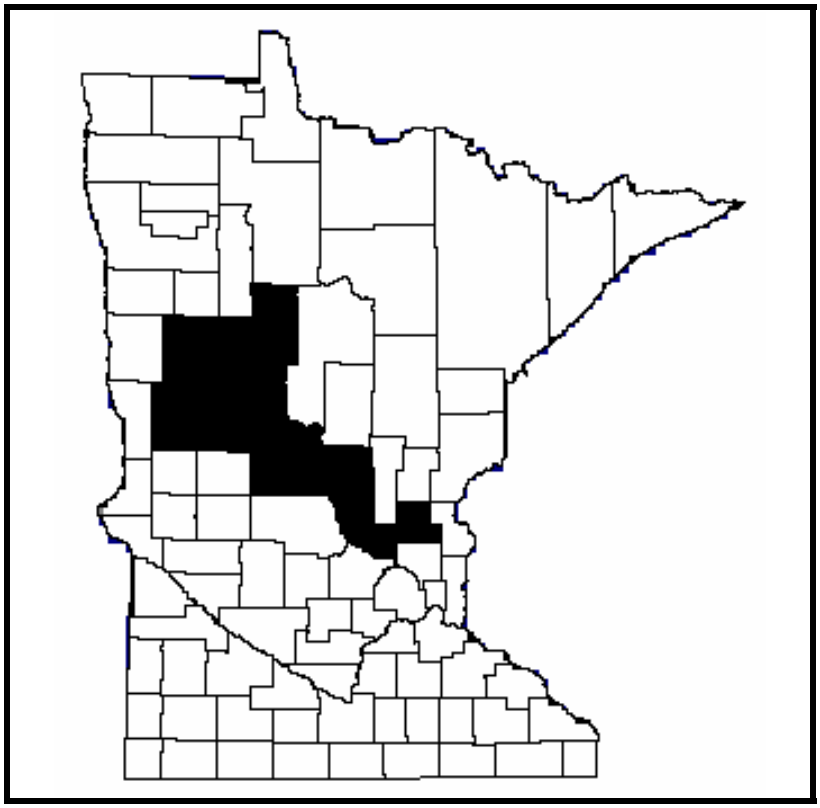
Potato Survey: Central Sands 1995



- **24 Producers covering over 19,000 of the approximately 29,000 acres on irrigated outwash sands in MN.**
- **Surveys were conducted in early spring of 1995 in cooperation with the Area II Potato Growers.**

MDA Nutrient Management Assessment Program
Denton Bruening 612-297-4400

Irrigated Potato Farms
General Information:

The Minnesota Area II Potato Growers Research and Promotion Council was contacted and a meeting took place with the chairman in February, 1995. The purpose of the meeting was to inform the Council of the details of the project and overall goals; obtain pertinent Area II information (i.e. locations of outwash sands and boundaries of Area II); and select potential candidates (potato growers) for the interviews. The Area II Council also served as an important link between the potato growers and the researchers; the Council made personal phone calls or visits to potential participants after the introduction letter was mailed. Part of the criteria for consideration was that the farms needed to have sandy soils, be in Area II, and the potato acres needed to be irrigated. Certain potato growers on the Anoka Sands Plain were not selected due to their intense involvement with another project. Likewise, producers in the Red River Valley and Hollendale areas were eliminated due to being located outside of Area II lack of irrigation respectively. A list of all potential candidates was developed and it was decided, due to the small number of growers, to contact all 37 potato growers who fulfilled the criteria in the project. Introduction letters, signed by the Commissioner of Agriculture, were mailed out to the 37 potato growers in March, 1995. The letter's intent was to identify: the overall LCMR project; the purpose of the nutrient assessment; why growers were selected; and what types of information and amount of their time would be necessary to successfully complete the project. Letters were sent to 37 potato growers and 24 growers (65%) went through the interview process. Potato growers interviewed were from Otter Tail, Hubbard, Wadena, Stevens, Todd, Stearns, Morrison, Benton, Sherburne, and Isanti counties and the interviews were performed in March and April.

Nutrient Management Data Collection:
Irrigated Potatoes

Inventory forms and data base design were patterned after those used in a previous successful project[1]. Timing, rates and method of applications were collected for all nitrogen (N),phosphate (P_2O_5),and potash (K_2O) inputs (fertilizers, manures, and legumes) on **a field-by-field basis for all potato acres owned or rented**. There were 209 management areas (only potatoes) in the entire study with a management area being defined as a field or group of fields (managed by the same producer) which had the same nutrient inputs. If an individual field was not managed uniformly, it would be broken down into separate management areas. Soil and manure testing results were also collected if available (only one grower applied manure to fields to be planted to potatoes). Nutrient inputs and yields were specific for the 1994 cropping season. Crop grown in 1993 and manure applications starting in the fall of 1993 were also collected for purposes of 1994 nitrogen credit determination. Long term yield data generally reflected the past 3 to 5 years.

[1]Effective Nitrogen and Water Management for Water Quality Sensitive Regions of Minnesota, LCMR 1991-1993.

Farm Size and Crop Characteristics of the Selected Farms: Irrigated Potatoes

Twenty four potato growers were interviewed during March and April of 1995. Total area inventoried was 19,354 acres in 209 separate management areas. According to the 1994 Edition of Minnesota Agriculture Statistics, potato acres (predominately irrigated), excluding the Red River Valley and Hollendale areas, totaled 24,900 acres in 1993 and 28,500 acres in 1994. The interview process inventoried approximately 68% of total potato acres (excluding the Red River Valley and Hollendale areas).

The potato acreage was divided into three categories according to when the potatoes matured (based on the average date the field was harvested). Early maturity was defined within the contents of this report as potatoes harvested before August 8; these are generally fresh-market potatoes generally and are grown on a cluster of farms located from Big Lake to St. Cloud. Medium maturity was defined as potatoes harvested August 8 through September 1; generally these potatoes are also harvested for the fresh market, although some are sold for processing, and are grown in a cluster of farms from Big Lake to St. Cloud, and in the Long Prairie and Little Falls areas. Late maturity potatoes are harvested after September 1. Late potatoes are generally for processing and are grown in the Park Rapids area and in small areas by Becker and Morris. Potato growers operating in the fresh market often grow multiple potato varieties, including Goldrush, Atlantic, Snowden, and Red Norlands. Also, fresh market growers tend to harvest potatoes August through September, in all three maturity groups. Potato growers operating in the processing markets generally harvest late and Russet Burbank is the variety grown on most acres. Yields varied according to the maturity of the potato from 334 cwt/A for early maturity potatoes to 429 cwt/A for late maturity potatoes using a five year average of yield (Table 1).

Table 1
Average Yields by Maturity
Harvested Yield

Potato Harvest Timing	Fields	Acres	Average Yield 1993 Cwt/A	Average Yield 1994 Cwt/A	Average Yield Last Five Years Cwt/A	Average Harvest Date[2]
Early Maturity	12	883	339	332	334	July 27
Medium Maturity	64	4,570	373	381	391	Aug. 24
Late Maturity	133	13,901	418	430	429	Sept. 21

[2] Harvest date information gathered is the average date the field is harvested.

Totals/Average	**209**	**19,354**	**403**	**413**	**415**	**Sept. 9**

Current Management Techniques and Nitrogen Balances: Irrigated Potatoes

Commercial fertilizer containing nitrogen was used on all potato acres. Potato acres received an average of 246 lb/A of nitrogen as commercial nitrogen. Best Management Practices (BMP's)[3] developed for potatoes recommend applying 212 lb/A for a yield goal of 435 cwt/A (Table 2). Across all potato acreage, there was an average of 34 lb/A of N applied more than the U/M recommends. However, 60% of potato acres had N applied at a rate of 30/A over the U/M recommendations and the average rate over U/M recommendations on these acres was 55 lb/A (Table 3). Over-application was the greatest on the early maturity potatoes. Sixty percent (60%) of all early maturity acres had an average excess of over 100 lb/A of N. Fifteen percent (15%) of all potatoes were short of N and an increase of N to U/M recommendations could increase the yield.

Table 2
Nitrogen Applications:
All Acres.

Potato Maturity	Acres	Yield Goal Cwt/A[4]	Fert. N Lbs/A	Required N Lbs/A	Excess N Lbs/A
Early Maturity	883	355	228	173	55
Medium Maturity	4,570	395	233	191	43
Late Maturity	13,901	453	252	222	30
Totals	**19,354**	**435**	**246**	**212**	**34**

[3]Carl Rosen 1995. Best Management Practices for Nitrogen Use: Irrigated Potatoes (Draft).

[4] Yield goal based on harvested yield plus unharvested potatoes (all tubers left in the ground).

Table 3 Nitrogen Applications: Acres over 30 lb/A above U/M recommendations.					
Potato Maturity	**Acres**	**Yield Goal Cwt/A[5]**	**Fert. N Lbs/ A**	**Required N Lbs/A**	**Excess N Lbs/A**
Early Maturity	535	293	251	143	108
Medium Maturity	2,940	382	247	183	64
Late Maturity	8,312	452	269	221	48
Totals	**11,787**	**427**	**262**	**208**	**55**

A high percentage of potatoes followed corn in the rotation. Nitrogen credits from legumes[6] was almost non-existent for potato farmers in the survey. Only one field provided legume credits and was not considered in the survey. Manure also provided very few N credits as manure as manure was rarely applied. Because manure credits were very limited, they were not considered in the analysis.

Nitrogen should also be credited from irrigation water if nitrate-N levels are over 10 ppm. Twelve growers tested wells for nitrates and all wells tested had nitrate-N levels below 10 ppm, possibly due to the depth of the irrigation wells (most were over 120 feet deep).

Correct irrigation management is critical in reducing leaching losses of nitrate. It is extremely difficult to determine of growers were using reasonable water scheduling techniques. This study only focused on which tools the growers used for making decisions on when to irrigate and on how much water to apply. Potato growers used several methods to determine soil moisture content for irrigation scheduling. The "feel" or hand method was the dominate method used, followed by experience (personal judgment on when to irrigate). Soil probing and plant appearance were among other methods used. The amount of water to apply was often determined by ET measurements and experience although growers often used several factors such as soil type, past rain fall, and forecasts to determine the amount of water to apply.

[5] Yield goal based on harvested yield plus unharvested potatoes (all tubers left in the ground).

[6] Edible beans do not contribute nitrogen credits to the succeeding potato crop according to U/M recommendations.

Timing of N fertilizer applications to potatoes is an important factor in maximizing fertilizer N use efficiency and minimizing environmental effects of nitrates. Due to the high probability of nitrate leaching on these irrigated sandy soils, the recommended strategy is to apply the N to closely match crop uptake. Best Management Practices (BMP's)[7] developed for irrigated potatoes focus on a number of timing issues. First, applying N in the fall is not recommended under any circumstances on sandy soils. In this study, there was no fall fertilization on early or medium maturity potatoes, and less than 1% of the N fertilizers used on late maturity potatoes was fall applied (Figures 1, 2, and 3).

[7]Carl Rosen 1995. Best Management Practices for Nitrogen Use: Irrigated Potatoes (Draft).

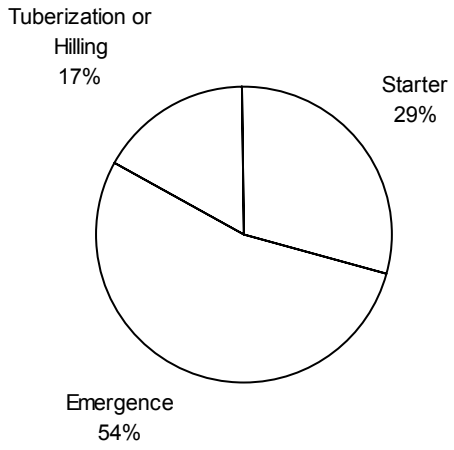


Figure 1. Timing of N fertilizer during the 1994 potato season on early maturity potatoes.

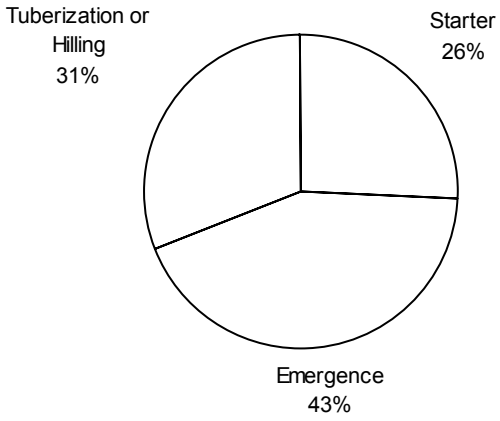


Figure 2. Timing of N fertilizer during the 1994 potato season on medium maturity potatoes.

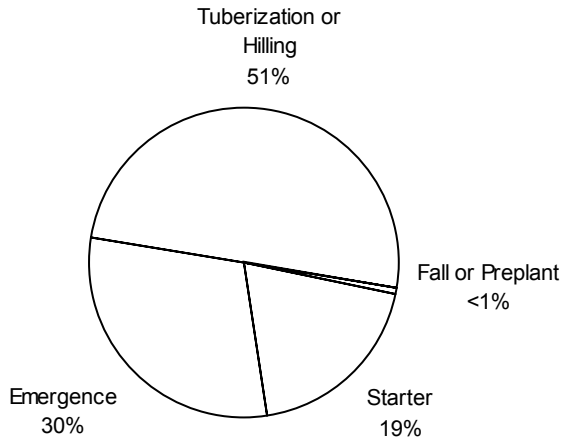


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Figure 3. Timing of N fertilizer during the 1994 potato season on late maturity potatoes.

Second, BMP's recommend applying 20 to 40 lb/A of N in the starter (no N is recommended in a preplant application) to prevent early season leaching. Starter N rates for early, medium and late maturity potatoes in the survey were 67, 59 and 46 lb/A respectively. Producers are encouraged to experiment with reduced rates of starter N until sufficient U/M research recommendations are available, espicially on the early and medium maturity potaotes. Rates of starter on all potatoes are within acceptable guidelines and suggested reductions may benefit the potato producer by reducing input costs.

Another important BMP is to split additional applications of one third to one half of recommended N at emergence, and one third of recommended N at tuberization or last hilling for all potatoes with additional possible applications determined by petiole analysis. Potato growers averaged over 4 applications of N per growing season (starter, emergence, hilling, plus one or two others) generally following recommended split described above. Amounts of N applied at emergence was between one-third and one-half of the total amount of N applied and one-third to one-half of the total N was applied during an average of two applications at the tuber stage or the when the potatoes were hilled.

Fertigation is a recommended practice and can be based on petiole analysis for nitrate content. N should be limited to 10 to 40 lbs/A N per application through the irrigation system. Thirteen of 24 growers were using petiole analysis (10 field test, 3 laboratory) to make management decisions. N applied through the irrigation systems was less than 1% of the total N for early maturity potatoes, 12% for the medium maturity, and 16.9% for the late maturity potatoes. Amounts of N applied though fertigation ranged from 7 to 28 lbs/A per application and practices appear consistent with the recommended BMP[8] amounts of 10 to 30 lbs/A per application.

The source of the commercial N used for potatoes is a key factor in preventing leaching. Fertilizers containing nitrate in the starter are not recommended and growers are generally following this recommended practice by using N in the ammonium form. Ninety-six percent (by weight) of N used for a starter was some type of dry mix. Figure 4 lists the sources of N used in the starter and Figure 5 lists each source of N applied to potatoes.

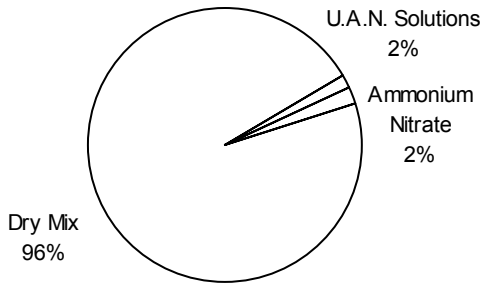

Figure 4. Percentage of total commercial n applied as a starter for the 1994 season by type[9]. Starter rates averaged 51 lb/A.

[8]Carl Rosen 1995. Best Management Practices for Nitrogen Use: Irrigated Potatoes (Draft).

[9]Dry mix represents an array of formulations. These formulations are ammonium or urea based.

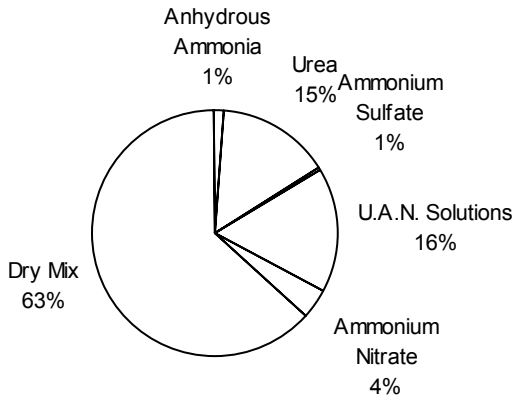

Figure 5. Sources of N fertilizers used during the 1994 season. Percentages are based on N.

An additional BMP used by potato growers is the use of post-harvest cover crops. Cover crops were established on 33% of potato fields (after harvest) covered in the survey with rye as the predominant choice for a cover crop. Cover crops provide both soil erosion protection on sandy soils and also will take up residual N resulting in less leaching of nitrates. Nitrogen will then be released from the vegetation the following season. Early maturity and medium maturity potatoes were normally followed with a cover crop while late maturity potatoes generally did not have a cover crop.

Soil testing is another valuable tool for determining fertilizer requirements[10] of potatoes on sandy soils. Potato growers had soil tests available for 68% of the acres surveyed. Nitrate tests were also performed on 5% of the total acres, although the test is not a recommended practice for potatoes on sandy soils. Results of the nitrate tests (NO_3-N) ranged between 8 to 48 lb/A of N and were too low to modify the recommendations. Requirements of P_2O_5 for potatoes, derived from soil tests and yield goals according to University of Minnesota recommendations[11], appear to be significantly less than actual amounts applied. The average yield goal from all potato fields with soil tests was 431 cwt/A, the average soil test for $Bray_{p1}$ was 75 ppm, and the average amount of P_2O_5 applied was 150 lb/A (average amount applied over all acres was 154 lb/A). The U/M recommends applying 50 lb/A of for potatoes with soil test P levels ($Bray_{p1}$) above 51 ppm and a yield goal of 400 to 499 cwt/A (Table 4). Although P_2O_5 applications may seem excess, recent research by the U/M suggests potatoes often respond to P_2O_5 amounts up to 150 lb/A and the recommended amount of P_2O_5 to apply per acre is now in the review process.

Table 4
P_2O_5 Applications.

Potato Maturity	Acres	Bray $_{p1}$ [12] ppm	Yield Goal	P_2O_5 Lbs/A Recommended[13]	P_2O_5 Lbs/A Applied	P_2O_5 Lbs/A Excess
Early Maturity	503	68	401	36	170	134
Medium Maturity	3,482	110	393	39	105	67
Late Maturity	9,228	63	447	50	166	117
AVERAGES/TOTALS	**13,213**	**75**	**431**	**46**	**150**	**104**

Commercial N applications may sometimes tend to run on the high side of recommendations to prevent certain diseases such as early blight, which often affects potatoes with nitrogen deficiency. If commercial N amounts were reduced to within 30 lb/A of university recommendations, approximately 289,000 lbs of N could be reduced on the

[10]George Rehm 1987. Unit 1 Soil Testing. AG-FO-3329.
[11]C. J. Rosen and R. C. Munter 1992. Nutrient Management for Commercial Fruit & Vegetable Crops in Minnesota. AG-BU-5886-F.
[12]Bray P column is based on results from 68% of all fields.
[13]Recommendations from University of Minnesota.

acres covered by the survey. U/M research shows there would be minimal risk for yield reduction if these recommendations are followed.

Conclusions and Summary of the Current Nutrient Management Practices For Irrigated Potatoes on Sandy Soils

Twenty-four potato growers covering over 19,000 acres, participated in the **FA**rm **N**utrient **M**anagement **A**ssessment **P**rogram (**FANMAP**) with staff from the Minnesota Department of Agriculture. Producers volunteered 2 to 4 hours of their time to share information about their farming operation. Potato producers with irrigation and on sandy soils in Area II were interviewed. The overall purpose of the program was to develop a clear understanding of current farm practices regarding agricultural nutrients and utilize this knowledge for future water quality educational programs.

Nitrogen management for potato growers on sandy soils is challenging due to the nature of the soils and additional management skills required to manage irrigation scheduling. The overall potato yield goal was 435 cwt/A and N inputs came primarily from commercial fertilizer. The N crediting was quite simplistic due to the fact that manure, legume or irrigation water credits were not factors in determining N recommendations.

Commercial inputs were in reasonable agreement with existing U/M recommendations. Producers have the opportunity to reduce N inputs by 30 to 35 lb/A on average. The greatest reduction of commercial N could be attained on the early and medium maturity potatoes with reduction on the acres of excess N applications. A reduction of an average of approximately 30 to 70 lbs/A is possible on early and medium maturity potatoes with excess N. In addition, potato growers are encouraged to experiment with reduced rates of starter N[14]. Research on early maturing potatoes, especially the new varieties, will provide further assistance to potato growers.

Proper timing of N applications is one of the key management strategies which producers in this region can implement to minimize N leaching losses. Producers have been encouraged to avoid fall preplant applications of commercial N and survey results suggest this practice is being endorsed. Timing of commercial N is in agreement with current BMP's. Split applications are being used, with all fields averaging over 4 applications per year. One-third to one half of the total N was applied at emergence and one-third to one-half at tuberization or during hilling as recommended. Source selection of N fertilizers appeared to be in excellent agreement with current BMP's developed by MES in conjunction with MDA, with very little commercial N applied as starter in the nitrate form.

A high percentage of commercial N applications through fertigation were based on petiole analysis and amounts of commercial N applied through irrigation ranged from 7 to 28 lb/A per application. Fertigation practices were also consistent with recommended BMP's.

[14] Recent U/M findings strongly indicate rates of 40 lb/A N is the correct amount of needed at planting.

Cover crops were used extensively for early and medium maturity potatoes. Over 75% of the early and medium maturity potatoes acres were planted with cover crops after potato harvest.

Soil testing was done on 68% of the potato acres providing information to assist the growers in correct fertilizer application amounts. In regard to P_2O_5 , growers were applying an average of150 lbs/A. Here again, research on additional varieties and early maturity potatoes will provide assistance to the potato growers.

There were some very positive findings from this study. There is strong evidence that producers are voluntarily adopting the educational materials and strategies developed by the University of Minnesota/MN Extension Service. It is also evident that promotional activities need to continue and be specifically targeted to deliver the most recent technology and recommendations.