PRODUCER ADOPTION OF NUTRIENT BEST MANAGEMENT PRACTICES IN COLORADO

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ABSTRACT
Many resources have been used to develop and extend best management practices (BMPs) for properly managing fertilizer and manure nutrients in irrigated crop production. We attempted to quantify producer adoption of these BMPs to generate information for more effective and focused research and outreach programs. Two written, surveys were mailed to approximately 3,200 growers in early 1997 and late 2001 to irrigating crop producers in Colorado. Producers returned roughly 40 percent of the surveys at each sampling event. Survey results were compared between areas of the state to determine regional differences in adoption rate. A sub-sample of producers that irrigated more than 50 acres of corn was used to compare adoption rate of selected BMPs across the two sample years. Significant regional differences existed among BMPs used by the respondents. Some of the basic nutrient management practices, i.e. soil testing were used at a high level in some areas; while others, particularly nitrogen crediting from non-fertilizer sources were used less frequently. Little improvement was seen in adoption rates from 1997 to 2001 among the irrigating corn growers. Further analysis of the factors impacting adoption obtained from the survey is needed to explain why an increase in adoption rates was not found.

OBJECTIVES
Public concern regarding water quality and the environment has increased the need for improved nutrient management to protect ground water. Rather than legislate overly restrictive measures on farmers and related industries, Colorado has elected to encourage the voluntary adoption of Best Management Practices (BMPs). Colorado State University Cooperative Extension and the Colorado Department of Agriculture developed BMPs with significant input from local producers and chemical applicators in several watersheds throughout the state. The goal of encouraging these BMPs is to prevent degradation of water quality through voluntary adoption of BMPs by Colorado farmers.

Until recently, there has been little quantified information on how many Colorado producers are using BMPs and where they are being used. This information is necessary to conduct relevant educational programming, research and training in the areas and topics where it is most needed. The data is also helpful in documenting the progress that Colorado producers are making in protecting water quality and to identify where more effort is needed. The objectives of this work were to obtain quantifiable information about specific nutrient management practices growers are using that maintain their productivity while protecting the environment.

METHODS
Written surveys were conducted in February 1997 and a follow-up in late November,

2001 to obtain information on BMP adoption. The USDA National Agricultural Statistics Service (NASS) drew a representative sample of all irrigators in the state from their crop production database. The surveys were mailed to producers who had at least 40 acres of cropland and irrigated at least one crop. As prescribed by Dillman (1978), reminder postcards were sent one week following the initial mailing of the survey to improve response rate. The confidential surveys asked producers about irrigation, nutrient, and pest BMPs utilized on their farms. We mailed 3,281 and 3,240 surveys in 1997 and 2001, respectively. The surveys consisted of approximately 50 questions. Part of the survey asked about practices used anywhere on the respondents' farms, and part about a particular "Representative Field" with field specific questions.

Producers returned 1,319 and 1,296 usable surveys in 1997 and 2001 respectively for a 40% response rate both years. The results were grouped into six geographic regions for summarizing responses. The six regions identified are the South Platte, the Eastern Plains, the Arkansas Valley, the San Luis Valley, the Mountains, and the Western Slope. These regions were defined based on known differences in water sources and cropping opportunities.

Since one objective of the survey work was to measure if growers are making progress in adopting nutrient management BMPs, a comparable set of growers was needed. For this analysis, producers growing 50 or more acres of irrigated corn were chosen to compare between surveys. Specific practices compared were: crop yield goals; soil test analysis; percent of acres soil sampled; plant tissue analysis; and manure, legume, and irrigation water nitrogen crediting.

RESULTS AND DISCUSSION

The regional distribution of responses for comparison of nutrient management practices is provided in Table 1. The regional distribution of respondents was fairly close between the two sample years with slightly more respondents from the Western slope and Arkansas Valley than the South Platte and High Plains from 1997 to 2001 (Table 1). Although the overall survey response rate was approximately 40 percent each year, the survey responses resulted in a larger sample size of irrigating growers with 50 or more acres of corn in 1997 (443) than 2001 (276). The San Luis Valley and Mountains regions did not have any significant corn acreage.

Table 1. Origin of respondents* by region of state.

	----- Year -----	
Region	1997	2001
	-----%-----	
S. Platte	53	49
E. Plains	30	28
Ark Valley	9	14
West Slope	7	9
Total N	443	276

*Respondents growing ≥ 50 acres of irrigated corn.

The subset of respondents chosen for analyzing the differences between adoption rates between years was fairly similar in all aspects except for percent of irrigated acres leased (Table 2), gross farm sales, and off-farm income (Table 3).

Table 2. Average characteristics of respondents used for comparison of nutrient management practices.

	----- Year -----	
	1997	2001
Total farm size (acres)	1470	1490
Irrigated (acres)	670	524
Irrigated corn (acres)	399	331
Total livestock (#)*	531	1609
Ground water sources (%)	51	48
Surface water sources (%)	49	50
Leased acres (%)	46	28

*Median value for livestock # was 150 both years.

Table 3. Average personal and farm characteristics of respondents used for comparison of nutrient management practices.

	Year	
	1997	2001
Irrigation experience (years)	31	31
Education*	2.4	2.7
Gross farm sales** ($)	3.4	2.1
Off farm job (%)	19	44
Net income from farm (%)	92	36

*Coded average where 1 = high school, 2 = technical school, 3 = some college, 4 = college, 5 = graduate degree
**Coded average where 1 = <$50,000; 2= $50,000 - $99,000; 3 = $100,000 - $249,000; 4 = $250,000 - $500,000; 5 = $500,000 - $1,000,000; and 6= >$1,000,000

Table 4 provides the results for selected nutrient management BMPs averaged within corn growing regions of Colorado for 2001. These particular BMPs had more variation between regions than others. These results illustrate the differences in nutrient management practices used between various regions. Some of these differences are to be expected given the tremendous variation in farm size, cropping patterns, and irrigation system and water sources found throughout Colorado.

One of the more significant differences is the sources growers use for fertilizer recommendations. Paid crop consultants are used by a nearly two-thirds of Eastern Plains corn growers while Western Slope growers preferred their dealer representative. These differences need to be taken in account when designing extension, research and outreach programs intended to improve adoption rates among the growers in these regions. Extension programs often target consultants and crop advisers in an attempt to reach more growers indirectly through their advisers.

Table 4. Regional differences between adoption rates of selected BMPs in 2001.

	---------- Region ----------			
	S. Platte	E. Plains	Ark Valley	West Slope
	---------- % Using ----------			
Soil test analysis	78	84	50	48
% Acres sampled in previous year	46	73	19	11
Recommendation from paid crop consultants	18	66	26	0
Recommendation from dealer rep.	57	27	37	39
Chi-test for Regions	0.0017	0.000	0.006	0.000

The majority of Colorado corn producers reported using on of the most basic tools, soil test analysis, to help make their fertilizer decisions. The adoption rate varied by 10 percent between years, but the acreage sampled in 2000 decreased more substantially from 1996. In both sampling years, nearly all growers reported using at least one nutrient management BMP in their nutrient management program.

Table 5. Average adoption rates between sampling years for key nutrient management BMPs.

	Year	
	1997	2001
	----- % Using -----	
Yield goal	79	69
Soil test analysis	88	74
% Acres sampled in previous year	64	47
Plant tissue sample	12	8
Crop consultants	40	32* / 44**
None used	0	2

*% using paid crop consultants for recommendation

**% using dealer representative for recommendation

Table 6. Reported nitrogen credits used by irrigating corn growers in both years.

	----- Year -----	
	1997	2001
	----- % Using -----	
Legume credit*	44	49
Irrigation water credit**	14	13
Manure Credit***	66	39

*% of respondents growing alfalfa on farm

**% of respondents using ground water

***% of respondents with > 25 confined livestock

Crediting nitrogen received from previous legume crops or from nitrate in ground water is a less accepted practice among this population than soil testing with little difference between years. Only about 40 to 50 percent of the corn growers statewide growing alfalfa reported using a legume credit when determining their fertilizer rate. This is surprising given that the nitrogen fixing capabilities of legume crops, especially alfalfa, should be well known. Likewise, only a few producers credit their water as a nutrient source. Crediting nitrate-nitrogen from irrigation water was primarily practiced by producers using groundwater the S. Platte river valley (18% adoption rate). This region has widespread geographic areas with higher concentrations of nitrate-nitrogen in groundwater that can be used by crops when this water is used for irrigation.

Overall, the survey results suggest that producers are accepting many of the nutrient management BMPs that help protect water quality and farm profitability. Practices that have an obvious economic benefit seem to be used more often than those where the return from increased managerial input is less obvious. However there were considerable differences between practices, regions, and producer demographic group. Additionally, we found little improvement among most practices from the 1997 to the 2001 surveys among this sample of the surveyed population. The decrease in gross farm sales and the increase in respondents having off-farm jobs may explain part of the apparent decrease in adoption rates between years. Previous work (Bauder et al, 1997) has found that growers with higher gross revenues adopted nutrient management BMPs at higher rates than those with less income. Further analysis is needed to determine whether these demographics fully explain the differences in the adoption rates or if other factors are involved.

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