STUDIES OF NITROGEN MINERALIZATION IN SUGARBEETS FOR IMPROVED CROP MANAGEMENT

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INTRODUCTION

Nitrogen management in sugarbeets is important because of the need to provide for the plant's nitrogen requirement while preventing excess nitrogen at season's end that depresses sugar content. Thus, nitrogen management is critical optimizing economic return from the sugarbeet enterprise. One of the factors affecting nitrogen management is mineralization, the microbial process of releasing inorganic nitrogen from organic matter in the soil. In order to provide better understanding of the Nitrogen mineralization under Elmore and Owyhee county conditions, the Elmore County Extension Staff conducted experiments to determine nitrogen mineralization.

One of the factors affecting nitrogen management is mineralization, the microbial process of releasing inorganic nitrogen from organic matter in the soil. To better understand the quantity and time course of nitrogen mineralization under Elmore and Owyhee County conditions, the Elmore County Extension staff conducted experiments to determine nitrogen mineralization (Tables 1-4).

METHODS

Nitrogen mineralization was determined by the buried bag method. In the buried bag method nitrogen mineralization is estimated under field conditions by incubating soil samples in a semi-permeable polyethylene bag (Westermann, 1980). Nitrogen mineralization is determined by subtracting ammonium and nitrate values of bags retrieved in the growing season from initial values. A representative soil sample was taken from the field at 0-12" and 12-24" and an initial sample was analyzed immediately for ammonium (NH_4^+) and nitrate (NO_3^-), the inorganic forms of nitrogen that are available to the plant. Subsamples were placed back in the field at their respective depths. Bags were retrieved monthly and analyzed for NH_4^+ and NO_3^- to determine the amount of additional nitrogen made available by mineralization. Ammonium and NO3-values in ppm were converted to lb N/A using a conversion factor at 4.0. Mineralization was calculated by subtracting lb N/A for the incubated sample from that for the initial value for lb N/A. Soil nitrogen supply was calculated by adding the initial nitrogen value to the last value for mineralized N+ (Stieber et al, 1995, Table 5).

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RESULTS AND DISCUSSION

The amounts of mineralized nitrogen measured in these studies varied from year to year (see tables 1-5). In general, the results show that substantial amounts of nitrogen are mineralized from mid-summer through early fall. These results have important implications for the management of irrigated cropping systems from an economic and an environmental standpoint. In recent years, groundwater quality has become an important environmental issue. Nitrate contamination of groundwater is a potential hazard on cropland because nitrogen fertilizer and mineralized nitrogen end up as NO_3^-, a form that is not adsorbed to soil colloids. When nitrogen input to the system exceeds crop removal, excess nitrate is left at the end of the season that may be leached into groundwater supplies. Nitrate leaching can be reduced if the balance between nitrogen added and nitrogen removal is fully understood. Crops should be managed to scavenge as much nitrogen as possible. Crops with a relatively deep root system such as sugar beets are useful in this regard. From the economic viewpoint, the goal is to receive optimal sugar yield from the fertilizer input. Research has shown that farmers commonly use more N fertilizer than is needed for maximum sucrose production. In these times of a stressed agricultural economy, it is vital to optimize economic return from fertilizer inputs (Shock et al., 2000, Stieber et al., 1999).

LITERATURE CITED

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Table 1. Nitrogen mineralization during 1995.

Site #	Depth	Initial N Level[1]	June	July	August	Sept	Oct	Soil N Supply[2]
				Pounds of N per acre				
#1	0-12"	52.0	- 8.0	16.0	28.0	28.0	28.0	80.0
	12-24"	108.0	-20.0	-16.0	20.0	-8.0	36.0	144.0
	TOTAL	**160.0**	**-28.0**	**0.0**	**48.0**	**20.0**	**64.0**	**224.0**
#2	0-12"	72.0	- 4.0	32.0	48.0	4.0	28.0	100.0
	12-24"	72.0	-20.0	28.0	20.0	-8.0	24.0	96.0
	TOTAL	**144.0**	**-24.0**	**60.0**	**68.0**	**- 4.0**	**52.0**	**196.0**

1 Initial N = NH_4-N + NO_3-N
2 Total soil N supply = initial soil N + mineralization N

Table 2. Nitrogen mineralization during 1996.

Site #	Depth	Initial N Level[1]	June	July	August	Sept	Oct	Soil N Supply[2]
				Pounds of N per acre				
#1	0-12"	112.0	-32.8	-15.2	-23.6	39.2	--	151.2
	12-24"	50.0	19.2	-11.2	21.6	-18.8	--	31.2
	TOTAL	**162.0**	**-13.6**	**-26.8**	**-2.4**	**20.4**	--	**182.4**
#2	0-12"	116.4	0.4	46.0	36.4	46.4	36	152.4
	12-24"	106.8	8.0	7.6	-0.4	-2.4	-88.8	18.0
	TOTAL	**223.2**	**8.4**	**53.6**	**36.0**	**44.0**	**-52.8**	**170.4**

1 Initial N = NH_4-N + NO_3-N
2 Total N supply = initial soil N + mineralization N

Table 3. Nitrogen mineralization during 1997.

Site #	Depth	Initial N Level[1]	June	July	August	Sept	Oct	Soil N Supply[2]
				Pounds of N per acre				
#1	0-12"	81.6	34.8	50.8	-43.2	78.0	99.6	181.2
	12-24"	84.0	-0.4	8.8	20.4	21.2	28.4	112.4
	TOTAL	**165.6**	**34.4**	**59.6**	**-22.8**	**99.2**	**128.0**	**293.6**
#2	0-12"	88.8	-0.4	23.2	29.6	46.8	62.0	150.8
	12-24"	90.4	-4.0	13.6	18.0	16.0	18.8	109.2
	TOTAL	**179.2**	**-4.4**	**36.8**	**47.6**	**62.8**	**80.8**	**260.0**

1 Initial N = NH_4-N + NO_3-N
2 Total soil N supply = initial soil N + mineralization N

Table 4. Nitrogen mineralization during 1999.

Site #	Depth	Initial N Level[1]	June	July	August	Sept	Oct	Soil N Supply[2]
		---Pounds of N per acre---						
#1	0-12"	288.4	39.6	91.6	56.4	82.8	94.8	383.2
	12-24"	140.4	22.8	72.0	64.0	141.2	70.8	211.2
	TOTAL	**428.8**	**62.4**	**163.6**	**120.4**	**224.0**	**165.6**	**594.4**
#2	0-12"	20.4	62.0	89.6	84.8	106.0	88.0	108.2
	12-24"	46.4	8.4	23.2	25.2	44.8	23.2	69.6
	TOTAL	**66.8**	**70.4**	**112.8**	**110.0**	**150.8**	**111.2**	**177.8**

1 Initial N = NH_4-N + NO_3-N
2 Total soil N supply = initial soil N + mineralization

Table 5. Nitrogen mineralization in sugarbeets during 2000.

Site	Depth	Initial N Level[1]	June	July	August	Sept	Soil N Supply[2]
		---Pounds of N per acre---					
#1	0-12"	121.6	35.0	71.6	95.6	134.4	256.0
	12-24"	151.2	16.4	44.0	44.8	36.5	187.7
	TOTAL	**272.8**	**51.4**	**115.6**	**140.4**	**170.9**	**443.7**

1 Initial N = NH_4-N + NO_3-N
2 Total soil N supply = initial soil N + mineralization