Survey of South Dakota Producers' Current Nutrient Management Practices

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Summary

Crops grown and production practices have changed significantly in South Dakota (SD) in recent decades along with available technology. Knowledge of common nutrient management practices and how they vary across the state are needed to compare against new practices that may potentially both optimize production and protect the environment. A survey of crop producers will be conducted to document adoption rates of current nutrient management practices related to the four R's of nutrient management (Right: rate, application timing, placement, and source) and the growers' decision making process. The survey will be executed in conjunction with a sociologist at SDSU who has extensive experience conducting producer surveys throughout the Midwest and within the state of SD. This information will guide future extension educational programs, and the direction of soil fertility research that will ultimately benefit producers by providing research and educational programming that meets their needs.

Goal and objectives

The goal of this project is to accurately document the current nutrient management practices in SD to guide future soil fertility research and educational programming. The objectives to reach this goal include: 1) create a survey to gather representative information from SD crop producers about their usage of specific nutrient management practices, the reasons they use/don't use such practices, and producer/operation background information and 2) analyze and publish results in extension and scientific formats to provide information to crop producers, researchers, extension specialists, and other stakeholders that will aid them in the decision-making process regarding nutrient management practices, research, and extension programming.

Results

Objective 1: Create a survey to gather representative information from SD crop producers about their usage of specific nutrient management practices, the reasons they use/don't use such practices, and producer/operation background information

A survey regarding farmers crop nutrient management practices (rate, placement, product, and timing) and the factors that went into their decision making has been created and reviewed by SDSU researchers and extension faculty. Three-thousand advanced letters with an explanation of the survey were mailed at the beginning of June with a $2 bill as an incentive to complete the survey on-line. A paper copy of the survey was mailed out the week of June 17th along with a stamped and addressed return envelope to those producers who have not yet filled out the survey with the option of still filling out the survey on-line. To further remind producers to fill out the survey, a second paper copy of the survey was mailed at the end of June.

A separate link was also created that goes to a different version of the same survey that is open to all crop producers in South Dakota. News releases and advertising on the extension website were completed to encourage growers to fill out the voluntary survey. Data from these survey respondents will be kept separate from the randomly selected producers to not introduce bias into the results. We will analyze data from both survey versions and combine them if results from the non-random surveys do not create any bias.

Objective 2: Analyze and publish results in extension and scientific formats to provide information to crop producers, researchers, extension specialists, and other stakeholders that will aid them in the decision-making process regarding nutrient management practices, research, and extension programming.

To this point we have created the crop nutrient management survey. All survey materials was cleared before use with the South Dakota State University Institutional Review Board (IRB) for use on human subjects. The survey was then distributed in three waves to 3,000 SD crop producers where corn, soybean, and small grains constitute a high percentage of planted acres. Currently, the information from approximately 446 returned surveys (as well as 16 refusals, 56 bad addresses, and 326 retired/not farming individuals) has been entered into the survey answer database (Tables 1–3). The approximate response rate is 17%, not out of the range of current response rates to surveys. Tests on non-response bias will be conducted to determine and adjust for representativeness.

Table 1. Number of surveys sent to farmers in South Dakota and by each Ag District.

	Whole Survey	Central	East Central	North Central	Northeast	South Central	Southeast
Total Sample	3000	559	515	685	489	252	500

Table 2. Number of returned surveys in South Dakota and by each Ag District.

Response	Whole Survey Freq.	Freq. by Ag District					
		Central	East Central	North Central	Northeast	South Central	Southeast
Retired/not farming	**326**	56	52	82	44	30	62
Responded wave 1	**119**	27	16	24	26	11	15
Responded wave 2	**203**	45	34	37	30	20	37
Responded wave 3	**124**	25	21	36	10	7	25
Refusal	**16**	2	3	7	1	1	2
Bad mailing address	**56**	12	9	10	12	2	11
Total responses	**446**	**97**	**71**	**97**	**66**	**38**	**77**

Table 3. Survey response rate in South Dakota and by each Ag District.

Response Rate	In General	By Ag District					
		Central	East Central	North Central	Northeast	South Central	Southeast
Rate 1	17.0%	19.8%	15.6%	16.4%	15.2%	17.3%	18.0%
Rate 2	26.2%	28.0%	24.3%	26.5%	23.1%	27.2%	28.4%

Note: Rate 1 = (Responded wave1+Responded wave2+Responded wave3) /(Total Sample-Retired/ not farming-Bad mailling address)

Rate 2 = (Retired/ not farming+Responded wave1+Responded wave2+Responded wave3) /(Total Sample-Bad mailling address)

In the second year of this crop nutrient survey project, we will finish inputting results from returned surveys into our database, complete quality checks of input data, analyze results, and write reports, factsheets, and scientific journal articles. The current graduate student will also write and defend their thesis using data from the survey.

As part of analyzing the crop nutrient survey data, we will conduct descriptive analysis (e.g., frequencies, percentages) to provide basic information about nutrient management BMP usage and attitudes among producers. We will also use multivariate logistic regression or ordinary least squares regression (depending on how the variable(s) of interest is measured) to predict the environmental and decision-making factors that are associated with use of nutrient management BMPs and their relative importance while controlling for other extraneous factors.

Survey results will be incorporated into soil fertility extension programming through presentations and published articles as well as professional publications. Maps will be created to display results of where and what nutrient management practices are common for each crop and nutrient. These maps will be placed online through the extension website and in printed publications for producers and other stakeholders to visually assess current nutrient management practices. Maps from future surveys can also be made to overlay these maps to determine the change in nutrient management practices over time.

Impacts/Products

- Edem Avemegah, a graduate student, and an undergraduate student are being trained in rural sociology and survey techniques
- Creation of a Crop Nutrient Management Survey (**https://nmsurveysd.questionpro.com**)

Timeline

Activity / Year - quarter	2019				2020			
	1	2	3	4	1	2	3	4
Creating and testing survey questions	***	***						
Surveying producers			***					
Data entering/processing/quality control			*	***	*			
Data analysis				*	***	**	*	
Publication and report writing						**	**	**

(The number of *s indicates the level of effort for each activity within each quarter.

Budget
Project Budget (As of January 1, 2020)

Budget Category	Budget	Total Expenses	Available Balance
Salaries	$ 26,973.00	27,309.54	-336.54
Benefits	$ 1,274.00	961.27	312.73
Travel	$ 1,000.00	655	345
Contractual	$ 1,000.00	6,560.00	-5,560.00
Supplies	$ 22,100.00	17,030.73	5,759.27
Tuition remission	$ 6,365.00	5,934.92	430.08
Total	**$ 58,712.00**	**$58,451.46**	**$950.54**

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Summary

Over the last decade many advancements have been made in crop nutrient management and precision agriculture management. Currently, farmers have many precision ag technologies at their fingertips to help them make farm management decisions. These technologies range from the use of GPS to guide their planting and spraying to GIS mapping of fields with multiple layers of yield, topography, and soil types to guide planting and fertilizing. In fact, all these options may feel like an information overload to many farmers. One goal of Extension is to understand the current management practices farmers are using, identify information gaps, and then provide science-based information and training to fill the gaps. This information and training help farmers understand the "why" and "how to" of different management practices that can help them improve their economic profit while minimizing potential negative environmental effects. To best accomplish this work, extension personnel need to know what nutrient management practices and precision agriculture technologies are used by farmers. Therefore, we developed a soil fertility survey and disseminated it to farmers throughout South Dakota (SD).

Objective

The goal of this project is to accurately document the current nutrient management practices in SD to guide future soil fertility research and educational programming.

Results

The overall response rate for the survey was 18% with 465 producers completing the survey (online =176 and mail =289). Bad mailing addresses, producers who refused to participate in survey, and those that were not currently farming or retired were 56, 16, and 326, respectively. These three groups were not included in the final calculation of the response rate. This response rate fell below the average response rate of 30% reported by others when using a similar multi-contact method (Busse et al. 2015, Mullendore et al. 2015, and Saak et al. Under Review) Our lower overall response rate was likely due to when our survey was sent to farmers in 2019. We targeted the arrival at homes of the first farmer contact to occur after completing planting of corn, soybean, and wheat. However, during 2019, planting was delayed due to wet spring conditions and planting was still being finished when the first round of surveys arrived at farmer's homes. Winter would have been a much better time to send out surveys because farmers are more likely to have the time needed to fill out a survey, which

would have improved the survey response rate. In the future, we recommend working with funding sources to make sure funding timelines and survey distribution correlate well with timings in the year where farmers are most likely able and willing to take the time to fill out surveys.

Farmers use soil nutrient test levels and yield goal most frequently in determining fertilizer rate guidelines along with previous crop credit for fertilizer-N rate (Figure 1). These results coincide with current SDSU fertilizer rate recommendations which include yield goal and soil test level for N, P, and K along with previous crop credit for N. Fertilizer-N rate guidelines can also be modified based off tillage system, but tillage was only used around 12% of the time to help make fertilizer-N rate recommendations. Therefore, future trainings on estimating fertilizer-N rate recommendations should include science-based information regarding the ability to modify fertilizer-N rate recommendations based on tillage system.

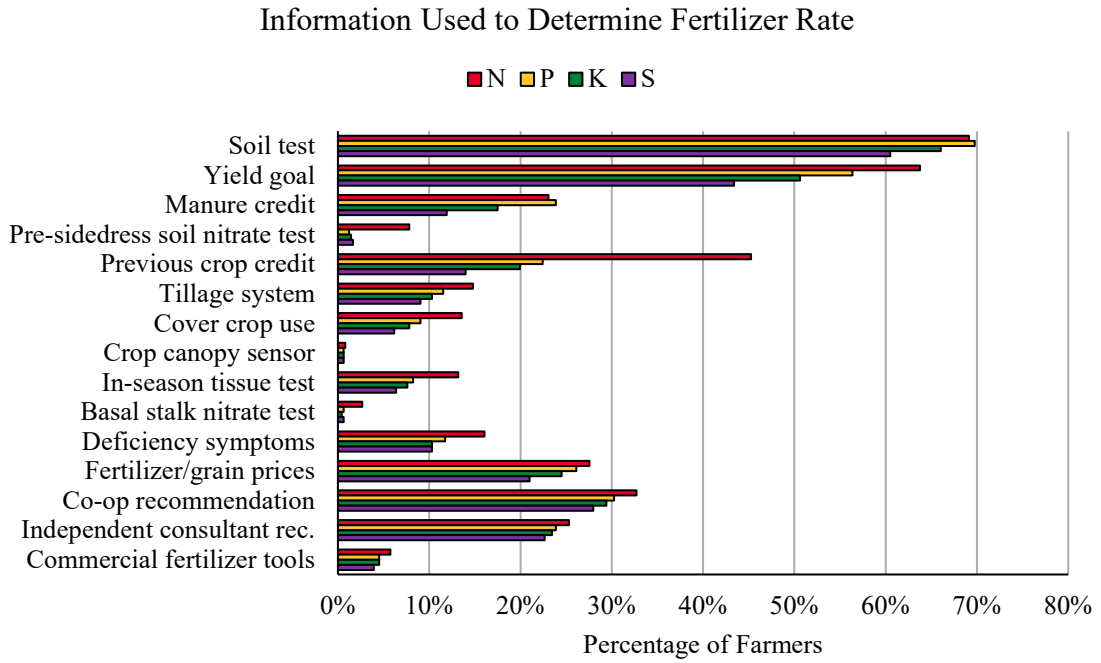

Figure 1. Percentage of farmers in central and eastern South Dakota using various parameters and information sources to make fertilizer rate decisions.

In-season soil and plant tests were minimally used to help determine fertilizer rate recommendations. This low adoption rate may be due to labor, time, money, and equipment required to use in-season soil and plant tests. For example, crop canopy sensors require additional equipment and the use of algorithms to make fertilizer recommendations. Further, the algorithms used are being continually modified by industry and academic researchers to improve their accuracy. Most farmers would likely be more willing to adopt such technologies as research improves their consistency in providing an accurate fertilizer rate estimate. Other factors that were moderately used by farmers to make fertilizer rate decisions were fertilizer and grain prices and recommendations from co-op agronomists and independent crop

consultants. These results indicate that extension and research should focus on providing information to farmers regarding in-season soil and plant tests to adjust fertilizer rate recommendations if research in these areas show improvement over current fertilizer rate guidelines.

Within the same field, farmers most frequently obtained and tested soil samples annually (36%) or every two years (39%) while 25% tested in intervals of every three years or greater (Figure 2). These results indicate that most SD farmers follow university soil sampling frequency guidelines of every two to three years for P and K and every year before a N requiring crop such as corn and small grains. Reasons for long frequencies of every four or more years may be due to using longer cropping rotations and the cost of collecting and analyzing soil samples.

Farmers obtain soil samples using a field composite methodology nearly two times as often as using a grid or zone methodology (Figure 3). Using a composite sample from at least 15 random cores from a field and mixing them together by depth increment is the traditional way SD producers obtain soil samples. However, using grid or zone soil sampling improves the nutrient availability information within a field by providing more precise soil test data. Recommended soil sampling methodologies (grid, zone, or composite) currently vary among the states neighboring SD. North Dakota recommends zone sampling or grid sampling using one sample per acre (Franzen, 2018). Iowa recommendations vary by nutrient with grid sampling being more effective for managing P and both grid and zones working well for managing K and pH (Mallarino and Wittry, 2004). Nebraska takes a similar stance where both grid and zone can work well, depending on the individual field situation (Ferguson and Hergert, 2000). Further research in SD is needed to best determine what sampling methodology is most accurate and cost-effective depending on climate and soil geography.

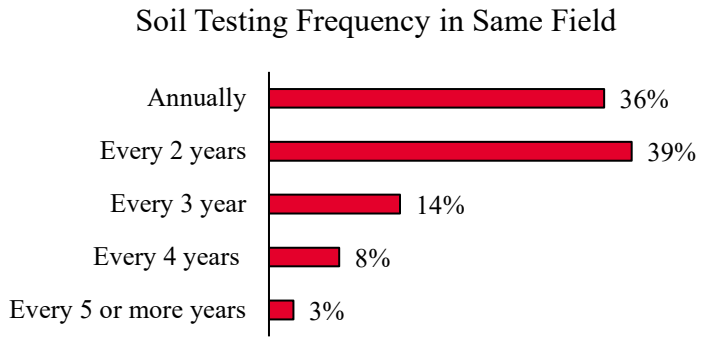

Figure 2. Percentage of farmers in central and eastern South Dakota regarding their use of different soil sampling intervals of the same fields.

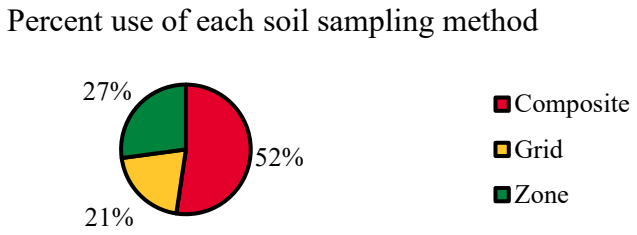

Figure 3. Percentage of farmers in central and eastern South Dakota using composite, grid, and zone soil sampling.

Impacts/Products

- Edem Avemegah, a graduate student, and an undergraduate student are being trained in rural sociology and survey techniques
- Creation of a Crop Nutrient Management Survey (**https://nmsurveysd.questionpro.com**)
- Publication entitled "An examination of Best Practices for Survey Research with Agricultural Producers" in Society & Natural Resources Journal.
- Abstract and oral presentation of study results at the ASA/CSSA/SSSA annual International Conference
- Abstract and poster presentation of study results at the ASA/CSSA/SSSA annual International Conference
- Proceedings paper and and poster presentation of study results at the North Central Extension-Industry Soil Fertility Conference
- Manuscripts and extension reports related to adoption of precision ag management practices, common source, rate, timing, and placement practices of South Dakota Producers, and most used information to make soil fertility management decisions are in preparation.

Project Budget (As of Jan. 1, 2020)

Budget Category	Budget	Total Expenses	Available Balance
Salaries	11,483.00	11,483.00	-
Benefits	115.00	87.62	61.7
Travel	5,000.00	-	5,000.00
Contractual	5,000.00	989.01	3,785.99
Tuition remission	6,651.00	-	3,484.00
Total	**$28,249.00**	**$15,951.63**	**$12,297.37**