Response of Sunflower to Nitrogen Fertilizer*

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In an environment of high production costs and low grain prices, efficient use of inputs is essential for maintaining economic viability of farming operations. Application of excessive amounts of nitrogen (N) fertilizer may reduce profitability and create groundwater pollution hazards. On the other hand, yield responses to N frequently make this technology cost effective, but determination of the optimum level of fertilizer is necessary to maximize profit.

Current North Dakota fertility recommendations for sunflower suggest 5 pounds N/cwt. yield goal (Dahnke, 1994). Thus, a 2,000 pound yield goal would require 100 pounds of total N (soil test nitrate-N + credit for a previous legume crop + applied fertilizer). However, experiment station trials sometimes show no yield benefit from N fertilization of sunflower and usage under production conditions varies greatly. The objectives of this study were to determine the effects of N fertilizer on sunflower yield and soil nitrate-N levels and the influence of tillage practices on these effects.

Sunflower data were analyzed from the Spring Wheat – Sunflower – Barley – Fallow rotation in a long-term cropping systems experiment, which was initiated in 1987. Fertilizer N levels (see below) and tillage practices (conventional, reduced, no-till) were arranged in perpendicular strips. Sunflowers were planted in 30" rows and managed to maximize yield by optimizing P fertility and pest control. Fall soil samples from two replicates were analyzed for nitrate-N concentration. Yield was measured on all three replicates.

Fertility Treatments (lbs N/acre)

	Low	Medium	High
1987-1990	30	60	90
1991-1997	0	40	80

Soil Nitrate-N Level (0-24")

Averaged across years, a nearly linear increase in fall soil nitrate-N concentration was observed with increases in the level of spring N fertilizer (Table 1). Over the nine years covered by data, N fertilization not only increased yield (see below), but improved the N-status of soil for the next crop in the rotation.

Tillage practice had essentially no effect on fall soil nitrate-N level within a given year (data not shown). Averaged across years, significantly lower nitrate concentration in the no-till plots was

likely due to uptake by weeds, which were more prevalent in this system. Higher water accumulation in these high-residue plots may have contributed to increased N losses by leaching.

Comparing the average fall nitrate-N values for years 88-90 (relatively low rainfall) with those for 93-95 (relatively high rainfall) points out the susceptibility of soil N to leaching and denitrification. The range of 4.3 to 47.3 pounds/acre stresses the importance of annual soil sampling to quantify the N-status of fields.

Yield

In most years, sunflower yield increased slightly with increases in N fertilization, but differences were not statistically significant (Table 2). However, the average across years shows an incremental increase in yield with applied N and the differences among treatments are highly significant.

In some years, significant yield reductions were observed in the no-till treatment (Table 3). These differences are attributed to inferior weed control in these plots, which will become less of a limiting factor as more post-emergence herbicides are labeled for use in sunflower. Yields under minimum tillage and conventional tillage were statistically similar in all nine years, which indicates the possibility of reducing tillage costs without affecting yield.

Dahnke, W.C. 1994. Fertilizer recommendations. p. 11-12. *In* D.R. Berglund (ed.) Sunflower Production. Extension Bulletin 25 (revised), North Dakota State University, Fargo. 98 p. •

Table 1. Effect of N Fertilization on Soil Nitrate-N Levels (ppm, 0-24") in Sunflower, NDSU Carrington Research Extension Center, 1988-1997.

	N Fertilizer Applied					
Year	Low	Medium	High	Average	LSD (0.05)	LSD (0.01)
1988	24.2	34.8	88.8	47.3	29.7	43.2
1989	22.9	43.2	53	39.7	NS[1]	NS
1990	5.9	30.5	22.3	18.9	10.2	14.9
1992	3.2	4	12	6.4	3.3	4.8
1993	3.2	4.1	5.4	4.3	NS	NS
1994	2.7	3.6	8.9	5		4.1
1995	3.1	3.1	8.1	4.8		2.1
1996	3.8	7.1	25.5	12.1		8.5
1997	3.1	8.5	26.8	12.8	10.9	15.9
X	8	15.1	27.9	17		4.4

[1]NS = non-significant difference

Table 2. Effect of N Fertilization on Yield (lbs/acre) of Sunflower,
NDSU Carrington Research Extension Center, 1988-1997.

	N Fertilizer Applied					
Year	Low	Medium	High	Average	LSD (0.05)	LSD (0.01)
1988	1098	1328	1430	1285	NS[1]	NS
1989	1250	1277	1154	1227	NS	NS
1990	1615	1753	1603	1657	NS	NS
1991	1548	1594	1632	1691	NS	NS
1992	777	785	897	820	NS	NS
1993	650	708	858	739	NS	NS
1995	1061	1110	1598	1257	206	284
1996	1537	1879	2099	1838	320	441
1997	696	745	868	770	NS	NS
X	1137	1242	1349	1243	103	137

[1]NS = non-significant difference

Table 3. Effect of Tillage Practices on Yield (lbs/acre) of Sunflower,
NDSU Carrington Research Extension Center, 1988-1997.

	Tillage				
Year	No Till	Minimum	Conventional	LSD (0.05)	LSD (0.01)
1988	986	1430	1440	NS[1]	NS
1989	1076	1254	1352	NS	NS
1990	1803	1670	1498	NS	NS
1991	1470	1732	1572	NS	NS
1992	202	1070	1187	195	268
1993	463	794	960	272	375
1995	619	1655	1496	206	284
1996	1918	1682	1915	NS	NS
1997	287	1051	971	235	324
X	980	1371	1377	103	137

[1]NS = non-significant difference