
Herbicide	$8.00	$30.00	$20.00	$42.00
Fuel	$18.00	$9.00	$26.10	$13.05
Machinery Operating	$20.00	$10.00	$24.50	$12.25
Interest on Operating	$8.03	$8.23	$17.15	$16.97
Diff Total Operating:	**$54.03**	**$57.23**	**$87.75**	**$84.27**
Diff Fixed Costs:				
Machinery Depreciation	$32.50	$24.38	$42.50	$28.05
Machinery Investment	$12.00	$9.00	$15.00	$9.90
Diff Total Fixed:	**$44.50**	**$33.38**	**$57.50**	**$37.95**
Diff Total Operating & Fixed:	**$98.53**	**$90.61**	**$145.25**	**$122.22**
Diff Labour	**$22.00**	**$16.50**	**$32.00**	**$24.00**
Diff Total Costs	**$120.53**	**$107.11**	**$177.25**	**$146.22**
Potential Benefit for No till		**$13.42**		**$31.03**

Note 1: Assuming Good Mgt, equal yields
Note 2: Rock Picking not conidered

Figure 2. Cost Comparisons of Tillage Systems

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This factsheet was prepared by Pat Toner and Walter Brown (New Brunswick Department of Agriculture, Fisheries and Aquaculture), April, 2006.

Greenhouse Gas Mitigation Program for Canadian Agriculture
Programme d'atténuation des gaz à effet de serre pour l'agriculture canadienne

Canadian Cattlemen's Association

Canadian Pork Council / Conseil canadien du porc

Dairy Farmers of Canada

Les Producteurs laitie du Canada

The Soil Conservation Council of Canada

Agriculture et Agroalimentaire Canada / Agriculture and Agri-Food Canada