Nutrient Management Plans - What Industry Agronomists are Doing

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Regulations increase in direct proportion to the age of a civilization. Manure Management Plans (MMP) are now required for many large livestock enterprises. Nutrient management plans (NMP) account for nutrients contained in the soil, manure and other sources in order to develop a fertility program, which ultimately specifies the rate, method and timing of fertilizer materials.

Crop inputs retailers and advisers are currently providing many of the components of a NMP, however the components are usually not presented to the producer customer as a formal package. A well thought out package for nutrient planning would add value to the ad-hoc services that are already being provided.

Advisers might want to consider standardizing a NMP package offering to present to their customers. A standardized format would prevent important considerations from being forgotten in the winter planning sessions that many retailers provide for their customers.

In order to assess the degree of on-going but informal nutrient management planning in Manitoba, a number of experienced agronomists were interviewed through telephone or personal visits. The interview surveyed their present soil fertility planning and compared it to the formalized NMP of the USDA- NRCS (Natural Resources Conservation Service). A brief background on such nutrient management plans can be found at www.nrcs.usda.gov/technical/ecs/nutrient/gm-190.html.

Firstly, there are 10 main components of a NRCS Nutrient Management Plan.

a) Locate facilities and fields on maps
b) Identify environmentally sensitive areas
c) Specify crop rotation
d) Determine expected yields
e) Obtain results of soil, plant, water, and manure analysis
f) Obtain nutrients from all sources available to the farm
g) Develop a nutrient budget for each field
h) Make recommendations of nutrient rate, timing, form, and method of application
i) Review and modify plan as needed
j) Maintain records

A total 16 agronomists were interviewed. Eleven of the 16 worked as retail agronomists and 5 were independent consultants. When possible, the agronomists were asked to display a sample of the process and records they keep for growers in preparing a fertilizer recommendation. Usually this sample would be of a "full-service" customer, and would not necessarily represent that of the typical client. Following are the findings and comments from that survey. Results are generally reported in graph or text form and the number of responses is indicated (as "n").

a) Locate facilities and fields on maps

The intent of the NRCS NMP is to identify the field with adjacent or enclosed farmsite and livestock buildings.

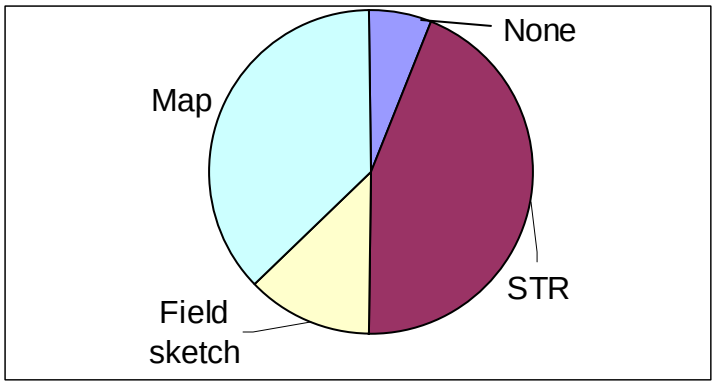


Figure 1. Location of field and facilities on a map.

Few of the MB agronomists provided such a detailed sketch that would include buildings, barns, etc.

- many simply provide Section-township-range details so the soil sampler could get to the correct field (n =7).
- few provide general field sketches (n=2)
- some occasionally use a more detailed map of fields (n=6) and many indicated that they could provide more detailed mapping and labeled sketches if desired/required (U-Count infra red maps (5), satellite images (5) and black & white orthophotos (2).
- The most sophisticated level of mapping was downloaded from the MLI (Manitoba Land Initiative) and provided a basemap in the field with soil type in the background. As areas were soil sampled, spots were GPS marked for future reference.

b) Identify environmentally sensitive areas (ESA)

Environmentally sensitive areas requiring identification in the NRCS program are areas of potential contamination of surface (creeks, rivers, potholes) or groundwater (wells, shallow aquifers) and established buffer distances are specified. Distances are also specified for certain practices in Canada and Manitoba. Buffer distances between certain pesticides and ESAs are listed in the current Crop Production Guide and summarized by Cavers in this same proceedings. The Manitoba Farm Practices Guidelines lists spreading setback distances between watercourses and manure spreading. These distances range from 16 feet with manure injection in a level site to 295 feet with surface applied, not incorporated manure on an area with 6-12% slope. These guidelines are independent of operation size not just restricted to larger operations and their required MMPs.

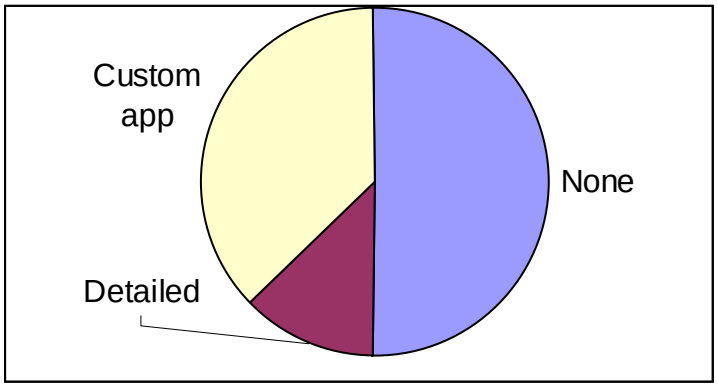


Figure 2. Identification of environmentally sensitive areas on field map.

Most MB agronomists did not mark such areas on their field maps

- Half made no designation of these areas (n=8)
- some did note environmentally sensitive areas (n=6) - not in response to "fertility" planning, but instead for their associated custom pesticide application business. Presently buffer strips are required for some pesticides in reference to water bodies (see Cavers in this proceedings)
- detailed demarcation of ESAs was done by 2 agronomists involved in formal manure management planning. One used a GIS program developed to demarcate buffer zones and another used Manitoba Conservation's groundwater hazard maps.

c) **Specify crop rotation**

How simple life can be when one only grows corn and soybeans like the examples used in NRCS NMPs? However our crop rotations are much more diverse and fluid in Manitoba. Most agronomists are closely involved in recording and proposing crop rotation or sequence options.

- 14 record the historic crop rotation, with some having up to 20 years records.
- 9 routinely advise on and propose rotational choices

Generally the crop sequences are not selected for fertility reasons.

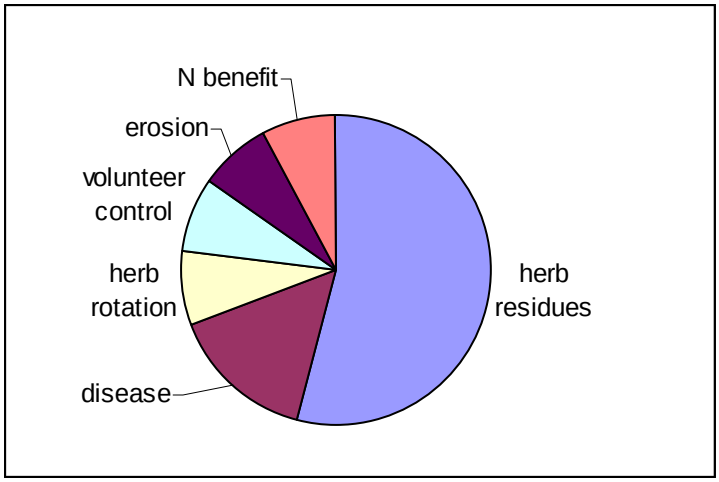


Figure 3. Key reasons for maintaining crop rotation records.

The top reasons are:

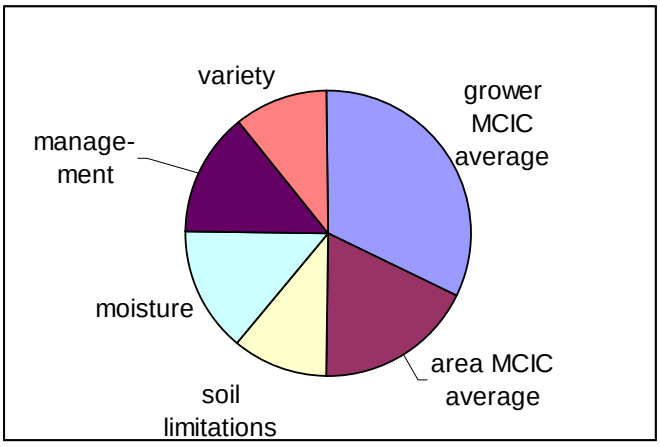
- to account for herbicide residues (n=7), especially for agronomists working with potatoes
- for disease management (n=2)
- for herbicide rotation to avoid development of resistance
- for effective control of volunteers, especially with herbicide tolerant crops
- for erosion and soil structural improvement in potato rotations
- for nitrogen benefit when following N contributing crops such as forages, pulses

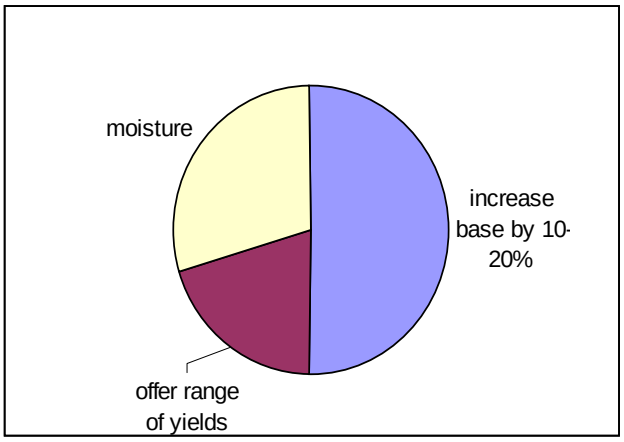
d) Determine expected yields

Determination of expected yields is critical, particularly in determining nitrogen recommendations. The USDA NRCS program recommends a strategy that includes crop productivity ratings, historic data, climatic conditions, level of producer management and any local research. One suggested technique is as follows:

From the past 5 year yields for that crop on the farm, drop the highest and lowest yields and determine the 3yr average. Add 5-10%.

Manitoba agronomists used a variety and combination of strategies to determine a base yield and to set the target yield.





Figures 4-5. Determination of base yield potential and adjustments made for setting target yields.

To establish base yield potential agronomists:

- use the grower's past yield averages, often from Crop Insurance (n=9), or the area crop insurance average (n=5)
- base yield expectations on known soil moisture levels and anticipated or long-term precipitation expectations (n=4)
- consider the management of the grower, particularly timeliness in completing critical operations like seeding (n=4)
- identified field soil limiting factors, such as poor drainage or salinity (n=3)
- consider variety characteristics – the high yield potential of hybrids and the lodging tolerance of cereal cultivars (n=3).

Once the baseline yield has been developed, it is often modified to set the target yield:

- increase to target yield potential by 10-20% (n=5)
- offer growers the range of yield potentials to consider – good, very good and excellent (n=2)
- base their yield potential exclusively on stored soil moisture and anticipate precipitation (n=3). These 3 agronomists were based in western Manitoba, where moisture more routinely limits yield potential.

e) Obtain results of soil, plant, water, and manure analysis and a basic nutrient application rate.

All MB agronomists based their fertility plans on a soil test. Many also provided a plant tissue sampling service – but at varying degrees (Figure 6).

- routinely do potato petiole sampling on a regular schedule (n=6)
- use tissue testing to evaluate the success of their recommended soil fertility program (n=3)
- offer this strictly as a diagnostic service to aid in identifying problems (n=9)

Only 2 agronomists were preparing formal manure management plans and were involved in the manure analysis. The only case where water sampling was conducted was to determine quality for pesticide applications.

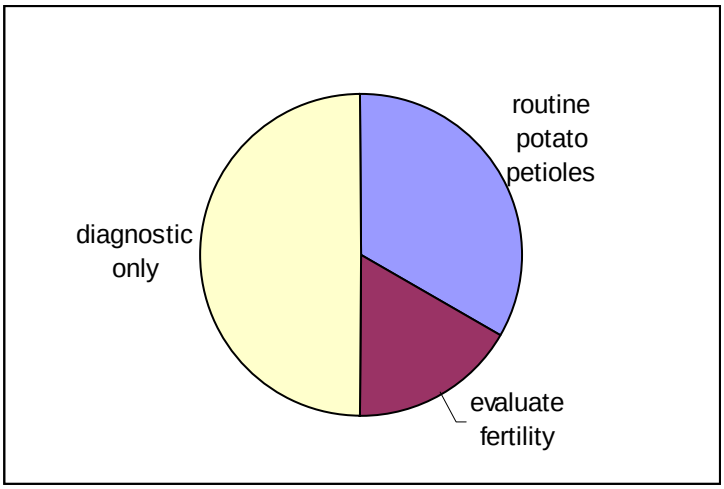


Figure 6. Range of plant tissue sampling services.

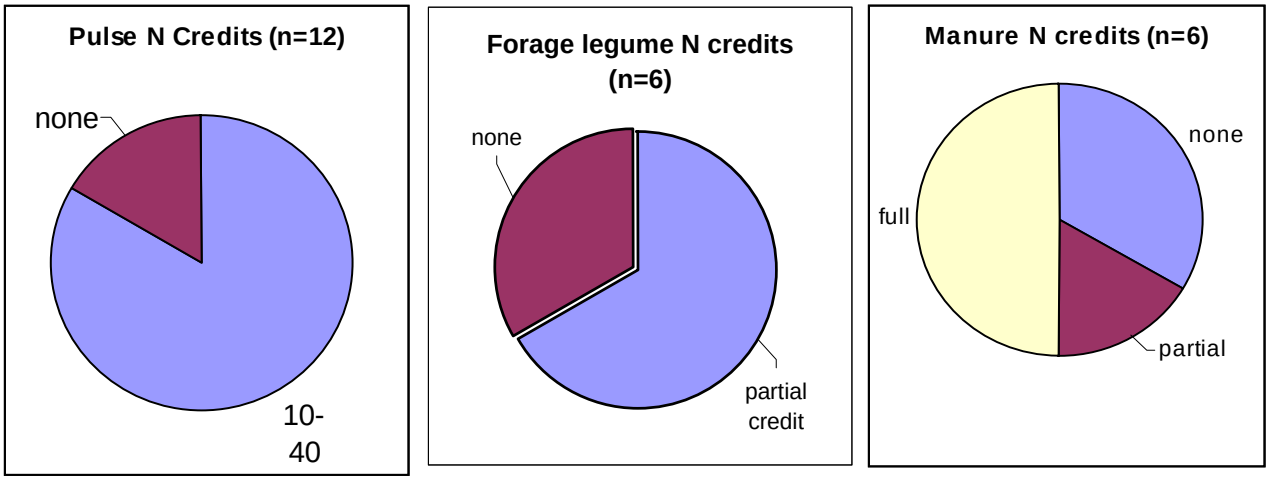
Based on the above information – c) crop, d) yield goal and e) soil test result, the NRCS NMP requires a recommended nutrient application rate to be stated. The recommendation is to be appropriate for that area and consistent with those based on land grant university studies. Standard industry practice is acceptable if recognized by the land grant university. Further steps serve to refine this recommendation.

Of the MB agronomists, several (5) rely on a yield goal based computer program to generate recommendations. Most (9) use the soil lab recommendation as base and modify based on local experience, farmer discussion, and other factors to be discussed later in this paper.

f) Obtain nutrients from all sources available to the farm

The NRCS program identifies that other nutrients may be available from legume or pulse crops, from current and historic manure application, atmospheric deposition of N and S and in irrigation water. The last 2 contributions are generally considered negligible in the prairies.

There was a considerable difference in how MB agronomists valued these contributions with many of these based on their observations of crop response in their local region.



Figures 7-9. Nutrient credits offered following pulse crops, forage legumes or manure applications.

Preceding pulse crops

- most provide N credits for preceding crops of peas or soybeans of 10-40 lb N/ac (n=10).
- 2 do not provide a pea N benefit – one felt that at very high pea yields most of the N would have been removed, and the other felt that the N contribution was strictly to be considered a bonus in producing higher yield and wheat protein.

Forage legumes – forages were not a major crop in many of the areas serviced by the agronomists

- 4 do offer some N credit, depending on the time of forage crop removal and upon the legume productivity of the stand
- 2 offer no credit – recognizing that forage stands were predominately grass by the time they were removed and N contribution would be minimal.

Manure – again was not part of the cropping system of many agronomists

- 2 offer no nutrient credit for applied manure – specifically beef manure due to its tendency to immobilize N (due to high straw content and C:N ratio) and variability in spread pattern
- 1 offered a partial credit for nutrients but tempered the credit due to the unpredictable nature of nutrient release
- 3 offered full nutrient credit for the manure – specifically injected, liquid hog manure

Other comments

- one agronomist mentioned that they recommended some supplemental N when high yielding corn stover was returned to the soil, due to its high C:N ratio and observed N deficiency in crops the following spring due to immobilization.

It is at this stage of the NRCS plan that nutrients designated from a formal "Manure Management Plan" would be imported.

g) Develop a nutrient budget for each field

This step appears overly simplistic in the NRCS program, particularly when fertilizer is the sole source of applied nutrients. The budget is simply the field nutrient recommendation, less the credits, less the actual fertilizer to be applied. In MB, fields are of sufficient size that specific blends can be formulated on a field-by-field basis, and the fertilizer blend would be designed to meet the fertility recommendation by the agronomist. The excess or deficit in nutrients would be small. Where manure is used some nutrients may well be present at levels greater than that recommended through the soil test (eg phosphorus or potassium).

A more valuable nutrient budget is that difference between the nutrients actually applied, and that removed in the harvested crop. This difference would indicate whether nutrient status is either being depleted, built-up or balanced.

Few of the agronomists were offering this service, although 5 could with their record keeping system if requested. However this type of balance is generally not done because:

- It is simply not requested by growers
- Lack of appropriate input data – that is the actual rate of nutrients applied and the resulting yield. Few growers actually report harvested yield data back to their soil fertility adviser, and few have reliable field-by-field records. For this budget to have full value individual yield results would be required for each field.

Agronomists may be overlooking a service to growers if field-by-field budgets are not kept. The nutrient budget will over time be reflected in soil test levels – those nutrients applied in excess of removal will build soil test levels and those "mined" from the soil in greater amounts that applied will be depleted.

h) Make recommendations of nutrient rate, timing, form, and method of application

All MB agronomists provided recommendation of fertilizer rates. Many indicated that the producer's production system and equipment line generally dictated the fertilizer timing, form and application method. These are important factors in further adjusting the application rate. Agronomic guidance in fertilizer timing and placement is more often provided when growers are making choices in upgrading or changing seeding equipment, and is not done every year or on a field-by-field basis.

i) Review and modify plan as needed

All agronomists met with the grower to review the fertility plan. Direct discussion with the grower is usually done in the winter, or earlier if year-end fertilizer purchases are planned. Plans are modified for a variety of reasons. During the course of the winter crop selection may change based on markets and expected returns or N prices. Fertility plans for individual fields may change as common blends are selected to accommodate as many individual fields as possible.
Spring modifications to plans may be based on the amount of moisture received over the winter and subsequent changes to yield goals. In-season fertility decisions may be based on tissue sampling of crops such as potatoes where irrigation provides flexibility in application timing.

j) Maintain records

Formal NRCS plans require detailed recordkeeping, including soil test results, quantities of nutrients applied, methods and date of application and crop yields. Most agronomists maintain a basic level of recordkeeping on their clients – chiefly of those inputs purchased from and applied by their business. However there is a wide range in the portion of their clients that demand and receive such a recordkeeping service (Figure 10)

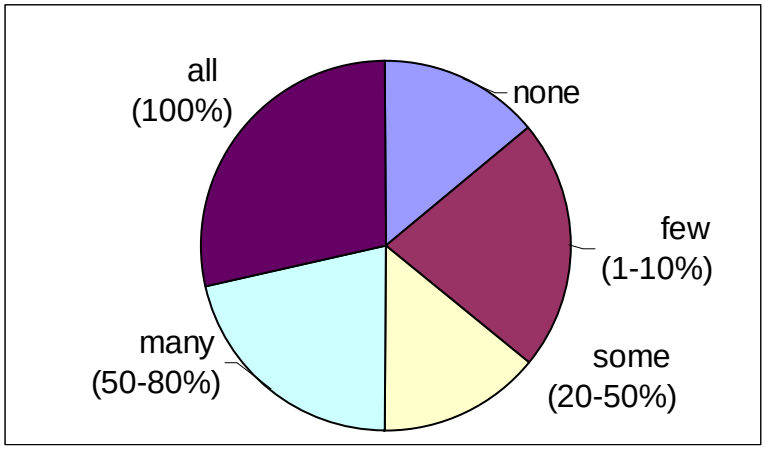


Figure 10. Portion of clients for which agronomists maintain detailed cropping records.

Those providing the detailed recordkeeping for all clients are either private consultants or those companies offering "full service" scouting programs.

There is a range of records kept –from simply a repository of past soil tests and custom application job orders to detailed computerized records (Figure 11).

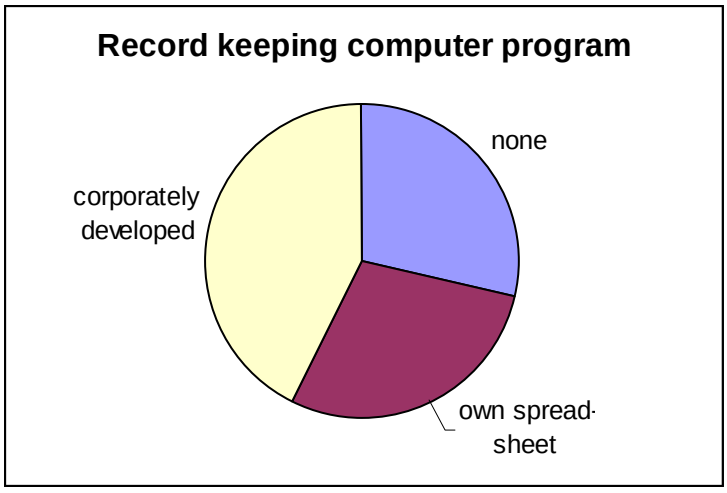


Figure 11. Those maintaining cropping records with a computerized system.

Those using a computer program to keep soil test and field records:

- Several (4) were keeping records simply as a file or binder of past soil test reports. Some of these individuals indicated that records could be computerized, but that substantial time would be required. Presently their clients were not looking for, or willing to pay for this service.
- Several (4) had developed their own system using a spreadsheet platform like Excel or an accounting program and modified it for their needs
- Many (6) had access to corporately developed record keeping programs that were used across the dealer network. Some also used programs that clients had started with on their own.

Some companies supply the same program for all their advisers, others encourage staff to develop what works for them

Since time and effort is required to assemble and maintain records, and this is currently not a "high demand" service by growers, the question arose whether additional fees were charged. Most generally do not charge extra for recordkeeping, but bundle it with soil sampling, crop scouting or consulting fees. A wide range of services is offered by many of these agronomists, yet fees can vary from $5/acre to bundling the soil sampling cost with fertilizer. Most retailers no longer bundle the soil lab analysis cost with fertilizer, but have the client pay.

Some agronomists did record and plot year-to year changes in soil test values. Some company and lab computer programs do offer the opportunity to plot soil test changes with time – although few were able to demonstrate farms where this had been completed over the long-term.

Summary

In summary, Table 1 ranks the success of current fertility management services offered by Manitoba agronomists in meeting those requirements of formal "Nutrient Management Plans"

Table 1. Success of current fertility management in meeting needs of formal NMPs.

	% of 16 MB agronomists completing presently
Locate facilities and fields on maps	50%
Identify environmentally sensitive areas	50%
Specify crop rotation	88%
Determine expected yields	100%
Obtain results of soil, plant, water, and manure analysis	100%
Obtain nutrients from all sources available to the farm	88%
Develop a nutrient budget for each field	Simplistic =100% Detailed = 31%
Make recommendations of nutrient rate, timing, form, and method of application	100%
Review and modify plan as needed	100%
Recordkeeping	88% - with a range of detail provided

The deficiencies from the formalized NMP are in the field mapping, the identification of environmentally sensitive areas, in providing a detailed nutrient budget and in maintenance of detailed records. These could be provided by most agronomists with some additional effort, but presently there is little to no demand by growers or regulation for these details.

Upon completion of this survey, the authors chose to develop a “draft” nutrient management plan template. This template incorporates the factors required under the US type plan. It also suggests the development of the more comprehensive “nutrient budget” based on actual crop removal values.

We welcome any comment from those that try this template in any further planning with their growers.

Company Name and Logo

NUTRIENT MANAGEMENT WORKSHEET

Grower: _____ Date: _____

Grower Contact information: _____

Field: _____(See map for details)

Crop Rotation

Projected Crop Year _____	Last Crop Year _____	Previous Crop Year _____	Previous Crop Year _____

Target yield for Projected Crop _____

Nutrient worksheet

Nutrients available from soil (tests)					
column	N	p	K	S	micro ____
1					
Nutrient recommendation for target yield based on soil test					
	N	P_2O_5	K_2O	S	micro ____
2					
Nutrient credits from previous crop (legume, crop loss, etc)					
3					
Nutrients already applied (if manure transfer info from Manure Management Plan)					
4					
Required additional fertilizer nutrients (row 2 less row 3 & 4)					
5					
Fertilizer nutrients to be added					
with seed					
away from seed					
at crop stage ____					
Nutrients actually applied					
6					

Comments and Recommendations: method, form and timing of applications

_____

PREPARED BY: _____

Detailed Nutrient budget worksheet

nutrient budget					
column	N	P_2O_5	K_2O	S	micro ____
total available & applied nutrients (add rows 3,4 &6)					
7					
Simplistic = total available & applied nutrients (rows 7) less required (row 2)					
8					
Detailed = total available & applied nutrients less crop removal (calculate below)					
Nutrient removal estimate by crop = Crop yield (bu/ac) x nutrient concentration (lb nutrient/bu).					
9	yield = _____ bu/ac				
wheat grain straw	@14.3% protein) 1.5 0.63	 0.58 0.22	 0.43 1.38	 0.1 0.13	
canola grain	 1.94	 1.17	 0.6	 0.34	
peas grain straw	 2.34 0.72	 0.7 0.16	 0.7 2.04	 0.14 0.12	
flax grain straw	 2.13 0.58	 0.63 0.12	 0.63 0.83	 0.21 0.25	
Nutrients removed = yield (row 9) times values in appropriate crop row. If straw is removed, calculate and add to removal in grain					
10					
Detailed = total available & applied nutrients (row 7) less crop removal (10)					
12					

Estimated nutrient values removed by other crops can be calculated using various charts or programs:

- Soil Fertility Guide (Manitoba Agriculture and Food), Table 1.
- "Nutrient Uptake and Removal by Field Crops – Western Canada1998 (Canadian Fertilizer Institute)
- Pkalc program, Potash and Phosphate Institute @ http://www.farmresearch.com/pkalc/default.asp

Appendix. Further details provide by Manitoba agronomists involved in fertility plans.

1) Does staff providing fertilizer recommendations to growers have any special accreditation?

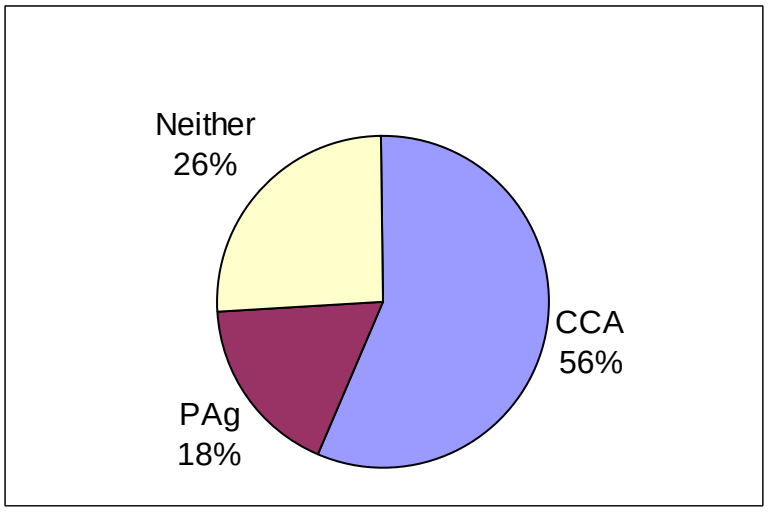


Figure 12. Credentials of staff providing fertilizer recommendations to growers

Most companies or consultants had Certified Crop Advisers (CCA's) or professional agrologists (P.Ag.'s) on staff providing fertility recommendations. Of the 16 companies contacted, 13 had CCAs on staff and 11 had P.Ag.'s. A small but growing number of agronomists hold both designations. A considerable portion of fertility planners hold neither of these designations.

2) What soil sampling strategies are used?

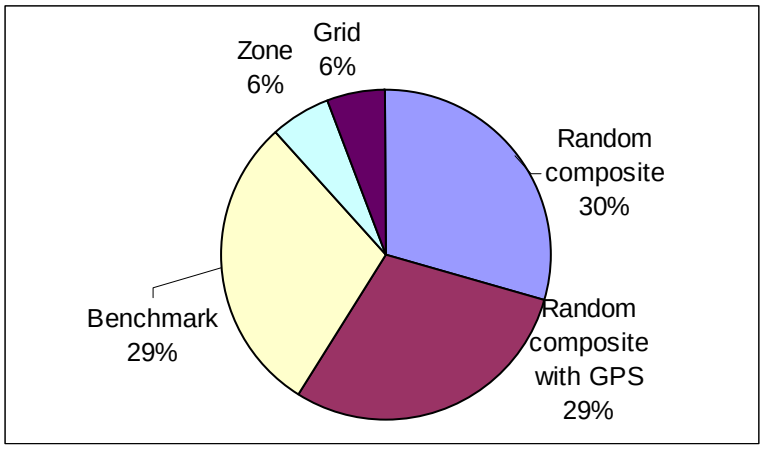


Figure 13. Soil sampling strategies used in Manitoba.

Some agronomists offer more than one sampling method depending on the needs of the client

- random composite sampling (5)
- random composite sampling with GPS (5), so sample points are marked and can be returned to for future sampling
- benchmark sampling (5)
- zone sampling (1), primarily for fields with large known variability and zones are selected based on satellite photos
- grid sampling (1) for variable rate fertilized potatoes

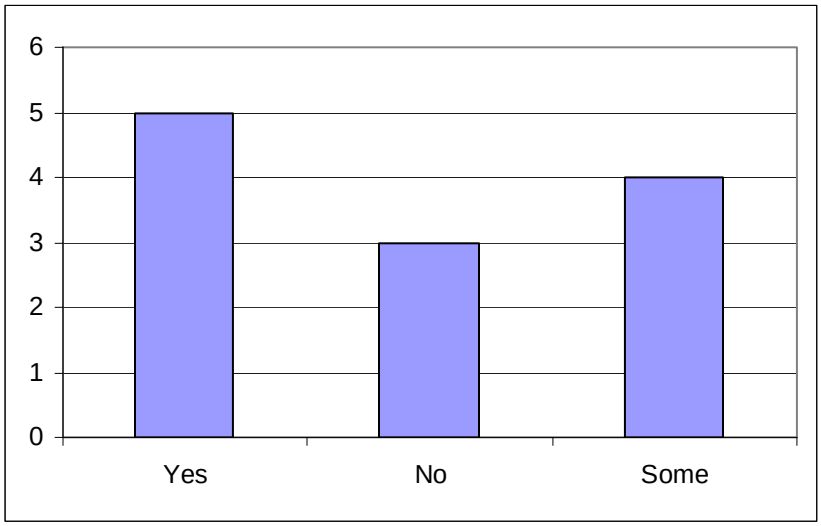
One of the challenges in benchmark sampling is in selecting an area representative of the entire field. These areas are generally selected by:

- growers
- based on uniformity from topography or images of crop growth (satellite images, infra red)

3) Are farmers participating in selection of composite points?

Yes = 7, no = 2
Many agronomists request assistance, but few provide it. Any grower assistance is generally in identifying places to "avoid" rather than where "to" sample. Some customers depend entirely on their experienced agronomist to select sampling points.

4) Do you prepare manure management plans?



Of the 5 prepared to complete manure management plans, 3 are actively engaged in this activity while 2 others have been hesitant due to liability concerns

- 3 have no intention of completing manure management plans
- 4 are involved in manure management plans through conducting the soil sampling, a 3rd party completes the Manure Management Plan, and then they prepare the supplemental fertilizer program