## LAND SPREADING OF YARD WASTE

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## LAND SPREADING OF YARD WASTE

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ABSTRACT: A field experiment at the Sand Plain Research Farm in Becker, Minn. was conducted to determine the effects of land applying yard waste (primarily tree leaves) on corn production and soil nitrate movement. The yard waste was applied in the fall of 1991. Treatments included four rates of yard waste (0, 20, 40, and 80 T/A) with either no fertilizer N applied, 200 lbs N/A during the 1992 growing season, or 66 lbs N/A applied with the yard waste plus 200 lbs N/A applied during the growing season. Yard waste application initially inhibited growth and depressed tissue nitrogen composition of developing corn plants. The inhibitory effect diminished when fertilizer N was applied. These results suggest that soil N was immobilized for 5-6 weeks after planting. Bv harvest, corn grain yield increased with increasing yard waste application when no fertilizer N was applied, presumably due to release of nitrogen and possibly other nutrients from the yard waste. When N was added during the growing season, with or without fall applied N, the effect of yard waste on grain yield was generally not significant. Without added N fertilizer, yard waste increased N content of corn plant by about 1 lb N/A for each ton of yard waste applied up to 40 T/A. At the 80 T/A rate, N content increased by only 0.75 lb N/A for each ton of yard waste applied. Maturity, as measured by % moisture in the grain, was delayed with yard waste application. In addition to increasing tissue N, yard waste also increased tissue levels of P, K, Mg, and Zn. Nonessential heavy metals in corn tissue were generally below detection limits or not affected by yard waste application. Application of yard waste slightly increased soil pH and soluble salts. Extractable P, K, Ca, Mn, Zn and B also increased with yard waste application. Availability of nonessential heavy metals were not affected by yard waste application. Nitrate leaching tended to decrease with increasing yard waste during the first year after application. Highest nitrate-N concentrations in soil water at the three foot depth were recorded when N was applied in the fall with or without yard waste. During the first year after yard waste application, acceptable yields were obtained at all rates of applied yard waste combined with 200 lb N/A without significant nitrate losses. This study needs to be continued to determine nitrogen release rates from yard waste in subsequent years.

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Rationale and Objectives: Until recently, yard wastes (tree leaves and grass clippings) accounted for 15-20% of the bulk in landfills. In 1990 (metro counties) and in 1992 (greater Minnesota), regulations were passed that prohibited dumping of vard wastes Because of this legislation, alternatives to landfilling yard waste need in landfills. immediate attention. Some options for using or recycling the yard waste include: 1) backyard composting and application of the compost to gardens; 2) municipal composting followed by land application of the compost; and 3) direct land application of noncomposted yard waste. While backyard composting is a desirable way to handle yard waste, not all homeowners desire to compost their own yard waste. Several problems with municipal yard waste composting include finding an acceptable site, controlling nutrient runoff, and controlling odors. Direct land application of noncomposted yard waste may be more efficient than composting and does not have the same problems associated with composting. Land application of yard waste may require an adjustment of nitrogen requirements, because of its generally low available nitrogen content. In addition, the effects on nitrogen use and crop production in general need to be ascertained. Therefore, the objectives of this study were to: 1) Determine the effects of direct application and incorporation of noncomposted yard waste (primarily tree leaves), with and without fertilizer nitrogen, on productivity of irrigated field corn, and 2) Characterize nitrogen release from the leaves during the growing in terms of availability for crop needs and movement through the soil profile.

<u>Review of Literature</u>: Many waste materials are currently being considered for land application including sewage sludge, food wastes, paper and yard wastes (Rynk, 1992). Direct land application is often less costly than composting because it involves less handling of materials and often has lower siting and regulatory costs. Major considerations for land application of waste include nutrient content and availability of the waste, nutrient needs of the crop, timing of waste application, and environmental degradation due to high trace metal content. The composition of yard waste is dependent on the time of the year. In the fall and early spring yard waste is primarily leaves with some grass clippings. In the summer, yard waste primarily consists of grass clippings. Yard waste high in grass clippings will have higher available nitrogen than yard waste high in tree leaves. The C/N ratio of tree leaves is between 40-80, while the C/N for grass clippings is 20 (Rosen et al., 1990).

Only a few studies have been reported that critically examine the effects of yard waste applications on crop growth and the environment. Many of the early studies using noncomposted waste tested municipal refuse and sewage sludge (King et al., 1974; Volk et al., 1973; Webber, 1978). While organic matter increased with addition of these materials, problems of incorporation, odor, aesthetics (Webber, 1978), and plant toxicity (King, et al. 1974) were reported.

Direct land application of yard waste is not hampered by the problems encountered with municipal refuse. The leaves are degradable and unsitely residues would not be present. Based on cost estimates, running a yard waste land application program is less than a full scale composting operation (Hgberg et al., 1990). States that have conducted experiments with land application of yard waste include New York (Nally,

1989), Minnesota (Buchite, 1990), and Wisconsin (Peterson, 1991). Land application of grass clippings has also been reported in Pennsylvania (Biocycle, 1991). All studies reported that metal levels in crop tissue were not affected by yard waste application. Peterson (1991) reported that corn yield was not consistently affected by yard waste amendment the year of application; however, a 30-50 bushel increase due to yard waste was measured in subsequent years. The yard waste increased available phosphorus and increased soil organic matter content. In New York, yard waste applications at high rates (40 tons/A wet weight) were shown to decrease yield if insufficient nitrogen fertilizer was supplied (Nally, 1989). Increasing nitrogen application rate was necessary to maintain corn yields in a Minnesota study (Buchite, 1990). In that study, application rates greater than 20 T/A required multiple tillage operations to obtain adequate incorporation. None of the studies reported qualitatively how much nitrogen could be expected to be released from the yard waste applications.

## PROCEDURES

The experiment was conducted at the Sand Plain Research Farm in Becker, MN on a Hubbard loamy sand soil. Initial soil chemical characteristics include (0-6"): organic matter, 1.7%; pH (1:1 soil:water), 6.8; Bray P1, 26 ppm; K (NH<sub>4</sub>OAc), 61 ppm. Extractable (KCI) nitrate-N and ammonium-N in the top 3 feet were 30 lbs/A and 4 Ibs/A, respectively. The previous crop was rye. Yard waste was collected in October 1991 and applied to 15' x 35' plots with a front end loader on October 31, 1991. The yard waste primarily consisted of tree leaves, although some garden plants and grass clippings were also present. Subsamples of yard waste applied to each plot were collected for the following chemical analyses: moisture, pH (1:1, water), C and S (dry combustion), N (Kjeldahl) and, P, K, Ca, Mg, Na, Al, B, Cr, Cu, Fe, Pb, Mn, Ni, and Zn (dry ashed, Munter and Grande, 1981). Twelve treatments were tested: 0, 20, 40, 80 dry tons/A yard waste (no added N); these same treatments with 200 lb N/A applied during 1992; these same treatments with 66 lb N/A applied in the fall of 1991 plus 200 Ib N/A applied during 1992. The fertilizer N source used in all cases was urea. An average of 30% moisture was assumed for application of all yard waste treatments. The experimental design was a randomized complete block with 4 replications. Yard waste was incorporated to a depth of 8 inches with a rototiller after application (fall 1991) and the whole field was moldboard plowed to a depth of 8-10 inches one week prior to planting in 1992. In addition, 235 lbs/A 0-0-22 and 200 lbs/A 0-0-60 were broadcast and incorporated prior to planting. Pioneer hybrid 3751 (100 day maturity) was planted on April 28, 1992 at a population of 30,700 seeds/A (2.5 ft. between rows). At planting, 185 lbs/A 0-14-42 was banded 2 inches to the side and two inches below the seed. For the N treated plots, 100 lbs N/A was sidedressed on May 27, with a hand pushed Gandy fertilizer applicator and cultivated in. Additional N at a rate of 50 lbs/A per application was applied with the Gandy applicator on June 17 and June 22 and irrigated in with 0.5 inch of water. Irrigation was used to supplement rainfall (Figure 1).

Soil samples at the 0-8 inch depth were collected from each plot before planting. After harvest, soil samples were collected from 0-6, 6-12, 12-24 and 24-36 inch depths. Soil nitrate and ammonium were determined on 2 N KCl extracts (Carlson et al., 1990). On the 0-6 inch sample additional soil chemical determinations were made: pH and soluble salts (1:1, water), P (Bray P-1); K, Ca, Mg, Na (1N ammonium acetate), Fe, Mn, Zn, Cu, Pb, Ni, Cr, and Cd (DTPA); and B (hot water). Detailed methodolgy for soil extraction procedures can be found in Rosen and Munter (1992).

Suction tubes with ceramic cups were installed at a depth of 3 feet in two replications of each treatment. Suction tubes at the 6 foot depth were installed in two reps for the control and 40 T/A yard waste plus 266 lbs of N treatments. Water samples were collected every two weeks through the growing season and analyzed for nitrate. On one set of water samples (September 11), a more extensive elemental analysis was performed using an ICP spectrophotometer (Munter and Grande, 1981).

Whole plant samples (4 per plot) were collected at the three leaf stage (May 26) before fertilizer N was applied in 1992. Whole plant samples (4 per plot) at the 8-12 leaf stage were collected on June 26 after all fertilizer N was applied. Ear leaf samples at 50% silking were collected on July 28. Two, 20 foot rows were harvested for grain and stover yield from each plot on October 10. Subsamples of stover and grain plus cob were taken for moisture determinations, shelling percentages, and nitrogen analyses. Plant tissue samples were dried and then ground through a 30 mesh screen. Dried samples were digested in concentrated sulfuric acid and Kjeldahl nitrogen was determined using conductimetric procedures (Carlson, 1978).

## <u>RESULTS</u>

<u>Yard Waste Elemental Composition</u>: The yard waste had an acid pH (Table 1). The average moisture content was 30% with a range of 18.6 - 48.1%. The outer part of the pile tended to be drier than the inner part. The C/N ratio averaged 37.8.1, which is on the low side for leaves, but is in a range that should initially immobilize N. The yard waste contained 21.2 lbs N/dry ton, 3.2 lbs P/dry ton (7.4 lbs  $P_2O_5$ ), and 14.4 lbs K/dry ton (17.3 lbs  $K_2O$ ). The yard waste contained significant quantities of Ca, Mg and S. Trace elements were also present in the yard waste, but were not at levels considered to be detrimental to the environment.

<u>Corn Growth and Yield</u>: Initial growth of corn was significantly inhibited as yard waste application rate increased (Table 2). Application of N tended to minimize the negative effect of yard waste application on initial corn growth. Greatest growth at the 8-12 leaf stage occurred when N was applied in the Fall and during the growing season. Yard waste application rate up to 40 T/A tended to increase final stand count. At the 80 T/A rate, stand count declined. Stand count also increased with increasing fertilizer N rate. At harvest, increasing yard waste rates increased grain yield when no N was applied, indicating a significant release of N from the yard waste. However, when N was added during the growing season with or without fall applied N, the effect of yard waste on

grain yield was generally not significant.. There was a slight decrease in grain yield at the highest yard waste rate and when fall N plus 200 lb N/A was applied. Stover yield increased with increasing yard waste application and fertilizer N rate. Yard waste and low fertilizer N tended to delay maturity as measured by higher kernel moisture percentage.

Tissue Nitrogen Concentrations and Total Nitrogen Uptake: Nitrogen concentrations in whole plants sampled at the 3 leaf stage decreased as yard waste application increased (Table 3). These results indicate that early in the season N was immobilized by the yard waste. Fall applied N significantly increased N concentrations in the plant. By the 8-12 leaf stage, yard waste application was beginning to have a positive effect on N concentrations in the plant, while the effect of fall application of N began to diminish. Ear leaf N increased with increasing yard waste application when no fertilizer N was applied, but was not affected by yard waste when fertilizer N was applied. Application of fertilizer N increased N concentrations in the ear leaf. Cob N concentrations were not affected by yard waste application and were not consistently affected by fertilizer N application (Table 4). Stover N concentrations tended to increase with increasing yard waste application, primarily when no fertilizer N was applied. Application of fertilizer N also increased N concentrations in the stover. Kernel N increased with increasing application of yard waste and increasing fertilizer N application. As with other tissues, the effect of yard waste was most pronounced when fertilizer N was not applied.

Dry matter production increased with increasing yard waste rate up to the 40 T/A rate and then decreased even when fertilizer was applied; however, without inorganic N fertilizer, dry matter increased linearly with increasing yard waste application (Table 4). Applied N nearly doubled dry matter production; however, fall applied N did not significantly increase dry matter production compared to lower rates applied during the season. Similarly, without added N fertilizer, yard waste increased N content of corn plant by about 1 lb N/A for each ton of yard waste applied up to 40 T/A. At the 80 T/A rate, N content increased by only 0.75 lb N/A for each ton of yard waste applied. With added N, N uptake was highest with the 40 T/A yard waste rate. Given the growing conditions in 1992, the nitrogen rate used could probably have been lowered to take better advantage of N mineralized from the yard waste. As expected, N uptake increased with increasing N rate.

<u>Tissue Elemental Concentrations</u>: Concentrations of elements (except N) in kernel, stover, and cob are presented in Tables 5, 6, and 7, respectively. Yard waste application significantly increased kernel P, K, Mg, B, Mn, and Zn, and decreased kernel Cu. Concentrations of Cd, Pb, Ni, Cr, Al, Fe, and Mo were either below detection limits or not affected by yard waste application. Increasing N rate decreased kernel K, Mg, Ca, P and Zn, and increased Fe and Mn. Increasing K concentrations in kernels were greater with yard waste than with N fertilizer, resulting in a significant interaction. Increases in kernel Mn with yard waste application were greater at low N rates compared to the higher N rates.

Yard waste application increased stover K and decreased stover Ca. Increases in stover Zn and P with yard waste were dependent on N application, with greatest increases occurring at the low N rates. Decreases in stover Al, Fe, and Mg with yard waste were also dependent on N application, with greatest decreases occurring at the low N rates. Stover Mo decreased with increasing N rate, but was not consistently affected by yard waste application. Concentrations of Cd, Ni, and Pb were below detection limits. Stover B, Na, Cr, and Cu were not affected by yard waste application and inconsistently affected by N application.

Yard waste application increased cob Mn, P, and Zn. Concentrations of Cu in cobs also increased with yard waste application, but increases were dependent on N applied. Greater increases in cob Cu with yard waste occurred at the lower N rates. Cob K decreased with yard waste application. Cob Ca and Mg also decreased with yard waste application, but decreases were more pronounced at the lower N rates. Concentrations of Al, B, and Fe were not affected by yard waste application. While cob Cd, Cr, Mo, Na, Ni, and Pb were generally below detection limits.

<u>Soil Nitrate-Nitrogen Content</u>: Soil nitrate-nitrogen increased with increasing yard waste application in the top 6 inches, but was not significantly affected by yard waste at the lower depths (Table 8). Soil nitrate-nitrogen increased with increasing fertilizer N application, with the fall applied N treatment having the highest residual N in the top 3 feet. It is interesting to note, however, that the initial soil nitrate-N content of 30 lbs/A was higher than the soil nitrate-N content following any of the fertilizer N and/or yard waste treatments.

<u>Soil Chemical Properties</u>: Effect of yard waste and nitrogen application on soil pH, Bray P1, ammonium acetate extractable cations, DTPA extractable microelements, and hot water extractable B in the top 6 inches after harvest are presented in Table 9. Soil pH slightly increased with yard waste application (6.9 to 7.2) and slightly decreased with N application. Soluble salts increased with both yard waste and N application; however, levels were not in a range that would toxicity problems. Extractable P, K, Ca, Zn and B increased with increasing yard waste application, but were not affected by N application. Extractable Mn increased with increasing yard waste and N application rates. Extractable Mg, Na, Fe, Cu, Pb, and Ni were not affected by yard waste application, extractable Na, Fe, Cu, and Ni increased with increasing N application. Extractable Cd and Cr were generally below detection limits.

<u>Soil Water Elemental Concentrations</u>: Elemental concentrations in soil water sampled on September 11 are presented in Table 10. Al, B, Cd, Cr, Cu, Fe, Mo, Ni, and Pb were generally below detection limits of the ICP. Ca, K, Na, and S tended to increase with increasing yard waste application. P concentrations tended to increase with increasing yard waste when no fertilizer N was applied, but was not consistently affected when fertilizer N was applied. Except for soil water nitrate (see below), other elements determined in soil water were not affected by yard waste application or fertilizer N.

Soil Water Nitrate Concentrations: Concentrations of nitrate-N in soil water as affected by treatments are presented in Figures 2-13. Yard waste applications tended to decrease nitrate concentrations in soil water at the three foot depth when fertilizer N was not applied. The control treatment had the highest water nitrate-N concentrations When yard waste was applied, nitrate-N with levels slightly above 10 ppm. concentrations were less than 10 ppm. When fertilizer N was applied during the season, nitrate-N concentrations in soil water at the three foot depth tended to be highest at mid-season when 80 T/A yard waste was applied. However, by the end of the season, the 0 yard waste treatment with fertilizer N had the highest nitrate concentrations. Nitrate-N concentrations in soil water were greatest when fertilizer N was applied in the fall. Highest concentrations at mid-season were recorded when 0 T/A leaves were applied. Yard waste application tended to decrease nitrate-N concentrations; however, compared to the other N treatments, fall applied N resulted in the highest losses at the end of the growing season. From these measurements, vard waste amendments appear to reduce nitrate-N losses during the first growing season after application.

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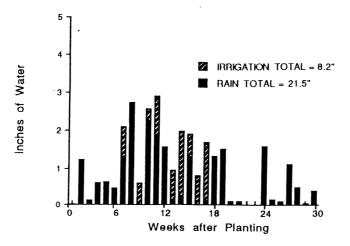


Figure 1. Rainfall and irrigation provided over the 1992 growing season.

	Mean	Standard Deviation	Minimum	Maximum	
рН	4.9	0.2	4.4	5.5	-
* moisture	29.7	7.7	18.6	48.6	
C to N ratio	37.9	3.2	29.6	42.6	lbs element/ dry ton
Macroelements (%)					
Carbon	39.76	3.49	33.56	45.95	795.2
Nitrogen	1.06	0.12	0.81	1.46	21.2
Phosphorus	0.16	0.02	0.12	0.20	3.2
Potassium	0.72	0.14	0.47	1.16	14.4
Calcium	2.33	0.25	1.75	2.75	46.6
Magnesium	0.37	0.04	0.27	0.49	7.4
Sulfur	0.19	0.02	0.15	0.22	3.8
Aicroelements (pp	m)				
Aluminum	. 1052	464	254	1960	2.1
Boron	65	9	48	97	0.13
Cadmium	<0.52	0.35	<0.16	1.30	<0.10
Chromium	7.5	3.5	1.6	14.4	0.015
Copper	8.4	1.2	5.6	10.7	0.016
Iron	969	334	359	1755	1.9
Lead	<15.5	7.7	<2.2	39.6	<0.031
Manganese	249	40	177	399	0.50
Nickel	<6.5	3.3	<0.9	13.4	0.013
Sodium	105	23	60	163	0.21
Zinc	61	9	40	85	0.12

Table 1. Elemental concentrations of original yard waste samples.

Yard		Whole plant	Final		
waste	Nitrogen	dry matter	stand	Grain	Kernel
rate	application	(8-12 leaf)	count	yield	moisture
-tons/A-	lbs/A	-grams/plant-	-plants/A-	-bu/A-	- % -
0	0	16.0	26463	76	36
20	0	5.5	26789	99	39
40	0	8.8	28532	124	38
80	0	6.0	26681	130	36
0	200	21.8	27770	188	29
20	200	12.5	27334	185	34
40	200	9.3	27770	188	35
80	200	10.5	27770	182	35
0	66+200	29.3	27660	195	31
20	66+200	25.5	28859	203	30
40	66+200	15.0	28859	195	35
80	66+200	13.0	27661	176	34
Significa	nce	**	NS	**	**
BLSD (5%	)	9.3		20	3
Main effe	cts				
	Yard Waste Rate				
	0	22.3	27298	153	32
	20	14.5	27661	162	34
	40	11.0	28387	169	36
	80	9.8	27370	162	35
	Significance	**	NS	NS	**
	BLSD (5%)	5.3			2
	Linear	**	NS	NS	**
	Quadratic	*	*	*	**
	Nitrogen Applica	tion			
	0	9.0	27116	107	37
	200	13.5	27661	186	33
	~~~~				
	66+200	20.8	28260	192	32
	66+200 Significance	20.8 **	28260 *	192 **	32 **
	66+200 Significance BLSD (5%)				
Interacti	Significance BLSD (5%)	**	*	**	**

Table 2. Effect of yard waste and nitrogen application on whole plant dry matter at the 8-12 leaf stage, final stand count, grain yield, and kernel moisture.

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

waste rate a -tons/A- 0 20 40 80 0 20 40 80 0 20 40 80 0 20 40 80	Nitrogen pplication lbs/A 0 0 0 200 200 200 200 200 66+200 66+200 66+200 66+200	3 leaf stage 4.19 3.19 3.03 2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10 2.60	8-12 leaf stage % Nitrogen 1.74 2.49 2.57 3.00 3.14 3.80 3.96 3.71 3.08 3.30	silking stage 1.34 1.97 2.05 2.31 2.89 2.94 2.68 3.04 3.00 2.51
-tons/A- 0 20 40 80 0 20 40 80 0 20 40 80 0 20 40	lbs/A 0 0 0 200 200 200 200 200 66+200 66+200 66+200 66+200	4.19 3.19 3.03 2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10	% Nitrogen 1.74 2.49 2.57 3.00 3.14 3.80 3.96 3.71 3.08 3.30	1.34 1.97 2.05 2.31 2.89 2.94 2.68 3.04 3.00
0 20 40 80 0 20 40 80 0 20 40	0 0 0 200 200 200 200 66+200 66+200 66+200 66+200	3.19 3.03 2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10	1.74 2.49 2.57 3.00 3.14 3.80 3.96 3.71 3.08 3.30	1.97 2.05 2.31 2.89 2.94 2.68 3.04 3.00
20 40 80 0 20 40 80 0 20 40	0 0 200 200 200 200 66+200 66+200 66+200 66+200	3.19 3.03 2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10	2.49 2.57 3.00 3.14 3.80 3.96 3.71 3.08 3.30	1.97 2.05 2.31 2.89 2.94 2.68 3.04 3.00
40 80 20 40 80 0 20 40	0 0 200 200 200 66+200 66+200 66+200 66+200	3.03 2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10	2.57 3.00 3.14 3.80 3.96 3.71 3.08 3.30	2.05 2.31 2.89 2.94 2.68 3.04 3.00
80 0 20 40 80 0 20 40	0 200 200 200 66+200 66+200 66+200 66+200	2.80 4.21 3.20 3.16 3.19 4.32 4.39 4.10	3.00 3.14 3.80 3.96 3.71 3.08 3.30	2.31 2.89 2.94 2.68 3.04 3.00
0 20 40 80 0 20 40	200 200 200 66+200 66+200 66+200 66+200	4.21 3.20 3.16 3.19 4.32 4.39 4.10	3.14 3.80 3.96 3.71 3.08 3.30	2.89 2.94 2.68 3.04 3.00
20 40 80 0 20 40	200 200 66+200 66+200 66+200 66+200	3.20 3.16 3.19 4.32 4.39 4.10	3.80 3.96 3.71 3.08 3.30	2.94 2.68 3.04 3.00
40 80 0 20 40	200 200 66+200 66+200 66+200 66+200	3.16 3.19 4.32 4.39 4.10	3.96 3.71 3.08 3.30	2.68 3.04 3.00
80 0 20 40	200 66+200 66+200 66+200 66+200	3.19 4.32 4.39 4.10	3.71 3.08 3.30	3.04 3.00
0 20 40	66+200 66+200 66+200 66+200	4.32 4.39 4.10	3.08 3.30	3.00
20 40	66+200 66+200 66+200	4.39 4.10	3.30	
40	66+200 66+200	4.10		2 51
	66+200			2.21
. 80		2 62	3.57	2.95
00	:	3.60	3.66	2.94
Significance		**	**	**
BLSD (5%)		0.72	0.40	0.76
BL	20 40 80 gnificance SD (5%) near	3.59 3.43 3.20 ** 0.39 **	3.20 3.36 3.46 ** 0.23 **	2.47 2.56 2.76 NS  NS
	adratic	*	**	NS
-	trogen Applic	ation		
	0	3.30	2.45	1.92
	200	3.44	3.65	2.89
	66+200	4.10	3.40	2.84
	gnificance	**	**	**
BL	SD (5%)	0.34	0.19	0.33
Interaction				
Yar	d Waste x Nit	rogen NS	NS	NS

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Table 3. Effect of yard waste and nitrogen application on nitrogen concentrations in corn tissues at various growth stages.

Yard												
waste	Nitrogen		rogen Concent	ration		Dry	Mass			Nitro	gen Content	
rate	application	Cob	Stover	Grain	Cob	Stover	Grain	Total	Cob	Stover	Grain	Total
-tons/A-	1bs/A		- % Nitrogen	n		T	'on/A				Lb N/A	
0	0	0.31	0.38	0.92	0.20	1.25	2.13	3.58	1.2	9.5	39.1	49.8
20	0	0.29	0.42	1.01	0.28	1.33	2.76	4.41	1.6	11.5	55.9	68.9
40	0	0.28	0.47	1.12	0.39	1.69	3.48	5.56	2.2	15.9	77.7	95.8
80	0	0.27	0.52	1.24	0.39	1.86	3.64	5.89	2.1	19.5	90.2	111.8
0	200	0.25	0.53	1.26	0.61	2.48	5.26	8.35	3.0	27.1	133.8	163.9
20	200	0.26	0.58	1.29	0.55	3.06	5.18	8.79	2.9	36.6	134.2	173.7
40	200	0.24	0.61	1.35	0.62	3.05	5.28	8.95	3.0	37.6	142.8	183.4
80	200	0.26	0.60	1.37	0.63	3.17	5.08	8.88	3.2	38.4	139.5	181.1
0	66+200	0.26	0.57	1.35	0.64	2.92	5.46	9.01	3.2	33.6	146.8	183.6
20	66+200	0.26	0.65	1.38	0.65	3.01	5.69	9.34	3.4	38.8	157.3	199.5
40	66+200	0.26	0.63	1.41	0.68	3.15	5.47	9.30	3.6	40.0	153.8	197.3
80	66+200	0.27	0.55	1.41	0.61	2.95	4.92	8.48	3.3	33.1	139.0	175.4
ignifica		**	**	**	**	**	**	**	**	**	**	**
BLSD (5		0.03	0.12	0.09	0.09	0.50	0.57	1.04	0.5	9.7	17.1	24.7
lain effe	ects											
	Yard Waste Rate											
	0	0.27	0.49	1.18	0.48	2.22	4.28	6.98	2.5	23.4	106.5	132.4
	20	0.27	0.55	1.23	0.49	2.48	4.54	7.52	2.6	28.9	115.8	147.4
	40	0.26	0.57	1.29	0.57	2.63	4.74	7.94	2.9	31.2	124.7	158.8
	80	0.26	0.56	1.34	0.54	2.66	4.55	7.75	2.9	30.3	122.9	156.3
	Significance	NS	NS	**	*	*	NS	*	*	*	**	**
	BLSD (5%)			0.05	0.06	0.34		0.72	0.3	6.6	11.2	16.2
	Linear	NS	NS	**	*	**	NS	*	**	*	**	**
	Quadratic	NS	NS	NS	NS	NS	*	*	NS	NS	*	*
	Nitrogen Application											
	· 0	0.29	0.45	1.07	0.32	1.54	3.00	4.86	1.8	14.1	65.7	81.6
	200	0.25	0.58	1.32	0.60	2.94	5.20	8.74	3.0	34.9	137.6	175.5
	66+200	0.26	0.60	1.39	0.64	3.00	5.39	9.03	3.4	36.4	149.2	188.9
	Significance	**	**	**	**	**	**	**	**	**	**	**
	BLSD (5%)	0.01	0.05	0.04	0.05	0.24	0.28	0.51	0.2	4.6	8.5	12.2
Interact	ion											
	Yard Waste x Nitrogen	NS	NS	*	NS	NS	**	*	NS	NS	**	•

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Table 4. Effect of yard waste and nitrogen application on nitrogen concentrations, nitrogen content and dry matter accumulation in cob, stover and grain at harvest.

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

rate	te Nitrogen application	Al	В	Ca	Cd	Cr	Cu	Fe	к	Mg	Mn	Мо	Na	Ni	Р	Pb	Zn
tons/A-	lbs/A								ppm -								
0	0	<6	3.2	58	<0.12	0.48	1.33	11	4464	1142	3.7	<0.41	<3.6	<0.67	3128	<1.8	17
20	0	<4	3.5	61	<0.12	0.43	1.05	10	4540	1229	4.2	<0.40	<3.7	<0.53	3409	<1.7	20
40	0	<4	3.3	51	<0.12	<0.37	1.00	10	4394	1226	4.5	<0.35	<3.6	<0.49	3442	<1.7	20
80	0	<5	3.4	50	<0.13	0.46	1.13	12	4376	1299	5.3	<0.39	<3.6	<0.52	3602	<1.8	22
0	200	<6	2.9	40	<0.13	0.39	1.29	19	3531	1057	4.3	0.43	<3.6	<0.50	2627	<1.8	14
20	200	<4	3.4	45	<0.12	<0.35	0.97	17	4114	1185	4.8	<0.30	<3.6	<0.48	3280	<1.7	18
40	200	<4	3.5	42	<0.12	0.38	0.92	16	4248	1200	4.9	<0.32	<3.6	<0.47	3464	<1.7	18
80	200	<5	3.4	44	<0.12	0.40	0.90	16	4320	1231	5.4	<0.31	<3.6	<0.44	3529	<1.7	19
0	66+200	<4	3.1	38	<0.12	0.39	1.06	19	3736	1148	4.7	<0.32	<3.6	<0.45	2895	<1.7	15
20	66+200	<5	3.5	46	<0.12	0.47	1.50	18	3822	1163	4.9	<0.39	<3.6	<0.63	3176	<1.7	17
40	66+200	<5	3.3	42	<0.12	0.50	1.06	25	4077	1215	5.0	<0.34	<3.6	<0.47	3403	<1.7	19
80	66+200	<5	3.4	41	<0.12	0.44	0.99	16	4132	1252	5.0	<0.34	<3.6	<0.47	3493	<1.7	18
ignifica	ance		*	**			NS	*	**	**	**				**		**
LSD (59			0.4	10				10	264	76	0.4				248		2
ain effe	ects																
	Yard Waste Ra	te															
	0	<5	3.1	45	<0.12	<0.42	1.23	16	3910	1116	4.2	<0.38	<3.6	<0.54	2883	<1.8	15
	20	<5	3.5	51	<0.12	<0.42	1.17	15	4158	1193	4.6	<0.36	<3.6	<0.54	3288	<1.7	18
	40	<4	3.4	45	<0.12	<0.42	1.00	17	4240	1213	4.8	<0.33	<3.6	<0.47	3437	<1.7	19
	80	<5	3.4	45	<0.12	0.43	1.01	15	4276	1261	5.3	<0.34	<3.6	<0.48	3541	<1.7	20
	Significance		**	NS			NS	NS	**	**	**				**		**
	BLSD (5%)		0.2						155	40	0.2				137		1
	Linear		*	NS			*	NS	**	**	**				**		**
	Quadratic		*	NS			NS	NS	*	NS	NS				**		**
	Nitrogen Appl	ication															
	0	<5	3.4	55	<0.12	<0.44	1.13	11	4443	1224	4.4	<0.39	<3.6	<0.55	3395	<1.7	20
	200	<5	3.3	43	<0.12	<0.38	1.02	17	4053	1168	4.9	<0.34	<3.6	<0.47	3325	<1.7	17
	66+200	<5	3.3	42	<0.12	0.45	1.15	19	3942	1195	4.9	<0.35	<3.6	<0.50	3242	<1.7	17
	Significance		NS	**			NS	**	**	*	**				*		**
	BLSD (5%)			4				4	127	39	0.2				136		1
Interact	ion																
	Yard Waste x N	itrogen															
	Tara Hance V H																

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Table 5. Effect of yard waste and nitrogen application on elemental composition of kernels at harvest - October 10, 1992.

NS = not significant, \* = significant at 5%, \*\* = significant at 1%.

ard was rate	te Nitrogen application	Al	в	Ca	Cd	Cr	Cu	Fe	к	Mq	Mn	Мо	Na	Ni	P	Pb	Z
tons/A-									ppm								
0	0	334	6.2	2653	<0.19	1.19	3.03	232	14463	2350	30.7	1.17	32.7	<1.20	1370	<3.2	
20	0	169	5.6	2095	<0.19	1.14	3.18	134	16169	2534	20.7	1.83	27.4	<0.93	3014	<2.9	
40	0	146	5.5	2034	<0.20	1.15	3.73	130	17506	2480	22.9	1.73	29.2	<0.98	3405	<3.1	
80	0	119	5.4	1975	<0.19	1.01	3.46	101	18527	2073	28.7	1.24	29.6	<0.90	3320	<2.9	
0	200	140	6.0	2382	<0.25	0.99	5.01	116	14358	2009	27.4	0.99	29.6	<1.04	469	<3.3	
20	200	120	6.2	2266	<0.23	0.91	4.49	101	15815	1461	27.3	1.12	32.9	<1.03	784	<3.3	
40	200	101	6.2	2077	<0.25	0.94	4.51	101	15803	1436	22.9	1.06	27.0	<1.06	1265	<3.5	
80	200	117	6.4	2236	<0.24	1.06	4.66	119	17561	1311	30.6	1.11	29.5	<1.05	1278	<3.3	
0	66+200	151	6.0	2527	<0.28	1.06	4.79	133	14305	2001	27.1	1.03	33.1	<1.13	485	<3.7	
20	66+200	115	6.5	2491	<0.25	0.98	4.26	96	18723	1513	25.8	0.88	33.6	<1.05	598	<3.5	
40	66+200	121	6.2	2347	<0.27	1.23	4.30	116	17541	1427	24.0	1.10	36.3	<1.10	951	<3.6	
80	66+200	106	6.2	2139	<0.25	1.06	4.21	105	18727	1428	24.5	0.98	30.4	<1.02	1317	<3.4	
Signific		**	*	**		NS	**	**	**	**	**	**	*		**		
LSD (5	%)	55	0.7	334			0.69	52	2648	225	5.9	0.25	6.9		488		
ain eff	ects																
	Yard Waste Ra	te															
	0	209	6.1	2521	<0.24	1.08	4.28	161	14375	2120	28.4	1.06	31.8	<1.12	775	<3.4	
	20	135	6.1	2284	<0.23	1.01	3.98	110	16902	1836	24.6	1.28	31.3	<1.00	1465	<3.2	
	40	123	6.0	2153	<0.24	1.10	4.18	116	16950	1781	23.3	1.30	30.8	<1.04	1873	<3.4	
	80	114	6.0	2117	<0.23	1.04	4.11	108	18272	1604	27.9	1.11	29.8	<0.99	1972	<3.2	
	Significance	**	NS	**		NS	NS	**	**	**	**	**	NS		**		
	BLSD (5%)	31		174				29	1352	132	3.0	0.16			283		
	Linear	**	NS	**		NS	NS	**	**	**	NS	NS	NS		**		
	Quadratic	**	NS	*		NS	NS	*	NS	*	**	**	NS		**		
	Nitrogen Appl	ication															
	0	192	5.7	2189	<0.20	1.12	3.35	150	16666	2359	25.8	1.49	29.7	<1.00	2777	<3.0	
	200	120	6.2	2240	<0.25	0.97	4.67	109	15884	1554	27.0	1.07	29.7	<1.04	949	<3.4	
	66+200	123	6.2	2376	<0.26	1.08	4.39	113	17324	1592	25.3	1.00	33.3	<1.07	838	<3.5	
	Significance	**	**	NS		*	**	**	NS	**	NS	**	*		**		
	BLSD (5%)	27	0.3	168		0.11	0.32	25		111		0.12	2.8		241		
nteract	<u>101</u>																
	Yard Waste x N	itrogen															
		**	NS	NS		NS	NS	*	NS	**	NS	**	NS		**		*:

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Table 6. Effect of yard waste and nitrogen application on elemental composition of stover at harvest - October 10, 1992.

NS = not significant, \* = significant at 5%, \*\* = significant at 1%.

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ard waste rate	e Nitrogen application	Al	В	Ca	Cd	Cr	Cu	Fe	K	Mg	Mn	Мо	Na	Ni	Ρ	Pb	Zn
tons/A-	lbs/A								ppm								
0	0	6	3.1	128	<0.12	0.49	1.85	11	16116	281	3.2	0.26	<3.8	<0.44	423	<1.7	29
20	0	5	3.4	93	<0.12	0.44	2.40	9	12921	211	3.3	0.30	<3.6	<0.45	668	<1.7	44
40	0	5	2.9	55	<0.12	0.44	2.78	11	10266	143	3.0	<0.25	<3.6	<0.44	779	<1.7	43
80	0	5	2.6	54	<0.13	0.40	2.71	8	9127	169	3.5	<0.24	<3.6	<0.45	813	<1.7	44
0	200	7	2.0	58	<0.13	0.41	2.29	10	6986	115	2.4	<0.24	<3.6	<0.69	218	<1.7	7
20	200	6	2.3	51	<0.12	<0.32	2.29	8	6482	95	2.8	<0.24	<3.6	<0.44	338	<1.7	15
40	200	5	2.1	45	<0.12	0.36	2.32	7	5781	93	2.6	<0.24	<3.6	<0.44	423	<1.7	15
80	200	6	2.2	51	<0.12	0.38	2.46	11	6154	105	3.0	<0.22	<3.6	<0.44	466	<1.7	19
0	66+200	6	2.0	41	<0.12	<0.32	2.17	10	6297	113	2.3	<0.23	<3.6	<0.48	232	<1.7	8
20	66+200	5	2.1	42	<0.12	<0.31	2.02	7	5897	108	2.5	<0.23	<3.6	<0.44	282	<1.7	12
40	66+200	5	2.1	48	<0.12	0.45	2.27	8	5225	105	2.6	<0.23	<6.1	<0.44	353	<1.7	14
80	66+200	6	2.2	51	<0.12	0.46	2.43	8	6135	122	3.0	<0.23	<3.6	<0.44	531	<1.7	20
ignifica	nce	NS	**	**			**	NS	**	**	**				**		**
LSD (5%			0.4	25			0.41		1574	43	0.4				94		7
ain effe	cts																
	Yard Waste Ra	te															
	0	6	2.4	76	<0.12	<0.41	2.10	10	9800	170	2.6	<0.24	<3.7	<0.54	291	<1.7	15
	20	6	2.6	62	<0.12	<0.36	2.24	8	8433	138	2.8	<0.26	<3.6	<0.44	429	<1.7	24
	40	5	2.3	49	<0.12	<0.42	2.46	9	7091	114	2.7	<0.24	<4.4	<0.44	518	<1.7	24
	80	5	2.3	52	<0.12	<0.41	2.53	9	7138	132	3.2	<0.23	<3.6	<0.44	603	<1.7	28
	Significance	NS	NS	**			**	NS	**	**	**				**		**
	BLSD (5%)			15			0.22		933	26	0.3				54		4
	Linear	NS	NS	**			**	NS	**	*	**				**		**
	Quadratic	NS	NS	*			NS	NS	**	**	NS				**		*
N	itrogen Applic	ation															
	0	5	3.0	82	<0.12	0.44	2.44	10	12107	201	3.2	<0.26	<3.6	<0.44	671	<1.7	40
	200	6	2.2	51	<0.12	<0.37	2.34	9	6354	102	2.7	<0.23	<3.6	<0.50	361	<1.7	14
	66+200	6	2.1	45	<0.12	<0.39	2.22	8	5889	212	2.6	<0.23	<4.2	<0.45	350	<1.7	14
	Significance	NS	**	**			NS	NS	**	**	**				**		**
	BLSD (5%)		0.2	12					776	21	0.2				46		3
nteractio	on																
1	Yard Waste x N	itroger	1														
		NS	NS	**			*	NS	**	**	NS				ب		NS

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Table 7. Effect of yard waste and nitrogen application on elemental composition of cobs at harvest - October 10, 1992.

NS = not significant, \* = significant at 5%, \*\* = significant at 1%.

Yard waste	e Nitrogen		Sampl	e depth (in	iches)	
rate	application	0 - б	6 - 12	12 - 24	24 - 36	Total
-tons/A-	lbs/A		1	bs nitrate-	N/A	
0	0	0.78	0.74	0.75	0.72	2.98
20	0	1.24	0.99	0.94	0.64	3.81
40	0	1.90	1.54	1.47	0.67	5.58
80	0	2.96	2.53	1.36	1.12	7.97
0	200	2.35	2.34	1.67	0.74	7.09
20	200	4.22	3.78	2.24	1.22	11.46
40	200	5.30	4.10	2.63	1.25	13.28
80	200	6.34	3.76	2.10	0.79	12.99
0	66+200	2.73	3.29	1.54	1.18	8.74
20	66+200	7.98	9.50	6.82	3.14	27.44
40	66+200	7.96	6.69	2.93	1.42	18.99
80	66+200	9.20	5.10	3.31	2.19	19.80
Significar		**	**	**	**	**
BLSD (5%)		3.41	4.62	2.96	1.24	10.80
<u>Main effec</u>	<u>ets</u> Yard Waste Rate					
	0	1.95	2.12	1.32	0.88	6.27
	20	4.48	4.76	3.33	1.67	14.23
	40	5.05	4.11	2.34	1.11	14.23
	80	6.17	3.80	2.26	1.37	13.59
	Significance	**	NS	NS	NS	*
	BLSD (5%)	1.94				6.57
	Linear	**	NS	NS	NS	NS
	Quadratic	NS	NS	NS	NS	NS
	Nitrogen Application					
	0	1.72	1.45	1.13	0.79	5.08
	200	4.55	3.49	2.16	1.00	11.20
	66+200	6.97	6.14	3.65	1.98	18.74
	Significance	**	**	**	**	**
	BLSD (5%)	1.57	1.93	1.28	0.54	4.78
Interactic	<u>on</u>					

Table 8. Effect of yard waste and nitrogen application on soil nitrate-N (lbs/A) in the top three feet at the end of the growing season.

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

Treat	ment		Soluble	Bray	11	NH₄OAC E	xtracta	able			I	TPA Ex	tracta	able			<u>Hot water</u>
Yard waste	Nitrogen	pН	Salts	Р	К	Ca	Mg	Na	Fe	Mn	Zn	Cu	Pb	Ni	Cr	Cd	В
rate	application																
(T/A)	(lb N/A)		(mnhos/cm	)						]	ppm						
0	0	7.1	0.10	23	61	779	170	5.2	16	4.7	0.4	0.3	0.8	0.4	<0.03	<0.02	0.4
20	0	7.1	0.15	28	96	1022	195	4.9	19	8.7	0.9	0.4	0.9	0.3	<0.05	<0.03	0.6
40	0	7.2	0.20	32	105	1080	198	4.7	18	9.6	1.1	0.4	0.6	0.4	0.05	0.04	1.1
80	0	7.2	0.23	41	156	1190	210	5.9	15	9.1	1.5	0.4	1.1	0.3	<0.03	<0.02	1.3
0	200	6.8	0.10	20	46	887	197	6.4	23	7.9	0.5	0.4	0.9	0.5	0.03	<0.05	0.4
20	200	6.9	0.17	29	104	1182	230	6.8	25	12.7	1.1	0.4	0.9	0.6	0.03	<0.06	0.8
40	200	7.0	0.17	31	117	1177	214	6.4	21	10.8	1.1	0.4	1.1	0.5	0.06	<0.04	0.9
80	200	7.0	0.25	50	188	1309	230	7.6	26	16.5	1.7	0.5	1.2	0.6	0.05	0.07	1.5
0	66+200	6.8	0.13	23	68	940	213	6.6	23	7.8	0.6	0.4	0.9	0.5	0.05	<0.05	0.4
20	66+200	6.9	0.20	30	108	1143	211	5.6	21	10.8	1.0	0.4	1.1	0.5	<0.04	<0.04	1.0
40	66+200	7.0	0.20	35	127	1181	212	6.2	22	13.7	1.2	0.5	0.9	0.7	0.05	<0.05	1.1
80	66+200	7.3	0.28	44	175	1327	235	6.5	16	10.7	1.5	0.4	1.1	0.4	0.04	<0.05	1.7
Significan	ice	*	**	**	**	**	NS	NS	NS	**	**	NS	NS	NS			**
BLSD (0.05	5)	0.3	0.07	14	41	256				5.9	0.5						0.4
<u>Main effec</u>	ts																
Yard Was	te Rate																
	0	6.9	0.11	22	58	868	193	6.1	21	6.8	0.5	0.4	0.9	0.5	<0.04	<0.04	0.4
	20	7.0	0.18	29	102	1116	212	5.8	22	10.7	1.0	0.4	1.0	0.5	<0.04	<0.04	0.8
	40	7.1	0.18	32	117	1146	208	5.8	20	10.9	1.1	0.4	0.9	0.5	0.05	<0.04	1.0
	80	7.2	0.26	46	173	1275	225	6.6	20	12.5	1.6	0.4	1.1	0.4	<0.04	<0.05	1.5
Signific	ance	*	**	**	**	**	NS	NS	NS	**	**	NS	NS	NS			**
Linea	ır leaf	**	**	**	**	**	NS	NS	NS	**	**	NS	NS	NS			**
Quadr	ratic leaf	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS			NS
Nitrogen	Application																
0		7.1	0.17	31	105	1017	193	5.2	17	8.0	0.9	0.3	0.8	0.4	<0.04	<0.03	0.9
200		6.9	0.18	33	114	1139	218	6.8	24	12.0	1.1	0.4	1.1	0.6	0.04	<0.06	0.9
66+200		7.0	0.20	33	120	1147	218	6.2	21	10.8	1.1	0.4	1.0	0.5	<0.04	<0.05	1.1
Signific	cance	**	NS	NS	NS	NS	NS	**	*	*	NS	*	NS	*			NS
BLSD (0.	05)	0.1						0.8	4	2.6		0.1		0.1			
Interactic	n																
V 1 V	- x Nitrogen	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS			NS

Table 9. Effect of yard waste and nitrogen applications on soil pH, Bray P1, ammonium acetate extractable cations, DTPA extractable microelements, and hot water extractable B, (0-6" depth) - Oct. 14, 1992.

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rate	application	Al	В	Ca	Cd	Cr	Cu	Fe	К	Mg	Mn	Mo	Na	Ni	Ρ	Pb	S	Zn
-tons/A-	1bs/A								ppm									
0	0	<0.18	<0.02	44	<0.006	<0.01	<0.03	<0.02	1.6	6	0.015	<0.01	6	<0.022	0.08	<0.09	33	0.11
20	0	<0.18	<0.03	55	<0.006	<0.01	0.06	<0.02	1.7	10	0.037	<0.01	38	0.028	0.08	<0.09	73	0.35
40	0	<0.18	0.17	111	<0.006	<0.01	<0.03	<0.02	1.6	13	0.052	<0.01	12	0.028	0.10	<0.09	97	0.15
80	0	<0.18	0.07	123	<0.006	<0.01	<0.03	0.03	3.8	14	0.017	<0.01	47	<0.024	0.21	<0.09	117	0.09
0	200	<0.18	<0.02	66	<0.006	<0.01	<0.03	<0.02	1.9	12	0.029	<0.01	12	<0.026	0.17	<0.09	58	0.17
20	200	<0.18	0.28	62	<0.006	<0.01	<0.03	<0.02	0.9	5	0.035	<0.01	17	<0.027	0.10	<0.09	45	0.20
40	200	<0.18	<0.02	81	<0.006	<0.01	<0.04	<0.02	1.6	8	0.027	<0.01	22	<0.023	0.08	<0.09	55	0.10
80	200	<0.18	<0.27	94	<0.006	<0.01	<0.05	<0.02	1.7	16	0.035	<0.01	27	<0.029	0.12	<0.09	83	0.13
0	66+200	<0.18	<0.15	89	<0.006	<0.01	<0.03	<0.02	2.7	10	0.036	<0.01	18	<0.029	0.07	<0.09	73	0.26
20	66+200	<0.18	<0.03	78	<0.006	<0.01	<0.03	<0.02	4.0	12	0.038	<0.01	24	<0.026	0.08	<0.09	67	0.19
40	66+200	<0.18	<0.04	67	<0.006	<0.01	<0.03	0.03	3.5	14	0.036	<0.01	22	<0.030	0.11	<0.09	65	0.19
80	66+200	<0.18	0.04	106	<0.006	<0.01	<0.03	0.04	8.3	20	0.096	<0.01	19	0.035	0.10	<0.09	86	0.25
Signific	ance			NS					NS	NS	NS		NS		*		NS	NS
BLSD (5	응)														0.08			
Main eff	ects																	
	Yard Waste Ra	ate																
	0	<0.18	<0.06	66	<0.006	<0.01	<0.03	<0.02	2.1	9	0.027	<0.01	12	<0.025	0.11	<0.09	55	0.18
	20	<0.18	<0.13	67	<0.006	<0.01	<0.03	<0.02	2.3	9	0.036	<0.01	24	<0.027	0.09	<0.09	60	0.23
	40	<0.18	<0.08	86	<0.006	<0.01	<0.03	<0.02	2.2	12	0.038	<0.01	19	<0.027	0.10	<0.09	72	0.15
	80	<0.18	<0.13	108	<0.006	<0.01	<0.04	<0.03	4.6	16	0.049	<0.01	31	<0.029	0.14	<0.09	96	0.16
	Significance			NS					NS	NS	NS		NS		*		*	NS
	BLSD (5%)														0.04		28	
	Linear			*					NS	*	NS		*		*		**	NS
	Quadratic			NS					NS	NS	NS		NS		*		NS	NS
	Nitrogen Appl	lication																
	0	<0.18	<0.08	87	<0.006	<0.01	<0.03	<0.02	2.2	11	0.029	<0.01	24	<0.025	0.12	<0.09	81	0.15
	200	<0.18	<0.15	76	<0.006	<0.01	<0.03	<0.02	1.5	10	0.031	<0.01	20	<0.026	0.12	<0.09	60	0.15
	66+200	<0.18	<0.06	85	<0.006	<0.01	<0.03	<0.02	4.7	14	0.051	<0.01	21	<0.030	0.09	<0.09	73	0.22
	Significance			NS					NS	NS	NS		NS		NS		NS	NS
	BLSD (5%)																	
Interact	ion																	
	Yard Waste x 1	Nitrogen																

.

Table 10. Effect of yard waste and nitrogen application on elemental composition of soil water collected at 3' from suction tubes - Sept. 11, 1992.

NS = not significant, \* = significant at 5%, \*\* = significant at 1%.

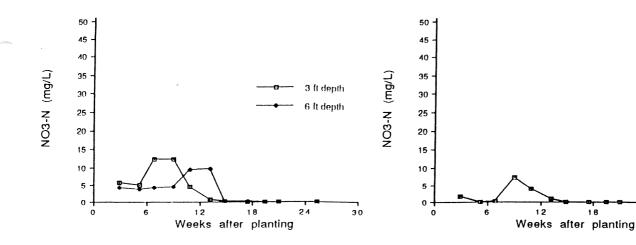


Figure 2. Nitrate-N concentration in soil water at 3 and 6 ft. depths over the 1992 growing season. Treatment 1: no leaves, no nitrogen applied.

Figure 3. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 2: 20 tons/A leaves, no nitrogen applied.

24

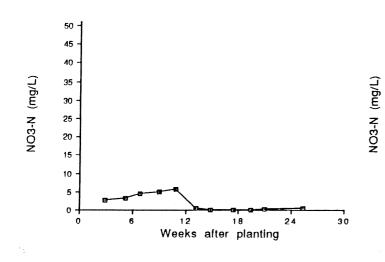


Figure 4. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 3: 40 tons/A leaves, no nitrogen applied.

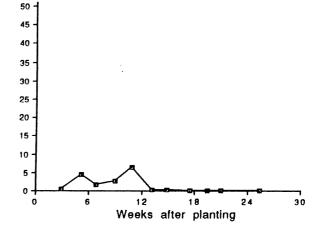
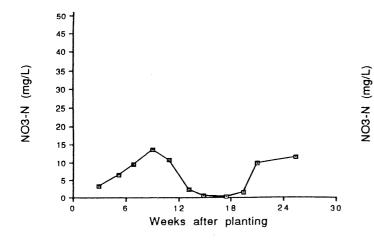


Figure 5. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 4: 80 tons/A leaves, no nitrogen applied.



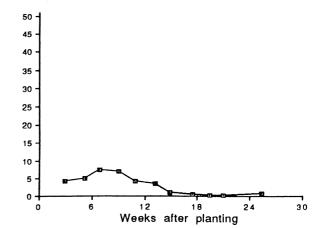


Figure 6. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 5: no leaves, 200 lbs/A nitrogen applied applied during the growing season.

Figure 7. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 6: 20 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.

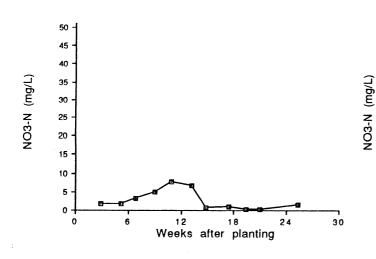


Figure 8. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 7: 40 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.

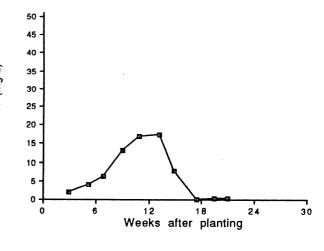
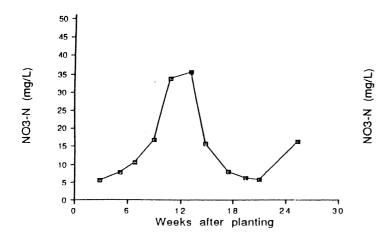


Figure 9. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 8: 80 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.



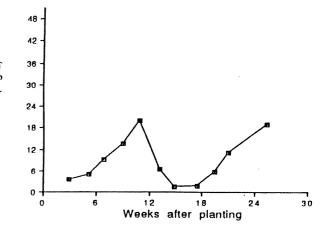


Figure 10. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 9: no leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

Figure 11. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 10: 20 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

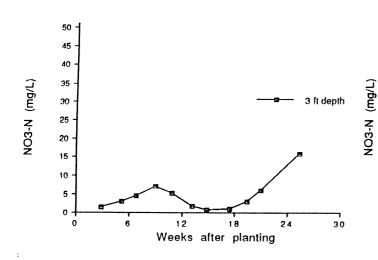


Figure 12: Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 11: 40 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

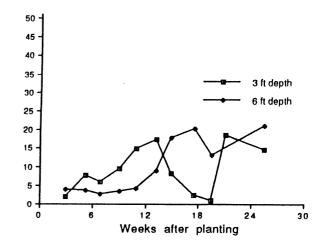


Figure 13: Nitrate-N concentration in soil water at 3 and 6 ft. depths over the 1992 growing season. Treatment 12: 80 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

# LAND SPREADING OF YARD WASTE

# **Final Report Submitted to the**

## **Legislative Commission on Minnesota Resources**

by

Department of Soil Science University of Minnesota

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### LAND SPREADING OF YARD WASTE

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ABSTRACT: A field experiment at the Sand Plain Research Farm in Becker. Minn. was conducted to determine the effects of land applying yard waste (primarily tree leaves) on corn production and soil nitrate movement. The yard waste was applied in the fall of 1991. Treatments included four rates of yard waste (0, 20, 40, and 80 T/A) with either no fertilizer N applied, 200 lbs N/A during the 1992 growing season, or 66 lbs N/A applied with the yard waste plus 200 lbs N/A applied during the growing season. Yard waste application initially inhibited growth and depressed tissue nitrogen composition of developing corn plants. The inhibitory effect diminished when fertilizer N was applied. These results suggest that soil N was immobilized for 5-6 weeks after planting. By harvest, corn grain yield increased with increasing yard waste application when no fertilizer N was applied, presumably due to release of nitrogen and possibly other nutrients from the yard waste. When N was added during the growing season, with or without fall applied N, the effect of yard waste on grain yield was generally not significant. Without added N fertilizer, yard waste increased N content of corn plant by about 1 lb N/A for each ton of yard waste applied up to 40 T/A. At the 80 T/A rate, N content increased by only 0.75 lb N/A for each ton of yard waste applied. Maturity, as measured by % moisture in the grain, was delayed with yard waste application. In addition to increasing tissue N, yard waste also increased tissue levels of P, K, Mg, and Zn. Nonessential heavy metals in corn tissue were generally below detection limits or not affected by yard waste application. Application of yard waste slightly increased soil pH and soluble salts. Extractable P, K, Ca, Mn, Zn and B also increased with yard waste application. Availability of nonessential heavy metals were not affected by yard waste application. Nitrate leaching tended to decrease with increasing yard waste during the first year after application. Highest nitrate-N concentrations in soil water at the three foot depth were recorded when N was applied in the fall with or without yard waste. During the first year after yard waste application, acceptable yields were obtained at all rates of applied vard waste combined with 200 lb N/A without significant nitrate losses. This study needs to be continued to determine nitrogen release rates from vard waste in subsequent years.

Rationale and Objectives: Until recently, yard wastes (tree leaves and grass clippings) accounted for 15-20% of the bulk in landfills. In 1990 (metro counties) and in 1992 (greater Minnesota), regulations were passed that prohibited dumping of yard wastes in landfills. Because of this legislation, alternatives to landfilling yard waste need immediate attention. Some options for using or recycling the yard waste include: 1) backyard composting and application of the compost to gardens; 2) municipal composting followed by land application of the compost; and 3) direct land application of noncomposted yard waste. While backyard composting is a desirable way to handle yard waste, not all homeowners desire to compost their own yard waste. Several problems with municipal yard waste composting include finding an acceptable site, controlling nutrient runoff, and controlling odors. Direct land application of noncomposted vard waste may be more efficient than composting and does not have the same problems associated with composting. Land application of yard waste may require an adjustment of nitrogen requirements, because of its generally low available nitrogen content. In addition, the effects on nitrogen use and crop production in general need to be ascertained. Therefore, the objectives of this study were to: 1) Determine the effects of direct application and incorporation of noncomposted yard waste (primarily tree leaves), with and without fertilizer nitrogen, on productivity of irrigated field corn, and 2) Characterize nitrogen release from the leaves during the growing in terms of availability for crop needs and movement through the soil profile.

<u>Review of Literature</u>: Many waste materials are currently being considered for land application including sewage sludge, food wastes, paper and yard wastes (Rynk, 1992). Direct land application is often less costly than composting because it involves less handling of materials and often has lower siting and regulatory costs. Major considerations for land application of waste include nutrient content and availability of the waste, nutrient needs of the crop, timing of waste application, and environmental degradation due to high trace metal content. The composition of yard waste is dependent on the time of the year. In the fall and early spring yard waste is primarily leaves with some grass clippings. In the summer, yard waste primarily consists of grass clippings. Yard waste high in grass clippings will have higher available nitrogen than yard waste high in tree leaves. The C/N ratio of tree leaves is between 40-80, while the C/N for grass clippings is 20 (Rosen et al., 1990).

Only a few studies have been reported that critically examine the effects of yard waste applications on crop growth and the environment. Many of the early studies using noncomposted waste tested municipal refuse and sewage sludge (King et al., 1974; Volk et al., 1973; Webber, 1978). While organic matter increased with addition of these materials, problems of incorporation, odor, aesthetics (Webber, 1978), and plant toxicity (King, et al. 1974) were reported.

Direct land application of yard waste is not hampered by the problems encountered with municipal refuse. The leaves are degradable and unsitely residues would not be present. Based on cost estimates, running a yard waste land application program is less than a full scale composting operation (Hgberg et al., 1990). States that have conducted exportiments with land application of yard waste include Nev Tork (Nally,

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1989), Minnesota (Buchite, 1990), and Wisconsin (Peterson, 1991). Land application of grass clippings has also been reported in Pennsylvania (Biocycle, 1991). All studies reported that metal levels in crop tissue were not affected by yard waste application. Peterson (1991) reported that corn yield was not consistently affected by yard waste amendment the year of application; however, a 30-50 bushel increase due to yard waste was measured in subsequent years. The yard waste increased available phosphorus and increased soil organic matter content. In New York, yard waste applications at high rates (40 tons/A wet weight) were shown to decrease yield if insufficient nitrogen fertilizer was supplied (Nally, 1989). Increasing nitrogen application rate was necessary to maintain corn yields in a Minnesota study (Buchite, 1990). In that study, application rates greater than 20 T/A required multiple tillage operations to obtain adequate incorporation. None of the studies reported qualitatively how much nitrogen could be expected to be released from the yard waste applications.

#### PROCEDURES

The experiment was conducted at the Sand Plain Research Farm in Becker, MN on a Hubbard loamy sand soil. Initial soil chemical characteristics include (0-6"): organic matter, 1.7%; pH (1:1 soil:water), 6.8; Bray P1, 26 ppm; K (NH<sub>2</sub>OAc), 61 ppm. Extractable (KCI) nitrate-N and ammonium-N in the top 3 feet were 30 lbs/A and 4 Ibs/A, respectively. The previous crop was rye. Yard waste was collected in October 1991 and applied to 15' x 35' plots with a front end loader on October 31, 1991. The yard waste primarily consisted of tree leaves, although some garden plants and grass clippings were also present. Subsamples of yard waste applied to each plot were collected for the following chemical analyses: moisture, pH (1:1, water), C and S (dry combustion), N (Kjeldahl) and, P, K, Ca, Mg, Na, Al, B, Cr, Cu, Fe, Pb, Mn, Ni, and Zn (dry ashed, Munter and Grande, 1981). Twelve treatments were tested: 0, 20, 40, 80 dry tons/A yard waste (no added N); these same treatments with 200 lb N/A applied during 1992; these same treatments with 66 lb N/A applied in the fall of 1991 plus 200 Ib N/A applied during 1992. The fertilizer N source used in all cases was urea. An average of 30% moisture was assumed for application of all yard waste treatments. The experimental design was a randomized complete block with 4 replications. Yard waste was incorporated to a depth of 8 inches with a rototiller after application (fall 1991) and the whole field was moldboard plowed to a depth of 8-10 inches one week prior to planting in 1992. In addition, 235 lbs/A 0-0-22 and 200 lbs/A 0-0-60 were broadcast and incorporated prior to planting. Pioneer hybrid 3751 (100 day maturity) was planted on April 28, 1992 at a population of 30,700 seeds/A (2.5 ft. between rows). At planting, 185 lbs/A 0-14-42 was banded 2 inches to the side and two inches below the seed. For the N treated plots, 100 lbs N/A was sidedressed on May 27, with a hand pushed Gandy fertilizer applicator and cultivated in. Additional N at a rate of 50 lbs/A per application was applied with the Gandy applicator on June 17 and June 22 and irrigated in with 0.5 inch of water. Irrigation was used to supplement rainfall (Figure 1).

Soil samples at the 0-8 inch depth were collected from each plot before planting. After harvest, soil samples were collected from 0-6, 6-12, 12-24 and 24-36 inch depths. Soil nitrate and ammonium were determined on 2 N KCl extracts (Carlson et al., 1990). On the 0-6 inch sample additional soil chemical determinations were made: pH and soluble salts (1:1, water), P (Bray P-1); K, Ca, Mg, Na (1N ammonium acetate), Fe, Mn, Zn, Cu, Pb, Ni, Cr, and Cd (DTPA); and B (hot water). Detailed methodolgy for soil extraction procedures can be found in Rosen and Munter (1992).

Suction tubes with ceramic cups were installed at a depth of 3 feet in two replications of each treatment. Suction tubes at the 6 foot depth were installed in two reps for the control and 40 T/A yard waste plus 266 lbs of N treatments. Water samples were collected every two weeks through the growing seascn and analyzed for nitrate. On one set of water samples (September 11), a more extensive elemental analysis was performed using an ICP spectrophotometer (Munter and Grande, 1981).

Whole plant samples (4 per plot) were collected at the three leaf stage (May 26) before fertilizer N was applied in 1992. Whole plant samples (4 per plot) at the 8-12 leaf stage were collected on June 26 after all fertilizer N was applied. Ear leaf samples at 50% silking were collected on July 28. Two, 20 foot rows were harvested for grain and stover yield from each plot on October 10. Subsamples of stover and grain plus cob were taken for moisture determinations, shelling percentages, and nitrogen analyses. Plant tissue samples were dried and then ground through a 30 mesh screen. Dried samples were digested in concentrated sulfuric acid and Kjeldahl nitrogen was determined using conductimetric procedures (Carlson, 1978).

### <u>RESULTS</u>

<u>Yard Waste Elemental Composition</u>: The yard waste had an acid pH (Table 1). The average moisture content was 30% with a range of 18.6 - 48.1%. The outer part of the pile tended to be drier than the inner part. The C/N ratio averaged 37.8:1, which is on the low side for leaves, but is in a range that should initially immobilize N. The yard waste contained 21.2 lbs N/dry ton, 3.2 lbs P/dry ton (7.4 lbs  $P_2O_5$ ), and 14.4 lbs K/dry ton (17.3 lbs  $K_2O$ ). The yard waste contained significant quantities of Ca, Mg and S. Trace elements were also present in the yard waste, but were not at levels considered to be detrimental to the environment.

<u>Corn Growth and Yield</u>: Initial growth of corn was significantly inhibited as yard waste application rate increased (Table 2). Application of N tended to minimize the negative effect of yard waste application on initial corn growth. Greatest growth at the 8-12 leaf stage occurred when N was applied in the Fall and during the growing season. Yard waste application rate up to 40 T/A tended to increase final stand count. At the 80 T/A rate, stand count declined. Stand count also increased with increasing fertilizer N rate. At harvest, increasing yard waste rates increased grain yield when no N was applied, indicating a significant release of N from the yard waste. However, when N was added during the growing season with or without fall applied N, the effect of ward waste on

grain yield was generally not significant. There was a slight decrease in grain yield at the highest yard waste rate and when fall N plus 200 lb N/A was applied. Stover yield increased with increasing yard waste application and fertilizer N rate. Yard waste and low fertilizer N tended to delay maturity as measured by higher kernel moisture percentage.

Tissue Nitrogen Concentrations and Total Nitrogen Uptake: Nitrogen concentrations in whole plants sampled at the 3 leaf stage decreased as yard waste application increased (Table 3). These results indicate that early in the season N was immobilized by the yard waste. Fall applied N significantly increased N concentrations in the plant. By the 8-12 leaf stage, yard waste application was beginning to have a positive effect on N concentrations in the plant, while the effect of fall application of N began to diminish. Ear leaf N increased with increasing yard waste application when no fertilizer N was applied, but was not affected by yard waste when fertilizer N was applied. Application of fertilizer N increased N concentrations in the ear leaf. Cob N concentrations were not affected by yard waste application and were not consistently affected by fertilizer N application (Table 4). Stover N concentrations tended to increase with increasing yard waste application, primarily when no fertilizer N was applied. Application of fertilizer N also increased N concentrations in the stover. Kernel N increased with increasing application of yard waste and increasing fertilizer N application. As with other tissues, the effect of yard waste was most pronounced when fertilizer N was not applied.

Dry matter production increased with increasing yard waste rate up to the 40 T/A rate and then decreased even when fertilizer was applied; however, without inorganic N fertilizer, dry matter increased linearly with increasing yard waste application (Table 4). Applied N nearly doubled dry matter production; however, fall applied N did not significantly increase dry matter production compared to lower rates applied during the season. Similarly, without added N fertilizer, yard waste increased N content of corn plant by about 1 lb N/A for each ton of yard waste applied up to 40 T/A. At the 80 T/A rate, N content increased by only 0.75 lb N/A for each ton of yard waste rate. Given the growing conditions in 1992, the nitrogen rate used could probably have been lowered to take better advantage of N mineralized from the yard waste. As expected, N uptake increased with increasing N rate.

<u>Tissue Elemental Concentrations</u>: Concentrations of elements (except N) in kernel, stover, and cob are presented in Tables 5, 6, and 7, respectively. Yard waste application significantly increased kernel P, K, Mg, B, Mn, and Zn, and decreased kernel Cu. Concentrations of Cd, Pb, Ni, Cr, Al, Fe, and Mo were either below detection limits or not affected by yard waste application. Increasing N rate decreased kernel K, Mg, Ca, P and Zn, and increased Fe and Mn. Increasing K concentrations in kernels were greater with yard waste than with N fertilizer, resulting in a significant interaction. Increases in kernel Mn with yard waste application were greater at low N rates compared to the higher N rates.

Yard waste application increased stover K and decreased stover Ca. Increases in stover Zn and P with yard waste were dependent on N application, with greatest increases occurring at the low N rates. Decreases in stover Al, Fe, and Mg with yard waste were also dependent on N application. with greatest decreases occurring at the low N rates. Stover Mo decreased with increasing N rate, but was not consistently affected by yard waste application. Concentrations of Cd, Ni, and Pb were below detection limits. Stover B, Na, Cr, and Cu were not affected by yard waste application and inconsistently affected by N application.

Yard waste application increased cob Mn, P. and Zn. Concentrations of Cu in cobs also increased with yard waste application, but increases were dependent on N applied. Greater increases in cob Cu with yard waste occurred at the lower N rates. Cob K decreased with yard waste application. Cob Ca and Mg also decreased with yard waste application, but decreases were more pronounced at the lower N rates. Concentrations of Al, B, and Fe were not affected by yard waste application. While cob Cd, Cr, Mo, Na, Ni, and Pb were generally below detection limits.

<u>Soil Nitrate-Nitrogen Content</u>: Soil nitrate-nitrogen increased with increasing yard waste application in the top 6 inches. but was not significantly affected by yard waste at the lower depths (Table 8). Soil nitrate-nitrogen increased with increasing fertilizer N application, with the fall applied N treatment having the highest residual N in the top 3 feet. It is interesting to note, however, that the initial soil nitrate-N content of 30 lbs/A was higher than the soil nitrate-N content following any of the fertilizer N and/or yard waste treatments.

<u>Soil Chemical Properties</u>: Effect of yard waste and nitrogen application on soil pH, Bray P1, ammonium acetate extractable cations, DTPA extractable microelements, and hot water extractable B in the top 6 inches after harvest are presented in Table 9. Soil pH slightly increased with yard waste application (6.9 to 7.2) and slightly decreased with N application. Soluble salts increased with both yard waste and N application; however, levels were not in a range that would toxicity problems. Extractable P, K, Ca, Zn and B increased with increasing yard waste application, but were not affected by N application. Extractable Mn increased with increasing yard waste and N application rates. Extractable Mg, Na, Fe, Cu, Pb, and Ni were not affected by yard waste application, extractable Na, Fe, Cu, and Ni increased with increasing N application. Extractable Cd and Cr were generally below detection limits.

Soil Water Elemental Concentrations: Elemental concentrations in soil water sampled on September 11 are presented in Table 10. Al, B, Cd, Cr, Cu, Fe, Mo, Ni, and Pb were generally below detection limits of the ICP. Ca, K, Na, and S tended to increase with increasing yard waste application. P concentrations tended to increase with increasing yard waste when no fertilizer N was applied, but was not consistently affected when fertilizer N was applied. Except for soil water nitrate (see below), other elements determined in soil water were not affected by yard waste application or fertilizer N.

Soil Water Nitrate Concentrations: Concentrations of nitrate-N in soil water as affected by treatments are presented in Figures 2-13. Yard waste applications tended to decrease nitrate concentrations in soil water at the three foot depth when fertilizer N was not applied. The control treatment had the highest water nitrate-N concentrations with levels slightly above 10 ppm. When yard waste was applied, nitrate-N concentrations were less than 10 ppm. When fertilizer N was applied during the season, nitrate-N concentrations in soil water at the three foot depth tended to be highest at mid-season when 80 T/A yard waste was applied. However, by the end of the season, the 0 yard waste treatment with fertilizer N had the highest nitrate concentrations. Nitrate-N concentrations in soil water were greatest when fertilizer N was applied in the fall. Highest concentrations at mid-season were recorded when 0 T/A leaves were applied. Yard waste application tended to decrease nitrate-N concentrations; however, compared to the other N treatments, fall applied N resulted in the highest losses at the end of the growing season. From these measurements, yard waste amendments appear to reduce nitrate-N losses during the first growing season after application.

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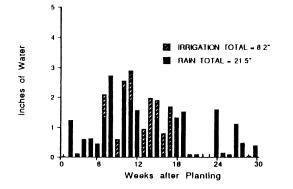
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Figure 1. Rainfall and irrigation provided over the 1992 growing season.

Table 1. Elemental concentrations of original yard waste sample	Table 1.	Elemental	concentrations	of	original	yard	waste	samples
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	Mean	Standard Deviation	Minimum	Maximum	
рH	4.9	0.2	4.4	5.5	-
<pre>% moisture</pre>	29.7	7.7	18.6	48.6	
C to N ratio	37.9	3.2	29.6	42.6	lbs element/ dry ton
Macroelements (%)					
Carbon	39.76	3.49	33.56	45.95	795.2
Nitrogen	1.06	0.12	0.81	1.46	21.2
Phosphorus	0.16	0.02	0.12	0.20	3.2
Potassium	0.72	0.14	0.47	1.16	14.4
Calcium	2.33	0.25	1.75	2.75	46.6
Magnesium	0.37	0.04	0.27	0.49	7.4
Sulfur	0.19	0.02	0.15	0.22	3.8
Microelements (pp	(m				
Aluminum	1052	464	254	1960	2.1
Boron	65	9	48	97	0.13
Cadmium	<0.52	0.35	<0.16	1.30	<0.10
Chromium	7.5	3.5	1.6	14.4	0.015
Copper	8.4	1,2	5.6	10.7	0.016
Iron	969	334	359	1755	1.9
Lead	<15.5	7.7	<2.2	39.6	<0.031
Manganese	249	40	177	399	0.50
Nickel	<6.5	3.3	<0.9	13.4	0.013
Sodium	105	23	60	163.	0.21
Zinc	61	9	40	85	0.12

Table 2. E	ffect of yard	waste and nit	ogen application on	whole plant dry matter
a	t the 8-12 le	af stage, final	stand count, grain	yield, and kernel
m	oisture.			

Yard		Whole plant	Final		
waste	Nitrogen	dry matter	stand	Grain	Kernel
rate	application	(8-12 leaf)	count	yield	moisture
tons/A-	lbs/A	-grams/plant-	-plants/A-	-bu/A-	- * -
0	0	16.0	26463	76	36
20	0	5.5	26789	99	39
40	0	8.8	28532	124	38
80	0	6.0	26681	130	36
0	200	21.8	27770	188	29
20	200	12.5	27334	185	34
40	200	9.3	27770	188	35
80	200	10.5	27770	182	35
0	66+200	29.3	27660	195	31
20	66+200	25.5	28859	203	30
40	66+200	15.0	28859	195	35
80	66+200	13.0	27661	176	34
ignifica	nce	**	NS	**	**
LSD (5%		9.3		20	3
		- י רי	77798	153	20
	0	22.3	27298	153	32
	20	14.5	27661	162	34
	40	11.0	28387	169	36
	80	9.8	27370	162	35 **
	Significance	**	NS	NS	
	BLSD (5%)	5.3			2 **
	Linear	**	NS *	NS *	**
	Quadratic	•	•	•	
	Nitrogen Applic	ation			
	0	9.0	27116	107	37
	200	13.5	27661	186	33
	66+200	20.8	28260	192	32
	Significance	**	*	**	**
	BLSD (5%)	4.3	892	10	2
nteracti					
nceracti	011				
	Yard Waste x Ni	trogen NS	NS	**	•

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

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	Nite				1					
rate application	Cob	Stover Gra	Grain	Сор	Stover	r Grain	Total	Сор	Stover Grain	Grain
-tons/A1bs/A		- % Nitrogen -			To	Ton/A		-		lb N/A -
	0.31		0.92	0.20	1.25	2.13	3.58	1.2		39.1
	0.29	0.42	1.01	0.28	1.33	2.76	4.41	1.6	11.5	55.9
0	0.28	0.47	1.12	0.39	1.69	3.48	5.56	2.2	15.9	77.7
	0.27	0.52	1.24	0.39	1.86	3.64	5.89	2.1	19.5	90.2
	0.25	0.53	1.26	0.61	2.48	5.26	8.35	3.0	27.1	133.8
	0.26	0.58	1.29	0.55	3.06	5.18	8.79	2.9	36.6	13
	0.24	0.61	1.35	0.62	3.05	5.28	8.95	3.0	37.6	142.8
200	0.26	0.60	1.37	0.63	3.17	5.08	8.88	3.2	38.4	13
0 66+200	0.26	0.57	1.35	0.64	2.92	5.46	9.01	3.2	33.6	146.8
	0.26	0.65	1.38	0.65	3.01	5.69	9.34	3.4	38.8	157.3
	0.26	0.63	1.41	0.68	3.15	5.47	9.30	3.6	40.0	153.8
	0.27	0.55	1.41	0.61	2.95	4.92	8.48	ບ. ເມ	33.1	139.0
Significance	**	* *	:	:	:	:	:	:	:	**
(5%)	0.03	0.12	0.09	0.09	0.50	0.57	1.04	0.5	9.7	17.1
Main effects										
Yard Waste Rate										
0	0.27	0.49	1.18	0.48	2.22	4.28	6.98	2.5	23.4	10
20	0.27	0.55	1.23	0.49	2.48	4.54	7.52	2.6	28.9	115.8
40	0.26	0.57	1.29	0.57	2.63	4.74	7.94	2.9	31.2	124.7
80	0.26	0.56	1.34	0.54	2.66	4.55	7.75	2.9	30.3	122.9
Significance	SN	SN	:	٠	٠	NS	•	٠	٠	:
BLSD (5%)	;	;	0.05	0.06	0.34	:	0.72	0.3	6.6	11.2
Linear	SN	SN	* *	+	:	SN	*.	**	٠	**
Quadratic	NS	NS	NS	NS	NS	٠	٠	NS	NS	
Nitrogen Application										
0	0.29	0.45	1.07	0.32	1.54	3.00	4.86	1.8	14.1	65.7
200	0.25	0.58	1.32	0.60	2.94	5.20	8.74	з.0	34.9	137.6
66+200	0.26	0.60	1.39	0.64	3.00	5.39	9.03	3.4	36.4	149.2
Significance	**	**	**	;	**	**	;	:	:	:
BLSD (5%)	0.01	0.05	0.04	0.05	0.24	0.28	0.51	0.2	4.6	8.5
Interaction										
Yard Waste x Nitrogen	SN	NS	٠	SN	SN	:	*	SN	SN	:

Table 3. Effect of yard waste and nitrogen application on nitrogen concentrations in corn tissues at various growth stages.

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Yard		Whole plant N	Whole plant N	Ear leaf N
waste	Nitrogen	3 leaf	8-12 leaf	silking
rate	application	stage	stage	stage
-tons/A-	lbs/A		% Nitrogen	
0	0	4.19	1.74	1.34
20	0	3.19	2.49	1.97
40	0	3.03	2.57	2.05
80	0	2.80	3.00	2.31
0	200	4.21	3.14	2.89
20	200	3.20	3.80	2.94
40	200	3.16	3.96	2.68
80	200	3.19	3.71	3.04
0	66+200	4.32	3.08	3.00
20	66+200	4.39	3.30	2.51
40	66+200	4.10	3.57	2.95
80	66+200	3.60	3.66	2.94
Significa		**	**	**
BLSD (5%	)	0.72	0.40	0.76
<u>Main effe</u>	<u>cts</u> Yard Waste Rate			
	0	4.24	2.66	2.35
	20	3.59	3.20	2.47
	40	3.43	3.36	2.56
	80	3.20	3.46	2.76
	Significance	**	**	NS
	BLSD (5%)	0.39	0.23	
	Linear	**	**	NS
	Quadratic	*	**	NS
	Nitrogen Applic	ation		
	0	3.30	2.45	1.92
	200	3.44	3.65	2.89
	66+200	4.10	3.40	2.84
	Significance	**	**	**
	BLSD (5%)	0.34	0.19	0.33
Interacti	on			

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

Cr.		20 80 Signific BLSD Main eff	rate app -tons/A :20 40 40 20 20 40 80 60 60 60 6	NS = not Table 5 Yard was	Interac		Main ef	0 20 40 80 20 20 40 80 80 80 80 80 80 80 80 80 80 80 80 80	Yard waste rate a
Yard Waste x N; significant, *	Significance BLSD (5%) Linear Quadratic Nitrogen Appl 0 200 200 66+200 Significance BLSD (5%)	0) 66+200 66+200 (ficance (5%) <u>effects</u> <u>vard Waste Rate</u> 20 40	application 1bs/Å 0 0 200 200 200 200 200 66+200	ignificant, Sffect of y	<u>tion</u> Yard Waste x I	0 200 66+200 Significance BLSD (5%)	effects Yard Waste Rate 0 209 20 135 40 123 80 114 Significance ** BLSD (5%) 31 Linear ** Quadratic ** Nitrogen Application		ste Nitrogen application lbs/A
NS NS			4 0 4 4 6 0 4 4 6 I	٤	Nitrogen	192 120 123 **	Rate 209 135 123 114 ** 31 **	334 169 119 120 120 120 101 117 117 117 117 115 115 125 125 125 125 125	P
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SN	** ** NS 1224 1168 1195 39	1163 1215 1252 ** 76 1116 11116 11193 1213	Mg 1142 1229 1226 1299 1057 1185 1200 1231 1148	of kernels	*	56 2359 84 1554 24 1552 24 1592 ** 111		33         2350           59         2534           27         2073           58         2073           58         2073           51         1461           51         1451           53         151           23         1436           23         151           23         151           23         151           23         151           23         151           23         151           23         151           24         27           27         1428           27         1428           27         1428           28         255	C Mg
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1	<pre>&lt; &lt;0 &lt; 2 &lt; &lt;</pre>	<pre>&lt;0.39 </pre> <pre>&lt;0.34 </pre> <pre>&lt;0.34 </pre> <pre><pre><pre><pre><pre><pre><pre><pre></pre></pre></pre></pre></pre></pre></pre></pre>	MO <0.41 <0.35 <0.39 <0.39 <0.39 <0.32 <0.30 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.32 <0.33 <0.42 <0.42 <0.35 <0.42 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35 <0.35	harvest	S	25.8 27.0 25.3 NS	223. 23. 4. 23. 4. 23. 23. 23. 23. 23. 23. 23. 24. 24. 24. 24. 24. 24. 24. 24. 24. 24	220.7 220.7 222.2 222.9 222.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 227.2 22.2 22.2 22.2 22.2 20.7 22.2 20.7 22.2 20.7 22.2 20.7 22.2 20.7 22.2 20.7 22.2 20.7 22.2 22.2	£
				1	*	1.49 1.07 1.00 ** 0.12	1.06 1.28 1.30 1.11 1.11 1.11 1.11 1.11 1.11 1.11	1.17 1.83 1.83 1.24 0.99 1.12 1.06 1.12 1.06 1.11 1.00 0.88 0.88 0.88 0.25	Mo
1				() H	NS	29.7 29.7 33.3 * 2.8	31.8 30.8 NS NS NS	32.7 227.4 29.6 29.6 29.6 227.0 227.0 227.0 227.0 233.1 235.5 30.4 30.4 30.4 30.4 30.4 30.4 30.4 30.4	Na
;	<ul> <li><ul> <li><ul< td=""><td><ul> <li>&lt;0.63</li> <li>&lt;0.47</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;18</li> <li>&lt;18</li> <li>&lt;19</li> <li>&lt;10.48</li> <li>&lt;10.48<!--</td--><td>N1 N1 N1 N1 N1 N1 N1 N1 N1 N1</td><td>10, 1992</td><td>;</td><td>&lt;1.00 &lt;1.04 &lt;1.07 </td><td>&lt;1.12 &lt;1.00 &lt;0.99</td><td><pre>&lt;1.20 &lt;0.93 &lt;0.94 &lt;1.03 &lt;1.03 &lt;1.03 &lt;1.05 &lt;1.05 &lt;1.05 &lt;1.02 &lt;</pre></td><td>Ni</td></li></ul></td></ul<></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul></li></ul>	<ul> <li>&lt;0.63</li> <li>&lt;0.47</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;17</li> <li>&lt;18</li> <li>&lt;18</li> <li>&lt;19</li> <li>&lt;10.48</li> <li>&lt;10.48<!--</td--><td>N1 N1 N1 N1 N1 N1 N1 N1 N1 N1</td><td>10, 1992</td><td>;</td><td>&lt;1.00 &lt;1.04 &lt;1.07 </td><td>&lt;1.12 &lt;1.00 &lt;0.99</td><td><pre>&lt;1.20 &lt;0.93 &lt;0.94 &lt;1.03 &lt;1.03 &lt;1.03 &lt;1.05 &lt;1.05 &lt;1.05 &lt;1.02 &lt;</pre></td><td>Ni</td></li></ul>	N1 N1 N1 N1 N1 N1 N1 N1 N1 N1	10, 1992	;	<1.00 <1.04 <1.07 	<1.12 <1.00 <0.99	<pre>&lt;1.20 &lt;0.93 &lt;0.94 &lt;1.03 &lt;1.03 &lt;1.03 &lt;1.05 &lt;1.05 &lt;1.05 &lt;1.02 &lt;</pre>	Ni
SN			P 3409 34409 34409 3642 2627 3627 3280 3464 3529 35295	N.	:	) 2777 949 838 ** 241	2 2 2 2 2 1 2 1 2 4 5 5 2 4 5 7 5 2 4 5 7 5 7 5 7 7 5 7 7 5 7 7 5 7 7 5 7 7 5 7 7 5 8 3 12 4 65 5 7 7 5 8 7 7 5 8 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 7 5 5 8 9 12 4 65 5 7 5 7 5 7 5 7 5 7 5 7 5 7 5 7 5 7	1370 3014 33405 33405 460 1265 5985 5985 5985 5985 5985 5985 5985 59	
:	<1.7 <1.7 <1.7 	<pre>&lt;1.7 &lt;1.7 &lt;1.7 &lt;1.7 &lt;1.7 &lt;1.7 &lt;1.7 &lt;1.7</pre>	PD		:	1 8 <3.0 	ουυσκα ΑΑΑΑ ΑΑΑΑΑ ΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑΑ	۵ 4 4 0 0 0 4 4 0 8 8 4 4 0 0 5 4 4 0 ۵ 8 9 4 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 4 5 8 5 7 8 5 8 5 8 5 8 5 8 5 8 5 8 5 8 5	
SN	1420 <b>* *</b> + <b>*</b>	117 119 2 * 8 119 12 12 12 12 12 12 12 12 12 12 12 12 12	Zn 17 20 20 20 19 19	7	\$ *		* * * * * 2 ¥ ¥ * * * * 2 ¥ ¥ * * * * 5 3 9 0		ł

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Table

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rate application	Al	œ	Ca	Cd	ç	5	Fe	ĸ	Mg	ł	Mo	Na	Ni	טי	Pb	5
0 0	σ	з. 1	128	<0.12	0.49	1.85	11	16116	281	з.2	0.26	<3.8	<0.44	423	<1.7	29
.20 0	u	3.4	56	<0.12	0.44	2.40	9	12921	211	ω	0.30	<3.6	<0.45	668	<1.7	44
	u	2.9	ភូ	<0.12	0.44	2.78	11	10266	143	3.0	<0.25	<b>^</b> 3.6	<0.44	779	<1.7	43
	σ	2.6	54	<0.13	0.40	2.71	89	9127	169	ա .Մ	<0.24	<b>^</b> 3.6	<0.45	813	<1.7	44
	7	2.0	58	<0.13	0.41	2.29	10	9869	115	2.4	<0.24	<3.6	<0.69	218	<1.7	, Andrew
20 200	σ	2.3	51	<0.12	<0.32	2.29	8	6482	95	2.8	<0.24	<3.6	<0.44	338	<1.7	ч
	M	2.1	45	<0.12	0.36	2.32	7	5781	93	2.6	<0.24	<b>^</b> 3.6	<0.44	423	<1.7	15
	6	2.2	51	<0.12	0.38	2.46	11	6154	105	3.0	<0.22	<3.6	<0.44	466	<1.7	19
66	σ	2.0	41	<0.12	<0.32	2.17	10	6297	113	2.3	<0.23	<3.6	<0.48	232	<1.7	89
	л	2.1	42	<0.12	<0.31	2.02	7	5897	108	2.5	<0.23	<3.6	<0.44	282	<1.7	12
40 66+200	υ	2.1	48	<0.12	0.45	2.27	80	5225	105	2.6	<0.23	<6.1	<0.44	353	<1.7	14
80 66+200	6	2.2	51	<0.12	0.46	2.43	8	6135	122	3.0	<0.23	<3.6	<0.44	531	<1.7	20
Significance	SN	**	:	;	1	;	NS	:	:	**	;	;	!	**	;	**
BLSD (5%)	1	0.4	25	!	;	0.41	;	1574	43	0.4	8	;	;	94	;	7
Malli ellects Vard Waste	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1															
0	თ	2.4	76	<0.12	<0.41	2.10	10	0086	170	2.6	<0.24	<3.7	<0.54	291	<1.7	15
20	თ	2.6	62	<0.12	<0.36	2.24	80	8433	138	2.8	<0.26	<3.6	<0.44	429	<1.7	24
40	v	2.3	49	<0.12	<0.42	2.46	9	7091	114	2.7	<0.24	<4.4	<0.44	518	<1.7	24
08	u	2.3	52	<0.12	<0.41	2.53	9	7138	132	3.2	<0.23	<3.6	<0.44	603	<1.7	28
Significanc		SN	*	1 t	;	:	SN	:	:	:	;	;	;	*	1	:
BLSD (5%)		;	15	;	-	0.22	1	556	26	0.3	;	;	;	54	1	4
Linear		NS	*	!	:	:	NS	:	٠	:	;	ł	;	:	;	:
Quadratic	NS	NS	٠	;	;	NS	NS	:	*	NS	!	;	;	:	1	٠
Nitrogen Application	1 Cation															
0	ບາ	з.0	82	<0.12	0.44	2.44	10	12107	201	3.2	<0.26	<3.6	<0.44	671	<1.7	40
200	σ	2.2	51	<0.12	<0.37	2.34	9	6354	102	2.7	<0.23	<3.6	<0.50	361	<1.7	14
66+200	σ	2.1	45	<0.12	<0.39	2.22	8	5889	212	2.6	<0.23	<4.2	<0.45	350	<1.7	14
Significance	7	**	*	;	!	NS	SN	* *	**	* *	:	;	!	:	ł	**
BLSD (5%)		0.2	12	•	:	1	ł	776	21	0.2	;	;	1	46	ł	L
nteraction																
Yard Waste x Nitrogen	Nitrogen															
	5									5						

Table 8.	Effect	of yard	waste	and ni	trogen	application	ons	soil nitrate-N	(lbs/A)	in the top	
	three f	eet at	the end	of th	e grow	ing season.					

Yard waste	e Nitrogen		Sampl	e depth (in	ches)	
rate	application	0 - 6	6 - 12	12 - 24	24 - 36	Total
-tons/A-	lbs/A		11	bs nitrate-	N/A	
0	0	0.78	0.74	0.75	0.72	2.98
20	0	1.24	0.99	0.94	0.64	3.81
40	0	1.90	1.54	1.47	0.67	5.58
80	0	2.96	2.53	1,36	1.12	7.97
0	200	2.35	2.34	1.67	0.74	7.09
20	200	4.22	3.78	2.24	1.22	11.46
40	200	5.30	4.10	2.63	1.25	13.28
80	200	6.34	3.76	2.10	0.79	12.99
0	66+200	2.73	3.29	1.54	1.18	8.74
20	66+200	7.98	9.50	6.82	3.14	27.44
40	66+200	7.96	6.69	2.93	1.42	18.99
80	66+200	9.20	5.10	3.31	2.19	19.80
Significan	ice	**	**	••	**	**
BLSD (5%)		3.41	4.62	2.Jh	1.24	10.80
Main effec	ts					
	Yard Waste Rate					
	0	1.95	2.12	1.32	0.88	6.27
	20	4.48	4.76	3.33	1.67	14.23
	40	5.05	4.11	2.34	1.11	12.61
	80	6.17	3.80	2.26	1.37	13.59
	Significance	**	NS	NS	NS	+
	BLSD (5%)	1.94				6.57
	Linear	**	NS	NS	NS	NS
	Ouadratic	NS	NS	NS	NS	NS

0	1.72	1.45	1.13	0.79	5.08
200	4.55	3.49	2.16	1.00	11.20
66+200	6.97	6.14	3.65	1.98	18.74
Significance	**	**	**	**	**
BLSD (5%)	1.57	1.93	1.28	0.54	4.78

Yard Waste x Nitrogen NS NS NS NS NS

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

<u>Yard Waste</u> NS = nonsi	<u>Nitrogen Appl</u> 0 200 66+200 Significance BLSD (0.05)	Main effects Yard Waste U 20 20 40 Significan Linear Quadrat	Treatment           Yard waste         Ni           rate         app           (T/A)         ()           20         40           40         20           40         20           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           20         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           80         66+2           81         50           82         50 <th>NS = not Table 9. E</th> <th>Interaction B S</th> <th></th>	NS = not Table 9. E	Interaction B S	
<u>inceración</u> <u>Yard Waste x Nitrogen</u> NS = nonsignificant, * =	<u>Nitrogen Application</u> 0 200 66+200 Significance BLSD (0.05)	<u>ain effects</u> <u>yard Waste Rate</u> 0 20 40 80 Significance Linear leaf Quadratic leaf	coelements. itrogen (1b N/A) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	μ + z	Nitrogen Application 0 <0.18 200 <0.18 66+200 <0.18 Significance BLSD (5%)	0 20 40 B0 Significance BLSD (5%) Linear Quadratic
NS signıf.	0 4 · 0 4 ·	NS * * 2 1 0 9	and hot pH 7.1 7.2 7.0 6.9 6.9 6.9 6.9 6.9 6.9 6.9 6.9 6.9 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.0 7.1 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2 7.2	Nitrogen 	<0.18 <0.18 <0.18 <0.18 <0.18 	~ ~ 0.18 ~ 0.18
NS NS NS significant at 5%, **	0.17 0.18 0.20 NS	0.11 0.11 0.18 0.26 ** **	<u>water</u> ext Saluble Salts (mmbos/cm) 0.10 0.20 0.21 0.15 0.12 0.17 0.17 0.17 0.17 0.17 0.13 0.25 0.13 0.25 0.12 0.25 0.12 0.25 0.25 0.25 0.25 0.25 0.25 0.25	rogen NS significant at 5%, ** = significant at li ste and nitrogen applications on soil pH,	<0.08 <0.15 	<0.06 <0.13 <0.13 <13
5*, **	2NN 23N 11 12 12	2 + + 4 6 N 9 N 5 + + 6 N 9 N	(tractal Bray 2 2 3 2 8 3 2 8 3 2 3 2 3 3 2 3 3 2 3 3 3 3	c s*,	- 16 NS 16	NS *
	105 114 120 NS	58 102 117 173 **	ble B K K              	sticati	<0.006 <0.006 <0.006 	<pre>&lt; 0.006 &lt; 0.006 </pre>
NS NS significant at	1017 11139 1147 	8 868 2 1116 7 11146 8 1275 8 NS	Image: NH Construction         Can           1         779           1         779           1         122           5         1080           5         1190           5         1129           5         1129           1         1177           7         11177           1         1143           3         1143           3         1143           1         1182           7         11177           1         1309           3         1143           3         1143           1         1182           7         1182           7         1182           7         1182           7         1182           7         1182           7         1182           1         1327           1         256	significant at stions on soil p	<0.01 <0.01 <0.01 	<pre>&lt;0.01 </pre>
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SN	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.4 0.4 NS	DTPPA Extractable Cu Pb Ni 0.3 0.8 0. 0.4 0.9 0. 0.4 1.1 0.	NS	<0.01 <0.01 <0.01 	<0.01 <0.01 <0.01  
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			·	К	0.15 0.22 NS	0.18 0.23 0.15 0.16 NS NS NS

Yard waste Nitrogen rate application Table 10. Effect of yard waste and nitrogen application g elem ental composition Pf. soil water collected ar 3' from suction tubes -. Sept. 11, 1992.

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Main effects

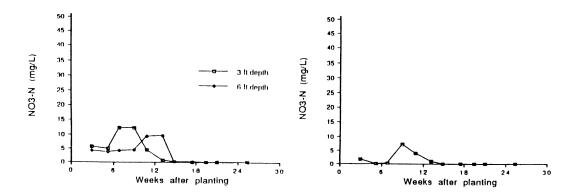
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Yard Waste

Rate

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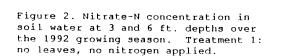


Figure 3. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 2: 20 tons/A leaves, no nitrogen applied.

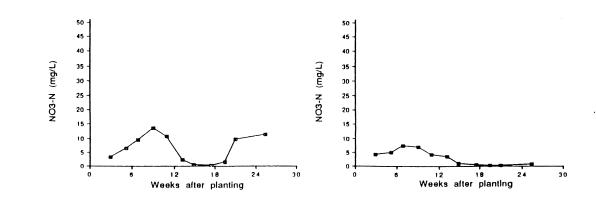


Figure 6. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 5: no leaves, 200 lbs/A nitrogen applied applied during the growing season.

Figure 7. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 6: 20 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.

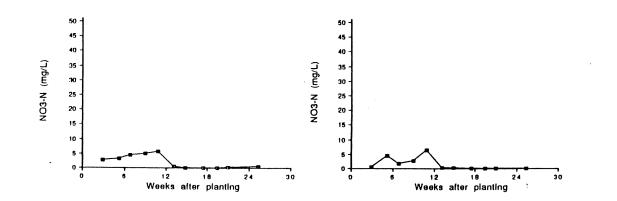


Figure 4. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 3: 40 tons/A leaves, no nitrogen applied.

Figure 5. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 4: 80 tons/A leaves, no nitrogen applied.

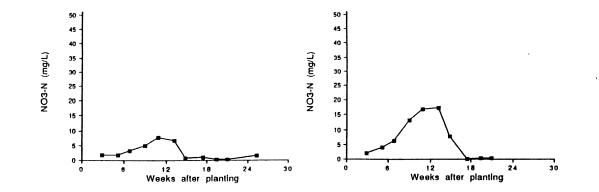


Figure 8. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 7: 40 tons/A leaves, 200 lbs/A nitrogen applied during t prowing season. Figure 9. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 8: 80 tons/A leaves, 200 lb-'A nitrogen applied during the grow' season.

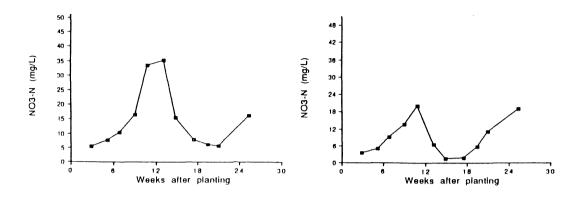


Figure 10. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 9: no leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

Figure 11. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 10: 20 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

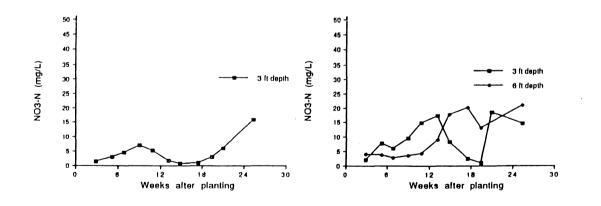


Figure 12: Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 11: 40 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

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Figure 13: Nitrate-N concentration in soil water at 3 and 6 ft. depths over the 1992 growing season. Treatment 12: 80 tons/A leaves, 66 lbs/A introgen fall applied and 200 lbs/A applied during the growing season.

#### June 30, 1993 LCMR Final Report

#### I. Title: Land Spreading of Yard Waste - Waste 12(b)

Program Manager: Thomas R. Halbach 439 Borlaug Hall Soil Science Department University of Minnesota St. Paul, MN 55108 (612) 625-3135

A.M.L. 1991. Ch.254, Art.1 Sec.14 Subd.12(b)

Appropriation: \$100,000 Balance: \$0.00

Land Spreading Yard Wastes: This appropriation is to the Office of Waste Management for a grant to the University of Minnesota, Soil Science Department, to determine the maximum and optimum rates that yard wastes can be applied to Minnesota soils without reducing yields or endangering the environment.

B. Compatible Data: In addition to satisfying the needs under Objective A the data collected under the program must satisfy the needs of Objective B: Developing a computer model.

#### C. Match Requirement: N.A. Funds Raised to Date: N.A.

#### II. Narrative

After January 1, 1990 in the metro counties, and January 1, 1992 in greater Minnesota, yard wastes may no longer be put in landfills. These yard wastes account for up to 18% of the bulk in landfills. Land spreading would extend the life of landfills and recycle a valuable natural resource. Research has shown that by direct land spreading more effective utilization of the plant nutrients in wastes is achieved than with composting and spreading compost. The yard wastes are typically deficient in nitrogen, but the rates of nitrogen needed to correct this imbalance so as not to reduce crop yields or to endanger the environment is not precisely known.

#### **III.** Objectives

A. To evaluate different application rates of vard waste applied and directly incorporated into agricultural soils, and to identify rates of nitrogen required to accelerate the decay of yard wastes that can be actively decomposed without reducing agricultural crop yields or presenting an unacceptable environmental threat to the soil.

A.1.Narrative: Tree leaf and wood wastes have high carbon to nitrogen ratios. Microbes decaying these wastes compete effectively for the nitrogen that is present, leaving little for the current crop. Supplemental nitrogen may have to be added to grow a crop. Appropriate rates of yard wastes and supplemental nitrogen applied to the land to maximize nutrient utilization and minimize potential environmental problems are not precisely known for Minnesota conditions.

A.2.Procedures: This study includes a review of the scientific literature available on this topic. Small research plots were established at the Becker Experiment Station. The soil types of the site are loamy sand soils. A chemical analysis of the fall leaves were conducted. The leaves were spread in the fall of the year and incorporated with a roto-tiller. A broadcast application of phosphorus and potassium were applied according to needs indicated by soil tests and U of M recommendations in the spring at planting. No additional N was applied to 16 of the plots, and 32 of the plots will receive the same amount of N,

based on U of M recommendations. Tree leaves (4 rates) were applied at 0, 20, 40, and 80 tons/acre (dry weight basis). Supplemental nitrogen (2 rates) were applied at 0, and 66 lb/acre in the fall at the time of incorporation of the tree leaves. Each treatment was replicated four times for a total of 48 treatments. Plots were six corn rows wide (30 inches each) and 30 feet long. The middle two rows were used for analyses. Corn was planted at the rate of 30,000 kernels per acre. The following soil tests were made on each plot prior to establishment of treatments and at the end of each cropping season: regular soil test(s), nitrate nitrogen, Kieldahl nitrogen and total organic carbon. Diagnostic leaf samples were taken at the 7 leaf stage. At harvest the following including whole plant analyses were made: Kieldahl-nitrogen, nitrate-nitrogen and ICP analyses for macro- and micro-nutrients. Suction cup samplers were installed in two plots (check vs. high nitrogen/high leaf treatment) at 3 and 6 foot depths. During the time when the soil is not frozen, soil water samples will be taken to monitor nitrate movement in the soil. All data will be statistically analyzed for significant differences.

#### A.3.Budget:

|                    | LCMR Fu     | <u>nds</u> | Matching Funds |
|--------------------|-------------|------------|----------------|
| a. Amount Budgeted | \$70,000.00 | N.A.       |                |
| b. Balance         | \$ 0.00     | N.A.       |                |

#### A.4.Time-line for products/tasks:

| July 91 Jan 92                | June 92 Jan 93 June 93 |
|-------------------------------|------------------------|
| Literature Review             | •••••                  |
| Establish field plots         |                        |
| Analyze soil chemistry        | •••••                  |
| Analyze tree leaf chemistry   |                        |
| Analyze whole plant chemistry |                        |
| Analyze water samples         |                        |

#### A.5.Status: This is the final report.

The first year of the field study at Becker. MN to determine the effect of yard waste on corn productivity has been completed. Yard waste application rate had no effect on final plant population. Initial growth of corn was significantly inhibited as leaf application rate increased. Fall application of N and N applied two weeks after emergence tended to minimize the negative effect of yard waste application on initial corn growth. Without added fertilizer nitrogen final grain and stover yield increased with increasing yard waste rate, suggesting release on nitrogen from the yardwaste over the season. With added fertilizer nitrogen, the influence of yard waste rate diminished. The 80 T/A yard waste rate tended to reduce yields compared to the lower application rates and the control. Fall application of nitrogen did not significantly affect final yields. Soil water samples have been collected at the 3-ft depth from two of the 4 replications and nitrate determinations have been completed. Nitrogen uptake by the crop and leaching of nitrate during the season has been completed. See Attachment A for additional details.

A.6.Benefits: Land spreading appears to offer a cost effective alternative for yard waste disposal. Yard wastes are a major component of the solid waste stream often accounting for 15% to 20% of the total Municipal Solid Waste stream. However, previous research has not established acceptable rates of these wastes plus supplemental nitrogen to optimize the needs of the crop and minimize potential environmental impacts. This research helps to establish rates of application of fall tree leaves and supplemental nitrogen. Substantial savings in landfill volume should be saved. In some cases direct incorporation of fall tree leaves into agricultural soils can be done at a lower total cost as compared to large scale composting of yard wastes and then applying the compost to agricultural soils.

B. To develop a prediction model so others can forecast the rate of yard waste decomposition under varying soil, climatic and tillage conditions.

B.1.<u>Narrative</u>: Field experiments can consider only a few combinations of yard waste and nitrogen application rates. Managerial scenarios not experimentally tried will be simulated by a computer predictive model. Computer simulation will also be used to analyze the long term effect of yard waste application. A computer model was developed by modifying an existing research computer model of carbon and nitrogen flows in the soil plant system.

B.2.<u>Procedures</u>: A user friendly interface was developed to make the research model NCSWAP accessible to non-experts. This software addresses some managerial options which are relevant to land spreading of yard wastes. This front end to the research model was tested with extension agents for ease of information accessibility. Validation of the model was performed with the field data collected.

B.3.Budget:

#### LCMR Funds Matching Funds

a. Amount \$30,000.00 N.A. b. Balance \$ 0.00 N.A.

B.4. Time-line for products/tasks:

July 91 Jan 92 June 92 Jan 93 June 93 First version of interface ............ Validation of first year data .......... Final version ........

B.5. Status: This is the final report.

The application program of NCSWAP is complete. Two of the three objectives for a phase 1 simulation model have been achieved. The first objective was to modify, then run the research version of NCSWAP on a microcomputer. Select variables were fixed or eliminated, and program code modified to reduce program size and improve run time. The second objective was to test the new application version for errors, and correct them. The third objective is to create a user-friendly program interface. This section allows the user to choose among various yard waste disposal scenario; cropping and weather conditions, application rates, etc. An output screen then tells the user the simulated results of the scenario and offers recommendations where appropriate. Scenario outcomes include crop yields, residue balance, nitrogen balance, and nitrates leached from the system. This third objective was not achieved. Validation of the first year's field data showed that Models's "useability" was not good enough to use with farmers. The model could not accurately predict the outcomes with only input data. It could come fairly close to real world outcomes when the outcomes were known. Additional real world numbers will be required with different crops, soils and weather if the third objective is to be achieved. See <u>Attachment B</u> for more detailed information.

B.6.<u>Benefits</u>: A user friendly version of the simulation model will be made available to managers of yard waste spreading sites. Managers will use the model to adjust rates and timing of waste and nitrogen application to variations in the climate and yard waste composition for optimum crop yield and minimum nitrate leaching.

IV. <u>Evaluation</u>: The success of the project may have several measures: 1) if no adverse effects of utilizing yard wastes are found this fact would greatly increase possible flexibility in utilizing these wastes as soil amendments or mulches; 2) if the research shows that there are limits to amounts that should be spread the data should provide guidelines that the regulatory agencies could use to develop limits in effectively regulating the use of

yard wastes; and 3) general acceptance by the farming community and general public permitting recycling of this resource would confirm its usefulness and credibility.

#### V. Context:

A. Research with yard waste has focused on demonstration type experiments with little quantitative potential. Land spreading of yard wastes has been shown to be feasible both here and in Wisconsin. High rates of leaves have also been shown to generate severe nitrogen deficiency for some types of agricultural crops. Yet these same leaves may contain large amounts of nitrogen which may be released as decomposition becomes nearly complete. When fully decayed, excess nitrogen from these yard wastes has the potential to pollute ground water. Thus, the process of management of yard wastes, particularly in terms of nitrogen management, must be better understood. Appropriate application rates of yard wastes and supplemental nitrogen under varying soil and meteorological conditions in Minnesota have not been precisely determined.

B. Determining the mineral nutrient balance of tree leaves from a variety of species and soil types and different stages of weathering should make a significant contribution to the scientific literature.

C. One of the cooperators worked with the OLEO group in their grant for 1987-1988. Their work was more qualitative than quantitative. Controls were inadequate to be scientifically acceptable. The original plot design was excellent but tillage, leaf rates, and supplemental nitrogen was not precisely replicated by the farmers. Data gathered here will yield valuable conclusions about rates of yard wastes and supplementary nitrogen that are acceptable.

#### D. Not applicable

E. Biennial Budget System Program Title and Budget see page 1.

#### VI. Qualification:

1. Program Manager Thomas R. Halbach, Assistant State Specialist - Waste Management and Water Quality Minnesota Extension Service, Dept. of Soil Science, University of Minnesota.

#### VII. Reporting Requirements:

Semi-annual status reports will be submitted no later than January 1, 1992; July 1, 1992; January 1, 1993 and a final status report by July 1, 1993.

## **1991 RESEARCH PROJECT ABSTRACT**

For the period ending June 30, 1993

Title:Land Spreading of Yard Waste - Waste 12(b)Program Manager:Thomas R. HalbachOrganization:Soil Science Department, University of MinnesotaLegal Citation:A.M.L. 1991. Ch.254, Art.1 Sec.14 Subd.12(b)Approp. Amount:\$100,000

## Statement of Objectives

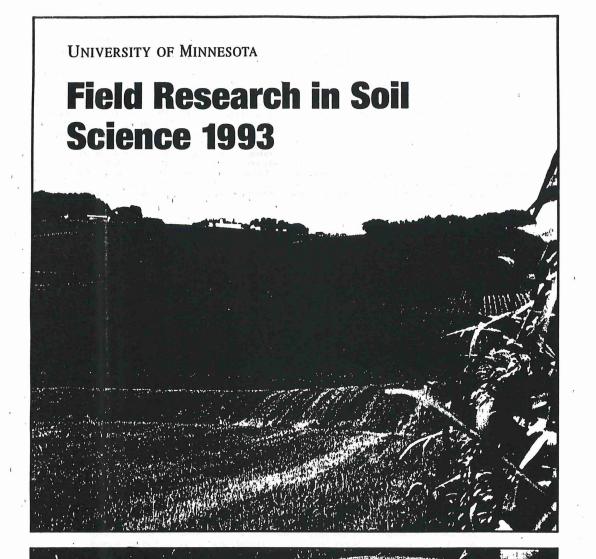
To evaluate different application rates of yard waste applied and <u>directly incorporated</u> into agricultural soils, and to identify rates of nitrogen required to accelerate the decay of yard wastes that can be actively decomposed without reducing agricultural crop yields or presenting an unacceptable environmental threat to the soil. To develop a prediction model so others can forecast the rate of yard waste decomposition under varying soil, climatic and tillage conditions.

## Results

The first year of the field study at Becker, MN to determine the effect of yard waste on corn productivity has been completed. Yard waste application rate had no effect on final plant population. Initial growth of corn was significantly inhibited as leaf application rate increased. Fall application of N and N applied two weeks after emergence tended to minimize the negative effect of yard waste application on initial corn growth. Without added fertilizer nitrogen final grain and stover yield increased with increasing yard waste rate, suggesting release on nitrogen from the yardwaste over the season. With added fertilizer nitrogen, the influence of yard waste rate diminished. The 80 T/A yard waste rate tended to reduce yields compared to the lower application rates and the control. Fall application of nitrogen did not significantly affect final yields. Soil water samples have been collected at the 3-ft depth from two of the 4 replications and nitrate determinations have been completed. Nitrogen uptake by the crop and leaching of nitrate during the season has been completed. On the basis of a single year's crop of corn at Becker, MN it appears that direct soil incorporation of fall tree leaves applied and incorporated in the fall can produce a similar yield following current U of M soil test recommendations when application rates are held to 40 dry tons to the acre or less. Other crops and other soils may be different. A four to five year study would be a useful addition to this study.

## Project Results Use and Dissemination

This study was published in the <u>Field Research in Soil Science 1993</u>, Miscellaneous Publication 79-1993, Minnesota Agricultural Experiment Station. This publication is a widely used reference for County Extension Educators and other soil science professionals. These results will be incorporated into presentation at Experiment Station field days and MES staff training as appropriate.



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## June 30, 1993 LCMR Final Report

Title: Land Spreading of Yard Waste - Waste 12(b)

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A.M.L. 1991. Ch.<u>254, Art.1</u> Sec.<u>14</u> Subd.12(b)

Attachment A

#### LAND SPREADING OF YARD WASTE

## Carl Rosen, Thomas Halbach, Jean Molina, Dave Birong, Jennifer Weiszel

ABSTRACT: A field experiment at the Sand Plain Research Farm in Becker, Minn. was conducted to determine the effects of applying yard waste applications (primarily tree leaves) on corn production and soll nitrate movement. The yard waste was applied in the fall of 1991. Treatments included four rates of yard waste (0, 20, 40, and 80 T/A) with either 0 fertilizer N applied, 200 lbs N/A during the 1992 growing season, or 66 lbs N/A applied with the yard waste plus 200 lbs N/A applied during the growing season. Yard waste application initially inhibited growth and depressed tissue nitrogen composition of developing corn plants. The inhibitory effect diminished when fertilizer N was applied. These results suggest that soil N was immobilized for 5-6 weeks after planting. By harvest, corn grain yield increased with increasing yard waste application when no fertilizer N was applied, presumably due to release of nitrogen and possibly other nutrients from the yard waste. When N was added during the growing season, with or without fall applied N, the effect of yard waste on grain yield was generally not significant. Maturity, as measured by • moisture in the grain, was delayed with yard waste application. Yard waste application tended to decrease nitrate leaching during the first year after application. Highest nitrate-N concentrations in soll water at the three foot depth were recorded when N was applied in the fall with or without yard waste. During the first year after yard waste application, acceptable yields were obtained at all rates of applied yard waste combined with 200 lb N/A without significant nitrate losses.

Until recently, yard wastes (tree leaves and grass clippings) accounted for 15-20% of the bulk in landfills. In 1990 (metro counties) and in 1992 (greater Minnesota), regulations were passed that prohibited yard wastes from being put in landfills. Because of this legislation, alternatives to landfilling yard waste need immediate attention. Some options for using or recycling the yard waste include: 1) backyard composting and application of the compost to gardens; 2) municipal composting followed by land application of the compost; and 3) direct land application of noncomposted yard waste. While backyard composting is a desirable way to handle yard waste, not all homeowners desire to compost their own yard waste. Several problems with municipal yard waste composting include finding an acceptable site, controlling nutrient runoff, and controlling odors. Direct land application of noncomposted yard waste may be more efficient than composting and does not have the same problems associated with composting. Land application of yard waste may require an adjustment of nitrogen requirements, because of its generally low available nitrogen content. In addition, the effects on nitrogen use and crop production in general need to be ascertained. Therefore, the objectives of this study were to: 1) Determine the effects of direct application and incorporation of noncomposted yard waste (primarily tree leaves), with and without fertilizer nitrogen, on productivity of irrigated field corn, and 2) Characterize nitrogen release from the leaves during the growing in terms of availability for crop needs and movement through the soil protile.

#### PROCEDURES

The experiment was conducted at the Sand Plain Research Farm in Becker, MN on a Hubbard loamy sand soll. Initial soll chemical characteristics include (0-6"): organic matter, 1.7%; pH (1:1 soil:water), 6.8; Bray P, 26 ppm; K (NH,OAc), 61 ppm. Extractable (KC1) nitrate-N and ammonium-N in the top 3 feet were 30 lbs/A and 4 lbs/A, respectively. The previous crop was rye. Yard waste was collected in October 1991 and applied to 15' x 35' plots with a front end loader on October 31, 1991. The yard waste primarily consisted of tree leaves, although some garden plants and grass clippings were also present. Subsamples of yard waste applied to each plot were collected for chemical analysis. The following 12 treatments were tested: 0, 20, 40, 80 dry tons/A yard waste (no added N); these same treatments with 200 lb N/A applied during 1992; these same treatments with 66 lb N/A applied in the fall of 1991 plus 200 lb N/A applied during 1992. The fertilizer N source used in all cases was urea. An average of 30% molsture was assumed for application of all yard waste treatments. The experimental design was a randomized complete block with 4 replications. The leaves were incorporated with a rototiller after application (fall 1991) and the whole field was moldboard plowed one week prior to planting. Pioneer hybrid 3751 (100 day maturity) was planted on April 28, 1992 at a population of 30,700 seeds/A (2.5 ft. between rows). At planting, 185 lbs/A 0-14-42 was banded 2 inches to the side and two inches below the seed. On May 27, 100 lbs N/A was sidedressed with a hand pushed Gandy fertilizer applicator and cultivated in. Additional N at a rate of 50 lbs/A per application was applied with the Gandy applicator on June 17 and June 22 and irrigated in with 0.5 inch of water. Irrigation was used to supplement rainfall (Figure 1).

Soil samples at the 0-8 inch depth were collected from each plot before planting. After harvest, soil samples were collected from 0-6, 6-12, 12-24 and 24-36 inch depths. Soil nitrate and ammonium were determined on 2 N KCl extracts.

Suction tubes with ceramic cups were installed at a depth of 3 feet in two replications of each treatment. Suction tubes at the 6 foot depth were installed in two reps for the control and 40 T/A yard waste plus 266 lbs of N treatments. Water samples were collected every two weeks through the growing season and analyzed for nitrate. On one set of water samples (September 11), a more extensive elemental analysis was performed using an ICP spectrophotometer.

Whole plant samples (4 per plot) were collected at the three leaf stage (May 26) before fertilizer N was applied in 1992. Whole plant samples (4 per plot) at the 8-12 leaf stage were collected on June 26 after all fertilizer N was applied. Ear leaf samples at 50% silking were collected on July 28. Two, 20 foot rows were harvested for grain and stover yield from each plot on October 10. Subsamples of stover and grain plus cob were taken for moisture determinations, shelling percentages, and nitrogen analyses. Plant tissue samples were dried and then ground through a 30 mesh screen. Following Kjeldahl digestion, total nitrogen in plant tissues was determined using conductImetric procedures.

#### RESULTS

<u>Yard Waste Elemental Composition</u>: The yard waste had an acid pH (Table 1). The average moisture content was 30% with a range of 18.6 - 48.1%. The outer part of the pile tended to be drier than the inner part. The C/N ratio averaged 37.8%, which is on the low side for leaves, but is in a range that should initially immobilize N. The yard waste contained 21.2 lbs N/dry ton, 3.2 lbs P/dry ton (7.4 lbs  $P_2O_3$ ), and 14.4 lbs K/dry ton (17.3 lbs K<sub>4</sub>O). The yard waste contained significant quantities of Ca, Mg and S. Trace elements were also present in the yard waste, but were not at levels considered to be detrimental to the environment.

<u>Corn Growth and Yield</u>: Initial growth of corn was significantly inhibited as leaf application rate increased (Table 2). Application of N tended to minimize the negative effect of yard waste application on initial corn growth. Greatest growth at the 8-12 leaf stage occurred when N was applied in the Fall and during the growing season. Yard waste application rate up to 40 T/A tended to increase final stand count. At the 80 T/A rate, stand count declined. Stand count also increased with increasing fertilizer N rate. At harvest, increasing yard waste rates increased grain yield when no N was applied, indicating a significant release of N from the yard waste. However, when N was added during the growing season with or without fall applied N, the effect of yard waste on grain yield was generally not significant. There was a slight decrease in grain yield at the highest yard waste rate and when fall N plus 200 lb N/A was applied. Stover yield increased with increasing yard waste application and fertilizer N rate. Yard waste and low fertilizer N tended to delay maturity as measured by higher kernel moisture percentage.

<u>Tissue Nitrogen Concentrations</u>: Nitrogen concentrations in whole plants sampled at the 3 leaf stage decreased as yard waste application increased (Table 3). These results indicate that early in the season N was immobilized by the yard waste. Fall applied N significantly increased N concentrations in the plant. By the 8-12 leaf stage, yard waste application was beginning to have a positive effect on N concentrations in the plant, while the effect of fall application of N began to diminish. Ear leaf N increased with increasing yard waste application of fertilizer N was applied, but was not affected by yard waste when fertilizer N was applied. Application of fertilizer N increased N concentrations in the ear leaf. Cob N concentrations were not affected by yard waste application and were not consistently affected by fertilizer N application. Stover N concentrations tended to increase with increasing yard waste application, primarily when no fertilizer N was applied. Application of fertilizer N also increased N concentrations in the stover. Kernel N increased with increasing application, primarily when the fertilizer N was applied. Application of grad waste and increasing fertilizer N application. Application fertilizer N also increased N concentrations in the stover.

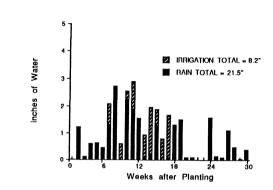
<u>Soil Nitrogen Content</u>: Soil nitrogen increased with increasing yard waste application in the top 6 inches, but was not significantly affected by yard waste at the lower depths (Table 4). Soil nitrogen increased with increasing fertilizer N application, with the fall applied N treatment having the highest residual N in the top 3 feet. It is interesting to note, however, that the initial soil nitrate-N content of 30 lbs/A was higher than the soil nitrate-N content following any of the fertilizer N and/or yard waste treatments.

<sup>&</sup>lt;sup>1</sup>Funding for this project was provided by the legislative Commission for Minnesota Resources <sup>3</sup>Extension Soil Scientist, Extension Waste Management Specialist, Professor, Junior Scientist, and Senior Research Plot Technician, respectively, Department of Soil Science.

Soil Water Elemental Concentrations: Elemental concentrations in soil water sampled on September 11 are presented in Table 5. Al, B, Cd, Cr, Cu, Fe, Mo, Ni, and Pb were generally below detection limits of the ICP. Ca, K, Na, and S tended to increase with increasing yard waste application. P concentrations tended to increase with increasing yard waste applied, but was not consistently affected when fertilizer N was applied. Except for soil water nitrate (see below), other elements determined in soil water were not affected by yard waste application or fertilizer N.

Soil Water Nitrate Concentrations: Concentrations of nitrate-N in soil water as affected by treatments are presented in Figures 2-13. Yard waste applications tended to decrease nitrate concentrations in soil water at the three foot depth when fertilizer N was not applied. The control treatment had the highest water nitrate-N concentrations with levels slightly above 10 ppm. When yard waste was applied nitrate-N concentrations were less than 10 ppm. Nitrate-N concentrations at the three foot depth, when fertilizer N was applied during the season, tended to be highest when 80 T/A yard waste was applied at mid-season. However, by the end of the season, the 0 yard waste treatment with fertilizer N had the highest nitrate concentrations. Nitrate-N concentrations in soil water were greatest when fertilizer N was applied in the fall. Highest concentrations at mid-season were recorded when 0 T/A leaves were applied. Yard waste application tended to decrease nitrate-N concentrations; however, compared to the other N treatments, fall applied in the highest losses at the end of the growing season. From these measurements, yard waste amendments appear to reduce nitrate-N losses during the first growing season after application.

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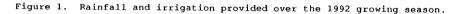


Table 1. Elemental concentrations of original yard waste samples.

|                       | Mean  | Standard<br>Deviation | Minimum | Maximum |                         |
|-----------------------|-------|-----------------------|---------|---------|-------------------------|
| рн                    | 4.9   | 0.2                   | 4.4     | 5.5     | -                       |
| <pre>% moisture</pre> | 29.7  | 7.7                   | 18.6    | 48.6    |                         |
| C to N ratio          | 37.9  | 3.2                   | 29.6    | 42.6    | lbs element/<br>dry ton |
| Macroelements (%)     | )     |                       |         |         |                         |
| Carbon                | 39.76 | 3.49                  | 33.56   | 45.95   | 795.2                   |
| Nitrogen              | 1.06  | 0.12                  | 0.81    | 1.46    | 21.2                    |
| Phosphorus            | 0.16  | 0.02                  | 0.12    | 0.20    | 3.2                     |
| Potassium             | 0.72  | 0.14                  | 0.47    | 1.16    | 14.4                    |
| Calcium               | 2.33  | 0.25                  | 1.75    | 2.75    | 46.6                    |
| Magnesium             | 0.37  | 0.04                  | 0.27    | 0.49    | 7.4                     |
| Sulfur                | 0.19  | 0.02                  | 0.15    | 0.22    | 3.8                     |
| Microelements (pp     | m)    |                       |         |         |                         |
| Aluminum              | 1052  | 464                   | 254     | 1960    | 2.1                     |
| Boron                 | 65    | 9                     | 48      | 97      | 0.13                    |
| Cadmium               | <0.52 | 0.35                  | <0.16   | 1.30    | <0.10                   |
| Chromium              | 7.5   | 3.5                   | 1.6     | 14.4    | 0.015                   |
| Copper                | 8.4   | 1.2                   | 5.6     | 10.7    | 0.016                   |
| Iron                  | 969   | 334                   | 359     | 1755    | 1.9                     |
| Lead                  | <15.5 | 7.7                   | <2.2    | 39.6    | <0.031                  |
| Manganese             | 249   | 40                    | 177     | 399     | 0.50                    |
| Nickel                | <6.5  | 3.3                   | <0.9    | 13.4    | 0.013                   |
| Sodium                | 105   | 23                    | 60      | 163     | 0.21                    |
| Zinc                  | 61    | 9                     | 40      | 85      | 0.12                    |

Leaf rate	Nitrogen application	Whole plant dry matter (8-12 leaf)	Final stand count	Grain yield	Dry stover	Kernel moisture
-tons/A-	lbs/A	-grams/plant-	-plants/A-	-bu/A-	-tons/A-	- 8 -
0	0	16.0	26463	76	1.25	36
20	0	5.5	26789	99	1,37	39
40	0	8.8	28532	124	1,68	38
80	0	6.0	26681	130	1,86	36
0	200	21.8	27770	188	2.48	29
20	200	12.5	27334	185	3.06	34
40	200	9.3	27770	188	3.05	35
80	200	10,5	27770	182	3.17	35
0	66+200	29.3	27660	195	2.91	31
20	66+200	25.5	28859	203	3.01	30
40	66+200	15.0	28859	195	3.15	35
80	66+200	13.0	27661	176	2.95	34
Significa	nce	* *	NS	**	**	* *
BLSD (5%	)	9.3		20	0.50	3
<u>Main effe</u>	cts					
	leaf Rate					
	0	22.3	27298	153	2.22	32
	20	14.5	27661	162	2.48	34
	40	11.0	28387	169	2,63	36
	80	9,8	27370	162	2,66	35
	Significance	**	NS	NS	*	**
	BLSD (5%)	5.3			0.34	2
	Linear	**	NS	NS	**	**
	Quadratic	*	*	*	NS	**
	Nitrogen Applicat	ion				
	0	9.0	27116	107	1.54	37
	200	13.5	27661	186	2.94	-33
	66+200	20,8	28260	192	3.01	32
	Significance	**	*	* *	**	**
	BLSD (5%)	4.3	892	10	0.24	2
Interactio	<u>on</u>					
. I	Leaf x Nitrogen	NS	NS	**	NS	*

Table 2. Effect of 1	leaf and nitrogen application on whole plant dry matter at the	ne 8-12
leaf stage,	final stand count, grain and stover yield, and kernel moist	ture.

Table 3. Effect of leaf and nitrogen application on percent nitrogen present at various growth stages and in various plant tissues.

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Leaf	Nitrogen	3 leaf	Whole plant 8-12 leaf	Ear leaf silking			
rate	application	stage	stage	stage	Cob	Stover	Kernel
-tons/∧-	1bs/A			% Nit	rogen		
0	0	4.19	1.74	1.34	0,31	0.38	0.92
20	0	3.19	2.49	1.97	0.29	0.42	1.01
40	0	3.03	2.57	2.05	0.28	0.47	1.12
80	0	2.80	3.00	2.31	0.27	0,52	1.24
0	200	4.21	3.14	2.89	0.25	0,53	1.26
20	200	3.20	3.80	2.94	0.26	0,58	1.29
40	200	3.16	3.96	2.68	0.24	0.61	1.35
80	200	3.19	3.71	3.04	0.26	0.60	1.37
0	66+200	4.32	3.08	3.00	0.26	0.57	1.35
20	66+200	4.39	3.30	2.51	0,26	0.65	1.38
40	66+200	4.10	3.57	2.95	0.26	0,63	1.41
80	66+200	3,60	3,66	2.94	0.27	0.55	1.41
Significa	nce	**	**	**	**	**	**
BLSD (5%	)	0.72	0.40	0.76	0.03	0.12	0.09
<u>Main effe</u>	cts						
	Leaf Rate						
	0	4.24	2.66	2.35	0.27	0.49	1.18
	20	3.59	3,20	2.47	0.27	0.55	1.23
	40	3.43	3.36	2,56	0.26	0.57	1.29
	80	3.20	3.46	2.76	0.26	0.56	1.34
	Significance	**	**	NS	NS	NS	**
	BLSD (5%)	0.39	0,23				0.05
	Linear	**	**	NS	NS	NS	**
	Quadratic	*	**	NS	NS	NS	NS
	Nitrogen Applicati	lon					
	0	3.30	2.45	1.92	0.29	0.45	1.07
	200	3,44	3,65	2.89	0,25	0.58	1.32
	66+200	4.10	3.40	2.84	0,26	0,60	1.39
	Significance	**	**	**	**	**	**
	BLSD (5%)	0.34	0.19	0.33	0,01	0.05	0.04
Interactio	on						
1	Leaf x Nitrogen	NS	NS	NS	NS	NS	*

NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

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NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

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0.15 0.15 0.22 NS

81 60 NS

<0.09
<0.09
<0.09
</pre>

0.12 0.12 0.09 NS

<0.025</pre><0.026</pre><0.030</pre>

24 21 NS

<0.01
</pre>

0.029 0.031 0.051 NS --

11 14 NS

2.2 1.5 4.7 NS

<0.02</pre><0.02</pre>

0.03 0.03

10.05 10.05

00.00600.00600.006

87 76 85 NS

<0.08
<0.15
<0.06
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<0.18 <0.18 <0.18

0 200 66+200 Significance BLSD (5%)

NS

NS

\*

NS

NS

NS

NS

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- 11 \* at 5%,

NS

Leaf x Nitrogen

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significant at 1%.

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Effect of leaf and nitrogen application on soil nitrate-N (lbs/A) in the top
three feet at the end of the growing season.

Leaf	Nitrogen		sampl	e depth (ir		
rate	application	0 - 6	6 - 12	12 - 24	24 - 36	Total
-tons/A-	lbs/A		1	bs nitrate-	N/A	
0	0	0,78	0.74	0.75	0.72	2.98
20	0	1.24	0.99	0.94	0.64	3.81
40	0	1,90	1.54	1.47	0.67	5.58
80	0	2.96	2.53	1.36	1.12	7.97
0	200	2.35	2.34	1.67	0.74	7.09
20	200	4.22	3.78	2.24	1.22	11.46
40	200	5,30	4.10	2,63	1.25	13.28
80	200	6.34	3.76	2,10	0.79	12.99
0	66+200	2,73	3.29	1,54	1.18	8.74
20	66+200	7,98	9.50	6,82	3.14	27.44
40	66+200	7.96	6.69	2.93	1.42	18,99
80	66+200	9.20	5.10	3.31	2.19	19.80
Significa		**	**	**	**	**
3LSD (5%		3.41	4.62	2,96	1.24	10.80
	Leaf Rate			1 20	0.00	6 07
	0	1.95	2.12	1.32	0.88	6.27
	20	4.48	4.76	3.33	1.67	14.23
	40	5.05	4.11	2.34	1.11	12.61
	80	6.17	3.80	2.26	1.37	13.59
	Significance	**	NS	NS	NS	6.57
	BLSD (5%)	1.94				
	Linear	NS	NS NS	NS NS	NS NS	NS NS
	Quadratic	NS	113	NS	113	115
	Nitrogen Application					
	0	1.72	1.45	1.13	0.79	5.08
	200	4.55	3.49	2.16	1.00	11.20
	66+200	6.97	6.14	3.65	1.98	18.74
	Significance	**	**	**	**	**
	BLSD (5%)	1.57	1,93	1.28	0.54	4.78
Interacti	on					
	Leaf x Nitrogen	NS	NS	NS	NS	NS

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NS = nonsignificant, \* = significant at 5%, \*\* = significant at 1%.

Leaf rate	Nitrogen application	Al	в	ß	g	ង	5	Э	м	Mg	М	Ŵ	Na	ĨN	¢,	qa	N	2n
-tons/A-	1bs/A																	
0	0	<0.18	<0.02	44	<0.006	<0.01	<0.03	<0.02	1.6	9	0.015	<0.01	9	<0.022	0.08	<0.09	33	0.11
20	0	<0.18	<0.03	55	<0.006	<0.01	0.06	<0.02	1.7	10	0.037	<0.01	38	0.028	0.08	<0.09	73	0.35
40	0	<0.18	0.17	111	<0.006	<0.01	<0.03	<0.02	1.6	13	0.052	<0.01	12	0.028	0.10	<0.09	97	0.15
80	0	<0.18	0.07	123	<0.006	<0.01	<0.03	0.03	3.8	14	0.017	10.0>	47	<0.024	0.21	<0.09	117	0.09
0	200	<0.18	<0.02	99	<0.006	<0.01	<0.03	<0.02	1.9	12	0.029	<0.01	12	<0.026	0.17	<0.09	58	0.17
20	200	<0.18	0.28	62	<0.006	<0.01	<0.03	<0.02	0.9	S	0.035	<0.01	17	<0.027	0.10	<0.09	45	0.20
40	200	<0.18	<0.02	81	<0.006	<0.01	<0.04	<0.02	1.6	80	0.027	<0.01	22	<0.023	0.08	<0.09	55	0.10
80	200	<0.18	<0.27	-94	<0.006	<0.01	<0.05	<0.02	1.7	16	0.035	<0.01	27	<0.029	0.12	<0.09	83	0.13
0	66+200	<0.18	<0.15	89	<0.006	<0.01	<0.03	<0.02	2.7	10	0.036	<0.01	18	<0.029	0.07	<0.09	73	0.26
20	66+200	<0,18	<0.03	78	<0.006	<0.01	<0.03	<0.02	4.0	12	0.038	<0.01	24	<0.026	0.08	<0.09	67	0.19
40	66+200	<0.18	<0.04	67	<0.006	<0.01	<0.03	0.03	3.5	14	0.036	<0.01	22	<0.030	0.11	<0.09	65	0.19
80		<0.18	0.04	106	<0.006	<0.01	<0.03	0.04	8.3	20	0.096	<0.01	19	0.035	0.10	<0.09	86	0.25
	ince	I	I	NS	1	I	I	I	NS	SN	NS	١	SN	۱	*	١	NS	NS
BLSD (5%)	4)	1	I	I	I	۱	I	I	١	۱	1	I	I	١	0.08	١	I	I
<u>Main effects</u>	icts																	
	Leaf Rate																	
	0	<0.18	<0.06	66	<0.006	<0.01	<0.03	<0.02	2.1	6	0.027	<0.01	12	<0.025	0.11	<0.09	55	0.18
	20	<0.18	<0.13	67	<0.006	<0.01	<0.03	<0.02	2.3	ი	0.036	<0.01	24	<0.027	0.09	<0.09	60	0.23
	40	<0.18	<0.08	86	<0.006	<0.01	<0.03	<0.02	2.2	12	0.038	<0.01	19	<0.027	0.10	<0.09	72	0.15
	80	<0.18	<0.13	108	<0.006	<0.01	<0.04	<0.03	4.6	16	0.049	<0.01	31	<0.029	0.14	<0.09	96	0.16
	Significance	I	I	NS	1	I	1	۱	NS	NS	SN	۱	NS	١	¥	١	*	NS
	BLSD (5%)	١	I	I	١	I	1	1	1	۱	١	١	1	I	0.04	١	28	1
	Linear	١	١	*	١	ł	I	1	NS	*	SN	1	*	I	*	1	**	NS
	Quadratic	ł	I	NS	1	I	I	1	SN	NS	NS	1	SN	1	*	١	NS	NS
	Nitrogen Application	ication.																

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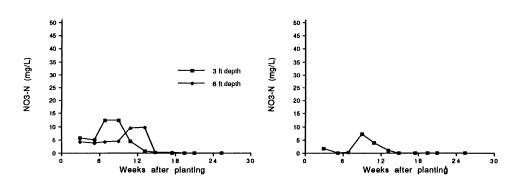


Figure 2. Nitrate-N concentration in soil water at 3 and 6 ft. depths over the 1992 growing season. Treatment 1: no leaves, no nitrogen applied. Figure 3. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 2: 20 tons/A leaves, no nitrogen applied.

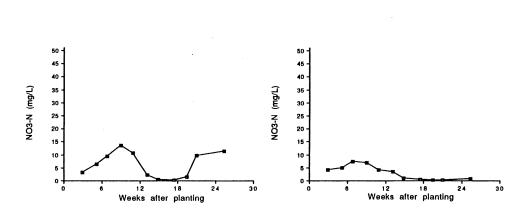


Figure 6. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 5: no leaves, 200 lbs/A nitrogen applied applied during the growing season. Figure 7. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 6: 20 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.

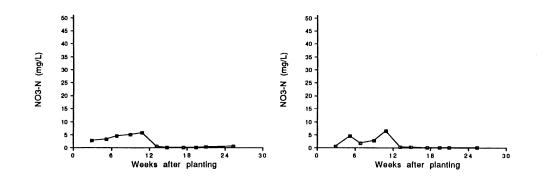


Figure 4. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 3: 40 tons/A leaves, no nitrogen applied.

Figure 5. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 4: 80 tons/A leaves, no nitrogen applied.

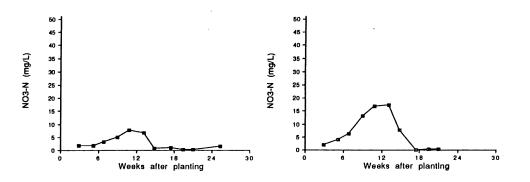
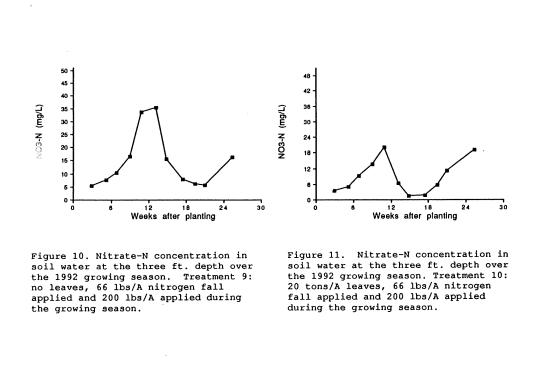


Figure 8. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 7: 40 tons/A leaves, 200 lbs/A nitrogen applied during the growing season. Figure 9. Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 8: 80 tons/A leaves, 200 lbs/A nitrogen applied during the growing season.



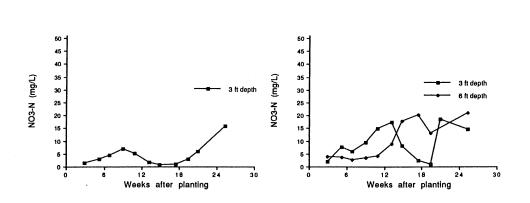


Figure 12: Nitrate-N concentration in soil water at the three ft. depth over the 1992 growing season. Treatment 11: 40 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season. Figure 13: Nitrate-N concentration in soil water at 3 and 6 ft. depths over the 1992 growing season. Treatment 12: 80 tons/A leaves, 66 lbs/A nitrogen fall applied and 200 lbs/A applied during the growing season.

#### June 30, 1993 LCMR Final Report

Title: Land Spreading of Yard Waste - Waste 12(b)

Program Manager: Thomas R. Halbach 439 Borlaug Hall Soil Science Department University of Minnesota St. Paul, MN 55108 (612) 625-3135

A.M.L. 1991. Ch.<u>254, Art.1</u> Sec.<u>14</u> Subd.12(b)

### Attachment B

#### Project Report Summary

#### Project objectives.

The goal of this project was to develop a computer simulation model that would predict the nitrogen affects from direct application of yard waste on Minnesota crops and soils. The project's two primary objectives were forecast user accessibility and accuracy. User accessibility was accomplished by designing software that is menudriven and user-friendly. Accuracy is measured by comparing simulation results with field trials from the Becker experiment station.

#### Research model modifications.

Phase one of the project called for modify the research model NCSWAP version 1.0. The baseline programming structure was developed by Dr. J.A.E. Molina of the University's Soil Science Department. This program was written for scientific researcher concerned with microbial carbon-nitrogen exchange and plant nitrogen use. Many of the features incorporated in version 1.0 were beyond the concerns of yard waste managers, and thus in the interest of improving program run-time many parameters were fixed or eliminated.

The initial research model's 7,000 lines of computer code were reduced to 4,500 lines, and inefficient algorithms were redesigned. Combined with modifications to the input-output routines, dramatic improvements were made in the program's run-time. To assure the integrity of the system following these changes, a lengthy error-checking process was conducted of the model's intermediate calculations and data exchanges among the many subroutines.

#### User interface development.

The project's second phase was the design of a program "shell" to give users an easy access point for testing yard waste application scenarios. User's are able to choose crop management options, as well as alternative environmental conditions. Version 1.1 allows the user to set planting and harvest dates, the type and amount of yard waste to be applied, plus the amount and incorporation depth of inorganic nitrogen. Environmental variables include climatic conditions (rain and air temperature) and field soil type. Each scenario results in information on crop growth and stress measures, as well as data on the soil profile nitrogen balance. These results are based on assumptions about initial field conditions and the expected outcome of a baseline reference crop.

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#### Validation and Calibration.

The project's final phase was to calibrate the model using data from yard waste application trials conducted at the Becker experiment station during 1992. The findings of this comparison are detailed in section 6 of this report. While the model fails to accurately predict the Becker trial results, it does appear to have potential as a forecasting devise.

#### Future program development potential.

A number of system changes would enhance both the accuracy and accessibility of NCSWAP version 1.1. Each section of this report details some aspect of the modelling system, and with each section are suggestions for potential improvements. In addition to these modifications, further testing against actual field results is needed to calibrate the model for a wider variety of crops and conditions.

#### Report outline.

This report is organized into the following sections:

Section 1.	User interface screens.
Section 2.	Model baseline assumptions.
Section 3.	Model baseline input files.
Section 4.	Model baseline results full report.
Section 5.	Factor relationship testing.
Section 6.	Becker simulations and trial results.
Appendix A.	User interface source code.

Appendix B. Main program source code.

#### Use of the software.

The diskette included with this report contains a copy of NCSWAP version 1.1. To initiate the program type SWAP2D. A co-processor is required for the program to execute. This version does not print a detailed report with each simulation, such as that found in section 4. It is important to remember that while the program exhibits a proper set of factor relationships, additional calibration is needed to improve the accuracy of point estimates. Section 1. User Interface Screens.

New software was developed to allow user's a fast and direct method for testing yard waste application scenarios. NCSWAP version 1.1 is really two programs, one operating within the other. The user interface screens found in this section are created by the "shell" program SWAP2D. The source code for this program can be found in Appendix A.

Five screens make up the user interface:

- Screen 1 is an introduction screen that appears only at the start of the program.
- Screen 2 is the menu from which alternative scenarios are created. The user can change options by using a mouse, or by tabbing from one option to the next. A carriage return actives the simulation.
- Screen 3 is displayed while the program is calculating the simulation results.
- Screen 4 displays the simulation results of the screen 2 scenario.
- Screen 5 allows the user to quit the program or run another scenario by returning to screen 2.

Some suggestions for improving the interface portion of the program might include:

Improvements to screen 2:

\* develop input values for other crops; potatoes, small grains.

\* modify the <u>C:N ratio</u> dialog to allow actual carbon nitrogen ratios when they are available, or require the user to input a value based on some guidelines found in a help screen.

\* eliminate the <u>N form</u> dialog and have the user input directly through the N rate dialog the amount of nitrogen applied. Again, a help screen could offer the user guidelines for calculating the nitrogen actually applied given some N form such as urea.

\* allow for split (or multiple) N applications. This would also have had an impact on the Becker results of section 6.

\* modify the <u>rainfall</u> and <u>air-temp</u> dialogs to let the user

choose an actual climate year for their location. A complete set of climate files (rainfall, air and soil temperatures, pan-evaporation) would create a more accurate scenario than the current structure which substitutes rainfall or air temperature file without making adjustments to the soil temperature and pan-evaporation data.

\* activate the percent total N and initial N input lines, also make allowance for changing the bulk density of the top layers when residue is added.

\* alter the CAP LOCK requirement for inputting dates.

Improvements to screen 4:

\* modifications should be made to eliminate any information which may confuse the user, or provide additional information to help the user interpret the result. Additional changes might include a summary of the simulation options chosen in screen 2 displayed on the screen.

\* Add a second screen detailing the scenario results or provide the user the option of printing out a more complete analysis of the simulation.

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Section 2. Model baseline assumptions.

This section outlines the baseline or default assumptions about initial soil conditions and crop management practices for the Becker field trials in 1992. Some of these assumptions are fixed values in the model, others are subject to change through the user interface. The following schematics help illustrate the "art" of setting the model's initial conditions.

#### Figure 1. Crop development assumptions.

The cropping option chosen for the baseline simulation is corn planted on April 28 at a seed rate of 30,700 plants per acre, and harvested on October 12. Key fixed crop development stages, set in relation to the date of plant emergence, are show on the top half of figure 1. Below are the rates of growth for root and topmass development. These assumptions need to reflect the actual growing conditions (at Becker), and the development pattern of the corn hybrid used in the reference growth curve.

#### Figure 2. Initial physical and hydraulic soil properties.

The bulk density and gravimetric water properties assumed in the model and those actually found at Becker are compared in this schematic. Four gravimetric water content settings are required; initial conditions (cubic centimeters per gram), the wilt point, field capacity, and saturation point. This figure also demonstrates the arbitrary allocation of a few discrete field measurements to the 6 cm. measurement continuum which makes up the model profile.

Figure 3. Initial inorganic nitrogen.

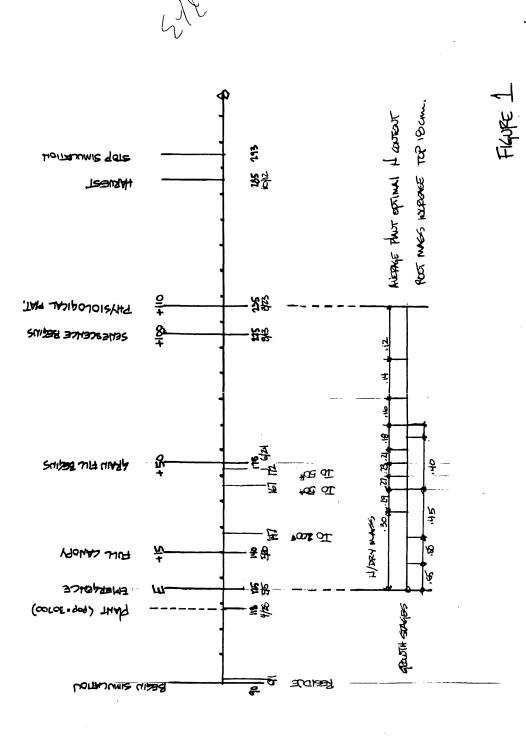
Initial soil profile NO3 and NH4 value (parts per million) are allocated to the models three horizons, from Becker data gathered from three field measurement depths.

Figure 4. Pool I -- microbial mass.

Carbon and nitrogen levels are assumed at 6 parts to 1 part for the microbial mass. No actual Becker data is available.

Figure 5. Pool II -- nutrient humus.

Carbon and nitrogen (ppm) levels are estimated from Becker data on soil percent organic matter taken from three sampling depths, and a rule-of-thumb allocation formula.



# WITTAL PHYSICAL ? HYDRAULIC PROPERTIES

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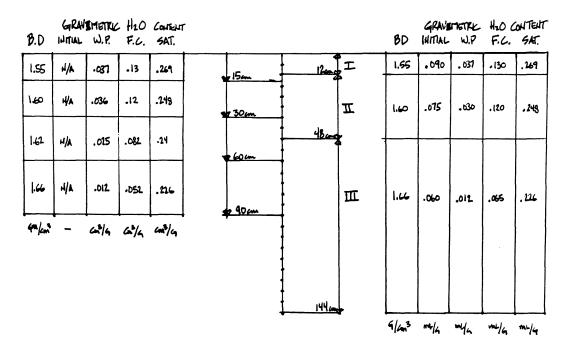


FIGURE 2

INITIAL INORGANIC NITROGEN





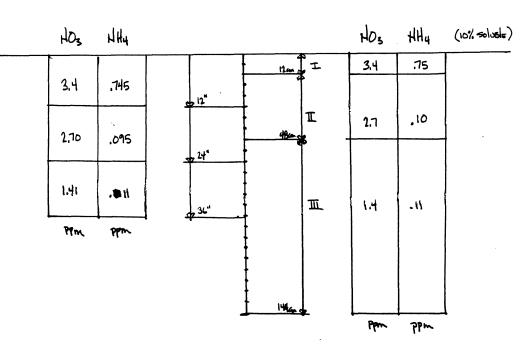


FIGURE 3.

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FIGURE 4

FIGURE 5

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#### Section 3. Model baseline input files.

This section contains the data files needed to run the baseline scenario of NCSWAP version 1.1. Files ending in .AVG are data files for the "average" or baseline scenario. Alternative files, ending for example in .WET or .DRY, are also used by the program to simulate alternative conditions, such as a wet or dry annual rainfall. Files ending in .PRN or .INC contain constant values. A complete set of data input files can be found in the subdirectory A:\DATAIN of the project documentation disk.

The following data files are examined in turn:

<u>File Name</u>	<u>Data set</u>
DATA8.AVG	Soil temperature
DATA11.AVG	Pan-evaporation
DATA12.AVG	Rainfall Events
DATA13.PRN	Reference Crop Air Temperature
DATA14.AVG	Actual Air Temperature
DATA55.INC	Soil Physical and Hydrologic Pr

Two files are used to exchange information between the user interface and the main model.

Properties

- DATA56.PRN Interface-to-Model simulation parameters
- DATA58.PRN Model-to-Interface simulation results

Information needed to run the model

Soil conditions

Nitrogen content for each soil horizon

- inorganic NO3 and NH4 (ppm)
- organic Pool I -- microbial mass C:N ratio and ppm carbon
- organic Pool II -- nutrient humus C:N ratio and ppm carbon

bulk density (gm/cm3)

gravimetric water content (ml/gm)

- initial content
- stress point

- field capacity

- saturation

Climatic data

daily rainfall (and irrigation) and duration daily high and low air temperatures weekly average pan-evaporation amounts weekly average soil temperature (for each horizon) reference crop daily high / low air temperatures

Reference crop

planting seed rate maximum plant population optimal plant population

date of planting (emergence) days (after emergence) to full canopy days (after emergence) until grain fill begins days (after emergence) until senescence begins days (after emergence) until physiological maturity is reached

topmass and rootmass growth stages -- days and rates reference crop growth curve coefficients (topmass and grain) maximum yields

Nitrogen management -- inorganic and organic (residue)

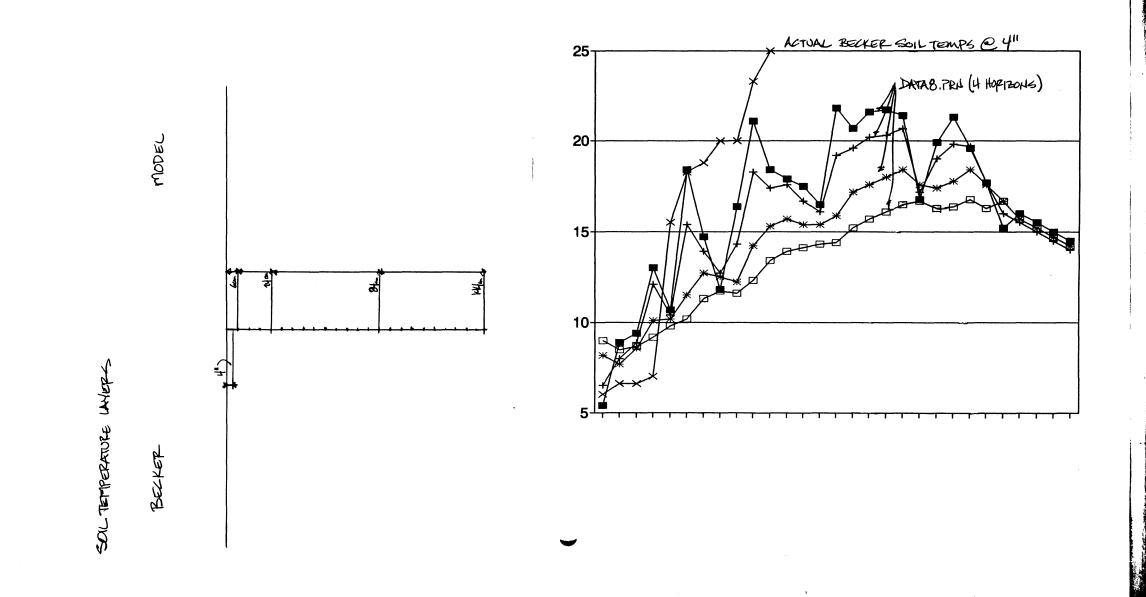
date of application(s) amount of nitrogen applied depth of incorporation

### DATA8.AVG -- soil temperature data (degrees Celsius)

This file contains the weekly average soil temperatures for the designated number (4) of soil temperature horizons. The values in DATA8.AVG correspond in number to the baseline time period (29 weeks), but are not based on actual soil temperature readings. Actual values from Becker are limited to 10 weekly average temperatures taken at a depth of 4 inches in early spring.

An input file of unknown origin, file DATA8.AVG has no clear relationship to Becker soil conditions, and appears to understate the actual temperatures in 1992. (See the graph showing the soil temperature file data compared to the limited data from Becker.) Based on this comparison, soil temperatures are arbitrarily increased by 10 percent on all four horizons. Two outcomes using the baseline scenario versus the cooler temperature regime of DATA8.AVG demonstrate the impact of this crude adjustment.

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DATA11.AVG -- pan-evaporation data (cm)

This file contains (52) weekly value for pan-evaporation in 1992 at the Becker experiment station. The program skips the weeks not required for the simulation period. Alternative scenarios use the values from the alternative year.

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----- C:\NCSWAP\DATA11.AVG

#### 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

-

0,0.64,4-7,5.6,3.86,4.86,6.14,5.71,7.28,5.0,3.02,7.86,8.5, 5.57,5.71,6.14,6.0,6.14,6.0,5.28,3.14,3.86,5.7,2.57,3.28,1.25, 1.,1.5,.5,0,0,0,0,0,0,0,0,0,0

### DATA12.AVG -- rain fall events (cm)

This file contains the rainfall (and irrigation) amounts for the 1992 simulation period; day 90 to day 272. Each event has an associated duration or length of time the event lasted. Since no actual data is available, duration is arbitrarily set at approximately 1 centimeter per hour for rain events greater than 1 centimeter. Each file begins with a number indicating how many events (in this case 60) occurred over the simulation period. The baseline scenario uses 1992 Becker rainfall and irrigation amounts totaling just over 64 cm.

C:\NCSWAP\DATA12.AVG	232, 0.2286, 1 235, 1.524, 1 236, 2.4638, 2 23 <sup></sup> 0.9144, 1 24 1.0922, 1 246, 0.3048, 1		
60 99, 0.1778, 1 100, 0.1524, 1 104, 0.1778, 1 107, 0.1016, 1 108, 0.1778, 1 109, 0.5334, 1 110, 0.0254, 1	247, 0.0254, 1 257, 0.0508, 1		
111,       0.0254,         123,       0.0508,         124,       0.0508,         130,       3.048,         131,       0.0254,         132,       0.0254,         135,       0.254,         138,       0.4572,         141,       0.3302,			
145, 0.5362, 1 145, 1.524, 1 146, 1.0508, 1 151, 0.2, 1 152, .57, 1 153, 0.2, 1 15 0.55, 1 150, 0.45, 1 158, 0.8636, 1			•
159,       1.143,         161,       1.905,         165,       2.2606,         166,       2.2606,         167,       1.905,         168,       0.127,         172,       0.6604,         175,       1.524,			
181,       1.4478,         182,       4.953,         183,       0.127,         188,       2.54,         190,       1.5748,         192,       3.2512,         194,       3.2512,         196,       0.254,			
200,       0.4826,         201,       2.032,         202,       0.0508,         203,       0.3048,         208,       2.54,         211,       1.905,         212       0.5842,         214,       0.5842,         215,       1.524,	Ţ	· · · · · · · · · · · · · · · · · · ·	
218, 2.7178, 3 222, 2.032, 2 230, , 3		· ·	

#### DATA13.PRN -- Reference crop air temperature (degrees celsius)

This file contains the reference crop air temperature data. There is a high and low value for each day of the simulation. In this case, the reference crop temperature is the same as the actual air temperature file DATA14.AVG. The reason for this unity is to eliminate the (air temperature) stress variable from the baseline scenario. This is an important assumption, and one which raises some questions about the impact on the simulation outcome from specification of the reference crop growth curve.

91,	7.67,	-8.28
92,	13.46,	1.01
93,	10.66,	-4.26
94,	17.56,	2.86
95,	13.96,	3.48
96,	10.11,	-1.98
97,	12.81,	2.17
98,	11.99,	2.49
99,	4.58, 3.55,	-0.95 -6.44
100,	3.35, 0.88,	-0.44
101, 102,	3.53,	-2.24
102,	8.15,	0.97
103,	5.84,	3.17
105,	9.10,	1.23
106,	10.14,	-2.44
107,	14.89,	6.21
108,	19.54,	11.02
109,	11.03,	2.35
110,	7.58,	1.50
111,	6.24,	1.31
112,	5.79,	-1.56
11	9.74,	1.00
114,	7.49,	0.80
115,	9.33,	-0.38
116,	14.81,	-2.91
117,	22.86,	4.99
1,18,	26.03,	10.26
119,	28.22,	9.41
120,	31.17,	15.17
121,	19.77,	6.32
122,	17.78,	2.10
123,	14.15,	2.86
124,	17.19,	-2.29
125,	22.95, 27.74,	4.40 11.19
126, 127,	28.43,	11.79
127,	29.87,	7.93
129,	29.71,	17.38
130,	23.07,	15.14
131,	20.57	8.51
132,	14.68,	4.09
133,	20.74,	7.28
134,	23.57,	12.99
135,	26.24,	16.19
136,	18.13,	7.76
137,	22.80,	7.19
138	28.50,	12.89
13	30.04,	15.02
140,	27.36,	16.77
141,	25.16,	6.87
142,	15.12,	5.64
143,	13.17,	2.06

----- C:\NCSWAP\DATA13.PRN

<b>H</b> 144,	11.06,	4.23						
145,	17.96,	2.06		- 1	204,	22.41,	11.65	
1					205,	25.76,	17.50	
146,	20.36,	6.63			206,	27.31,	14.27	
147-	22.23,	9.92		1	20~	29.23,	10.00	
14	23.11,	8.62						
149,	26.44,	6.24			20	26.51,	14.87	
150,	27.80,			1	209,	23.58,	8.15	
		8.82			210,	24.38,	9.64	
151,	27.97,	12.61			211,	26.57,	10.52	
152,	27.70,	9.51			212,	29.15,	16.97	
153,	30.07,	15.20						
154,	24.77,	12.55			213,	24.31,	12.73	
155,	25.27,	8.23			214,	22.67,	10.78	
					215,	24.56,	7.59	
156,	20.34,	8.52			216,	25.76,	10.56	
157,	21.04,	6.61			217,	22.24,	14.72	
158,	19.92,	11.70						
159,	27.53,	14.06			218,	24.23,	17.95	
160,	29.75,	15.64			219,	32.05,	18.13	
					220,	33.79,	22.80	
161,	32.45,	15.69			221,	25.69,	15.11	
162,	33.78,	15.75			222,	26.09,	12.15	
163,	33.33,	15.16			223,			
164,	26.61,	16.01				19.67,	11.37	
165,	24.41,	14.67			224,	20.93,	8.45	
					225,	22.89,	6.20	
166,	24.23,	15.34			226,	23.06,	8.73	
167,	20.94,	16.42			227,	24.15,	9.93	
168,	26.69,	16.89			228,	23.18,	15.21	
169,	16.97,	4.10						
170,	19.50,	2.67			229,	25.49,	10.55	
171,	20.21,				230,	25.70,	9.34	
		3.16			231,	26.67,	13.02	
172,	15.52,	10.84			232,	26.06,	18.73	
17 *	24.36,	14.32			2	28.19,	18.14	
174,	23.82,	13.13			234,	29.55,	18.88	
175,	21.77,	10.43						
176,	21.53,	7.32			235,	23.68,	15.58	
					236,	18.71,	11.00	
177,	25.23,	6.44			237,	19.32,	10.89	
178,	29.18,	14.93	•		238,	20.48,	10.60	
179,	23.45,	10.48			239,	21.94,	10.06	
180,	19.74,	9.71			-			
181,	30.02,	12.47			240,	25.98,	13.52	
182,	20.62,	13.59			241,	20.89,	10.69	
					242,	20.19,	7.61	
183,	21.46,	13.14			243,	23.49,	8.10	
184,	21.89,	10.61			244,	24.36,	14.74	
185,	24.26,	9.77			245,	23.21,	9.30	
186,	25.06,	10.04						
187,	27.42,	17.14			246,	22.63,	13.01	
188,	29.42,	17.54			247,	23.47,	14.41	
					248,	22.41,	8.83	
189,	27.95	15.26			249,	20.09,	7.78	
190,	24.27,	16.19			250,	17.93,	6.19	
191,	22.44,	14.96			251,	18.89,	9.93	
192,	25.84,	15.50						
193,	21.43,	13.83			252,	17.95,	5.75	
					253,	22.14,	4.89	
194,	25.58,	12.17			254,	23.35,	15.46	
	23.19,	15.04			255,	26.19,	14.31	
196,	25.25,	13.80			256,	25.06,	11.38	
197,	25.63,	14.23				24.53,	8.61	
	25.53,	13.07						
	23.95,				25R	28.29,	13.47	
-		13.44				19.63,	11.22	
	21.91,	11.98			260,	15.11,	3.35	
	24.93,	11.07			261,	18.41,	2.26	
202,	16 👕	10.60			262,	24.84,	10.46	
203,		10.15						
				k	£03 f	25.69,	8.25	
				¥.				
1				đ				

DATA14.AVG -- Actual air temperature (degrees celsius)

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29-

26

15.25,

21.79,

21.62,

23.24,

17.43,

22.10,

12.96,

19.00,

25.16,

30.00,

32.05,

23.62,

21.88,

22.69,

15.77,

8.25,

9.11,

12.58,

15.11,

18.90,

13.05,

11.50,

7.76,

6.33,

4.07,

7.18,

3.23,

4.07,

3.67,

12.85,

2.54

2.66

11.92

10.26

6.69

1.69

-1.01

-2.74

5.25

5.68

6.94

6.59

5.38

8.78

6.77

6.10

6.14

8.06

3.43

-0.83

2.50

0.09

-2.39

-3.24

-2.99

-3.85

-7.75

-6.12

-1.85

-0.60

This file contains the actual air temperature for Becker during the simulation period, with each day having a maximum and minimum temperature. For the baseline scenario these are the same values as the crop reference temperatures in DATA13.PRN.

----- C:\NCSWAP\DATA14.AVG

-

91, 7.67, -8.28 92, 13.46, 1.01 93, 10.66, -4.26 94, 17.56, 2.86 95, 13.96, 3.48 96, 10.11, -1.98 97, 12.81, 2.17 98, 11.99, 2.49 99, 4.58, -0.95 100, 3.55, -6.44 101, 0.88, -9.11 102, 3.53, -2.24 103, 8.15, 0.97 104, 5.84, 3.17 105, 9.10, 1.23 106, 10.14, -2.44 107, 14.89, 6.21 108, 19.54, 11.02 109, 11.03, 2.35 110, 7.58, 1.50 111, 6.24, 1.31 112, 5.79, -1.56 1/ 9.74, 1.00 114, 7.49, 0.80 115, 9.33; -0.38 116, 14.81, -2.91 117, 22.86, 4.99 118, 26.03, 10.26 119, 28.22, 9.41 120, 31.17, 15.17 121, 19.77, 6.32 122, 17.78, 2.10 123, 14.15, 2.86 124, 17.19, -2.29 125, 22.95, 4.40 126, 27.74, 11.19 127, 28.43, 11.79 128, 29.87, 7.93 129, 29.71, 17.38 130, 23.07, 15.14 131, 20.57, 8.51 132, 14.68, 4.09 133, 20.74, 7.28 134, 23.57, 12.99 135, 26.24, 16.19 136, 18.13, 7.76 137, 22.80, 7.19 13<sup>p</sup> 28.50, 12.89 1 30.04, 15.02 140, 27.36, 16.77 141, 25.16, 6.87 142, 15 12, 5.64 143, 2.06

,

144 , 11.06, 4.23 145, 17.96, 2.06 146, 20.36, 6.63 14~ 22.23, 9.92 23.11, 14 8.62 149, 26.44, 6.24 150, 27.80, 8.82 27.97, 151, 12.61 152, 27.70, 9.51 153, 30.07, 15.20 154, 24.77, 12.55 155, 25.27, 8.23 156, 20.34, 8.52 157, 21.04, 6.61 158, 19.92, 11.70 159, 27.53, 14.06 160, 29.75, 15.64 161, 32.45, 15.69 162, 33.78, 15.75 163, 33.33, 15.16 164, 26.61, 16.01 165, 24.41, 14.67 166, 24.23, 15.34 167, 20.94, 16.42 168, 26.69, 16.89 169, 16.97, 4.10 170, 19.50, 2.67 171, 20.21, 3.16 172, 15.52, 10.84 1 24.36, 14.32 174, 23.82, 13.13 21.77, 175, 10.43 176, 21.53, 7.32 177, 25.23, 6.44 178, 29.18, 14.93 23.45, 179, 10.48 180, 19.74, 9.71 181, 30.02, 12.47 182, 20.62, 13.59 183, 21.46, 13.14 21.89, 184, 10.61 24.26, 185, 9.77 186, 25.06, 10.04 187, 27.42, 17.14 29.42, 188, 17.54 189, 27.95, 15.26 190, 24.27, 16.19 191, 22.44, 14.96 192, 25.84, 15.50 193, 21.43, 13.83 194, 25.58, 12.17 23.19, 195, 15.04 196, 25.25, 13.80 197, 25.63, 14.23 19# 25.53, 13.07 1 23.95, 13.44 200, 21.91, 11.98 201, 24.93, 11.07 202, 16.84, 10.60 203, 22.99, 10.15

204, 22.41, 11.65 264, 15.25, 2.54 205, 25.76, 17.50 265, 21.79, 2.66 21.62, • 11.92 206, 27.31, 14.27 266, 26-23.24, 20- 29.23, 10.00 17.43, 2L 26.51, 14.87 2L 209, 23.58, 269, 22.10, 8.15 270, 12.96, 210, 24.38, 9.64 211, 26.57, 10.52 271, 19.00, 272, 25.16, 212, 29.15, 16.97 273, 30.00, 213, 24.31, 12.73 274, 32.05, 214, 22.67, 10.78 275, 23.62, 215, 24.56, 7.59 276, 21.88, 216, 25.76, 10.56 277, 22.69, 217, 22.24, 14.72 218, 24.23, 17.95 278, 15.77, 219, 32.05, 18.13 279, 8.25, 220, 33.79, 22.80 280, 9.11, 281, 12.58, 221, 25.69, 15.11 282, 15.11, 222, 26.09, 12.15 283, 18.90, 223, 19.67, 11.37 13.05, 224, 20.93, 8.45 284, 285, 11.50, 225, 22.89, 6.20 286, 7.76, 226, 23.06, 8.73 287, 6.33, 227, 24.15, 9.93 228, 23.18, 15.21 288, 4.07, 289, 7.18, 229, 25.49, 10.55 230, 25.70, 9.34 290, 3.23, 4.07, 231, 26.67, 13.02 291, 292, 3.67, -1.85 232, 26.06, 18.73 21 12.85, -0.60 27 28.19, 18.14 234, 29.55, 18.88 23.68, 235, 15.58 236, 18.71, 11.00 237, 19.32, 10.89 238, 20.48, 10.60 239, 21.94, 10.06 240, 25.98, 13.52 241, 20.89, 10.69 242, 20.19, 7.61 243, 23.49, 8.10 244, 24.36, 14.74 245, 23.21, 9.30 246, 22.63, 13.01 247, 23.47, 14.41 248, 22.41, 8.83 249, 20.09, 7.78 250, 17.93, 6.19 251, 18.89, 9.93 252, 17.95, 5.75 253, 22.14, 4.89 254, 23.35, 15.46 255, 26.19, 14.31 256, 25.06, 11.38 257, 24.53, 8.61 258 28.29, 13.47 25 19.63, 11.22 260, 15.11, 3.35 261, 18.41, 2.26 262, 24.84, 10.46 263, 25.69, 8.25

10.26 6.69 1.69 -1.01 -2.74 5.25 5.68 6.94 6.59 5.38 8.78 6.77 6.10 6.14 8.06 3.43 -0.83 2.50 0.09 -2.39 -3.24 -2.99 -3.85 -7.75 -6.12

# DATA55.INC -- Soil physical and hydrologic properties

This file contains parameter specifications for soil properties under the three user options SAND, LOAM, and CLAY. These variables are incorporated into the program at compilation using an include statement. These are important assumptions that the user should be made aware of, and perhaps given the option to modify. ----- C:\NCSWAP\DATA55.INC

c data statements for soil type rev. 9/31/92; 3/16/93 c Becker corn '92

character\*5 soiltex(9)
real sta(12,9)

- c bdh,thi,td,ksat,fcsat data (sta(1,i),i=1,9) /1.2,1.5,1.6,1.55,1.6,1.66,1.2,1.25,1.3/ data (sta(2,1),i=1,9) /0.84,.067,.063,.09,.075,.06,.25,.24,.231/ data (sta(2,1),i=1,9) /3\*.05,.037,.03,.012,3\*.14/ data (sta(4,1),i=1,9) /9\*99/ data(sta(5,1),i=1,9) /.1836,.2307,.2533, 1.485,.4838,.2888,.548,.568,.589/
- c anh3,ano3
  data (sta(6,i),i=1,9) / 2,1,1,.745,.1,.11,2,1,1/
  data (sta(7,i),i=1,9) /10,2,2,3.4,2.7,1.4,10,2,2/
- c conc1, 14, 6, 2, seratio
   data (sta(8,1),i=1,9) / .5, .5, .1, .5, .5, .1, .5, .5, .1/
   data (sta(9,i),i=1,9) / .5, .5, .1, .5, .5, .1, .5, .5, .1/
   data (sta(10,i),i=1,9) / 9\*0/
   iata (sta(11,i),i=1,9) / 30, 31, 10, 5, 1, 30, 3, 1/
   data (sta(12,i),i=1,9) / 3\*.5, 3\*.1, 3\*.1/

data soiltex / 'sand1','sand2','sand3','beck1','beck2','beck3',
1'clay1','clay2','clay3'/

#### ----- C:\NCSWAP\DATA56.PRN

### DATA56.PRN and DATA58.PRN

These two files are used to communicate between the user interface program and the main model program. They are written and read, back and forth, for each simulation run.

30700 OCT 12 1 1 APR 2 20 2 2 NAY 30

APR 28

- 200 1
- 1

----- C:\NCSWAP\DATA58.PRN

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128.31

30.45 29.18 14804.88 .00 5.02 273.51 79.57

.01

Section 4. Model baseline results -- full report.

This section contains the full (baseline) report, file OUT3.PRN. This report reprints the input files (from section 3), and the outcome values on the last day of the run. Generating the full report is useful for debugging and other purposes, but slows the program runtime, especially when executed from a diskette. Therefore, the demonstration disk program does not generate this report. (See section 2 for more details on the baseline scenario.)

S. Andrews		)				1						1		
				1	.7	3.4	.0	6.	.0 6.0	) 1	00.0 10.0	.1		
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C:\NCSWAP\OUT3.PRN				3	.1	1.4	.0	1.	.2 6.0	D	10.0 10.0	.1		
-														
							CATION (P							
							- DAYS							
1					HORIZON	91-150 15	1-160 161	-1/0 1/1-4	273					
					1	20.0	20.0 2	20.0 20	.0					
,					2			20.0 20						
					3			20.0 20						
SUNNARY OF MAJOR OPTI	ONS SELECTED FOR THIS RUN													
				DENI	RIFICATION	CONSTANT AT	WATER SATU	JRATION : C	STDEN= 6.00	(PPM C / PPM	i ND			
I TEMS:	OPTIONS SPECIFIED										-	10 10		
				REDU	CTION FACTOR	AT 80.00 PE	RCENT WATE	K SATUKATI	UN IDENIIKIP	1041108, 13	0 ; NITRIFICATI			
TIME V	ARIABLES			DEDI		TO SOLUTES	FLOU + .8	0						
				REDU	TION TROTO	10 3020120								
REFERENCE DATE:														
MONTH = 1						INIT	IAL PHYSIC	CAL PROPERT	IES PER HORI	ZON				
DAY = 1														
						HOR	120N	TEXTURE	BULK DENS		BBON' WHEN WET			
DAYS OF RUN RELATIVE TO REFERENCE DATE:									(GM/CM*	*3)	(E\$ (1) NO (0)			
STARTING DAY = 91								h h 4			•			
STOPPING DAY = 293							1	beck1	1.55 1.60		0			
HARVEST DAY = 282							2 3	beck2 beck3	1.66		õ			
							•				-			
X	SOIL	ROOT AND												
COMPUTATIONAL TIME STEPS (DAY):	BIOLOGICAL TRANSFORMATIONS	CROP TOP GROWTH	INFILTRATION			INIT	IAL HYDRAU	ULIC PROPER	TIES PER HOR	1ZON	-			
DAYS WITH WATER INFILTRATION	.20	1.00	.20								[		040401TV	
DAYS WITH NO WATER INFILTRATION	1.00	1.00			GRAVIMET		WATER STI		AT SATU			T WATER FIELD IC VOLUMETRIC		
				HORIZON	WATER CON			NL/CH##3)	GRAVIMETRIC (ML/GM)	(ML/CH**3			) SATURATION	
PROFIL	E GEOMETRY				(ML/GM	) (nu)	Gen j Ca	nu/ un ' J/	(ne/ un/		, (,,	(112) - 11		
	····			1	.090		37	.057	.268	.415	. 130	.201	48.50	
NUMBER OF HORIZONS = 3				2	.075		30	.048	.248	.396	.120	. 192	48.38	
				3	.060		012	.020	.225	.374	.065	.108	28.88	
HORIZONS: DEPTHS FROM SURFACE														
TO LOWER BOUNDARIES (CM) = 12.0	48.0 144.0													
						YDRAULIC SU								
THICKNESS OF SEGMENTS (CN) = 6.0				HORIZON	CONDUCT		ETTING FR							
NUMBER OF DEPTH INCREMENTS			•		(CM/DAY	,	(CM)							
FOR HYDRAULIC PROCESSES = 31				1	99.0	0								
				2	99.0									·
NUMBER OF TEMPERATURE LAYERS = 4				3	99.0									
TEMPERATURE LAYER DEPTHS (CM) = 6.0	24.0 84.0 144.0													
				HOD	RATLY TO EX	CESSIVELY WE	LL DRAINED	SOIL						
INITIAL CHEMICAL AND BIOCH	ENICAL PROPERTIES DED HODITON -													
INITIAL CREMICAL AND BIOCH	ILTIONE FROFENTIES FER NURIZUN "			÷ ۲		-	SIIP	FACE PROPER	RTIES	-				
<b>—</b>	POOL I	POOL II RATI	O OF SOLUBLE				30K							
HORIZON TOTAL NH4 NO3 UREA			TOTAL NH4	N.	FRA	CTION OF SUR	FACE THAT	IS BARE			20		•	
PPM N PPM N PPM N		H C C/N		r.		UCTION IN EV			IDUE		80			
					NUM	BER OF TOP S	EGMENTS CO	NTRIBUTING	TO EVAPORAT	ION	1			

------ WATER APPLICATIONS (RAINFALL, IRRIGATION, . . .) ------Total Applied: 64.1 CM

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	AMOUNT	NITROGEN CON	TENT (PPM N)	DURATION
DAY	(CH)	NH4-N	NO3-N	(HRS)
99	. 18	.0000E+00	.0000E+00	1.0
100	. 15	.0000E+00	.0000E+00	1.0
104	.18	.0000E+00	.0000E+00	1.0
107	.10	.0000E+00	.0000E+00	1.0
108	.18	.0000E+00	.0000E+00	1.0
109	.53	.0000E+00	.0000E+00	1.0
110	.03	.0000E+00	.0000E+00	1.0
111	.03	.0000E+00	.0000E+00	1.0
123	.05	.0000E+00	.0000E+00	1.0
124	.05	.0000E+00	.0000E+00	1.0
130	3.05	.0000E+00	.0000E+00	3.0
131	.03	.0000E+00	.0000E+00	1.0
132	.03	.0000E+00	.0000E+00	1.0
135	.25	.0000E+00	.0000E+00	1.0
138	.46	.0000E+00	.0000E+00	1.0
141	.33	.0000E+00	.0000E+00	1.0
145	1.52	.0000E+00	.0000E+00	1.0
146	1.05	.0000E+00	.0000E+00	1.0
151	.20	.0000E+00	.0000E+00	1.0
152	.57	.0000E+00	.0000E+00	1.0
153	.20	.0000E+00	.0000E+00	1.0
155	.55	.0000E+00	.0000E+00	1.0
156	.45	.0000E+00	.0000E+00	1.0
158	.86	.0000E+00	.0000E+00	1.0
159	1.14	.0000E+00	.0000E+00	1.0
161	1.90	.0000E+00	.0000E+00	2.0
165	2.26	.0000E+00	.0000E+00	2.0
166	2.26	.0000E+00	.0000E+00	2.0
167	1.90	.0000E+00	.0000E+00	2.0
168	.13	.0000E+00	.0000E+00	1.0
172	.66	.0000E+00	.0000E+00	1.0
175	1.52	.0000E+00	.0000E+00	1.0
181	1.45	.0000E+00	.0000E+00	1.0
182	4.95	.0000E+00	.0000E+00	5.0
183	.13	.0000E+00	.0000E+00	1.0
188	2.54	.0000E+00	.0000E+00	2.0
190	1.57	.0000E+00	.0000E+00	1.0
192	3.25	.0000E+00	.0000E+00	3.0
194	3.25	.0000E+00	.0000E+00	3.0
196	.25	.0000E+00	.0000E+00	1.0
200	.48	.0000E+00	.0000E+00	1.0
201	2.03	.0000E+00	.0000E+00	2.0
202	.05	.0000E+00	.0000E+00	1.0
203	.30	.0000E+00	.0000E+00	1.0
208	2.54	.0000E+00	.0000E+00	2.0
211	1.90	.0000E+00	.0000E+00	2.0
212	.58	.0000E+00	.0000E+00	1.0
215	.58	.0000E+00	.0000E+00	1.0
216	1.52	.0000E+00	.0000E+00	1.0
218	2.72	.0000E+00	.0000E+00	3.0
222	2.03	.0000E+00	.0000E+00	2.0

230	2.54	.0000E+00	.0000E+00	3.0
232	.23	.0000E+00	.0000E+00	1.0
235	1.52	.0000E+00	.0000E+00	1.0
236	2.46	.0000E+00	.0000E+00	2.0
237	.91	.0000E+00	.0000E+00	1.0
243	1.09	.0000E+00	.0000E+00	1.0
246	.30	.0000E+00	.0000E+00	1.0
247	.03	.0000E+00	.0000E+00	1.0
257	. 05	.0000E+00	.0000E+00	1.0

#### -----WEEKLY PAN EVAPORATION DATA (CH)-----

1: .00; 2: .00; 3: .00; 4: .00; 5: .00; 6: .00; 7: .00; 8: .00; 9: .00; 10: .00; 11: .00; 12: .00; 13: .00; 14: .00; 15: .64; 16:4.70; 17:5.60; 18:3.86; 19:4.86; 20:6.14; 21:5.71; 22:7.28; 23:5.00; 24:3.02; 25:7.86; 26:8.50; 27:5.57; 28:5.71; 29:6.14; 30:6.00; 31:6.14; 32:6.00; 33:5.28; 34:3.14; 35:3.86; 36:5.70; 37:2.57; 38:3.28; 39:1.25; 40:1.00; 41:1.50; 42: .50; 43: .00; 44: .00; 45: .00; 46: .00; 47: .00; 48: .00; 49: .00; 50: .00; 51: .00; 52: .00;

#### ----- DAILY MAX, MIN, & AVE AIR TEMPERATURES (DEG CELSIUS) ------

D	AY MAXI	NH MINIM	M AVERAGE	E DAY	MAXIMUN	MINIMUM	AVERAGE	DAY	NAXINUN	MINIMUM	AVERAGE	DAY	HAXINUH	MINIMUM	AVERAGE	
	91 7.0	57 -8.20	330	92	13.46	1.01	7.24	93	10.66	-4.26	3.20	94	17.56	2.86	10.21	
	95 13.9			96	10.11	-1.98	4.06	97	12.81	2.17	7.49	98	11.99	2.49	7.24	
	99 4.5			100	3.55	-6.44	-1.45	101	.88	-9,11	-4.11	102	3.53	-2.24	.64	
	03 8.1			104	5.84	3.17	4.51	105	9.10	1.23	5.16	106	10.14	-2.44	3.85	
	07 14.8			108	19.54	11.02	15.28	109	11.03	2.35	6.69	110	7.58	1.50	4.54	
	11 6.2			112	5.79	-1.56	2.12	113	9.74	1.00	5.37	114	7.49	.80	4.14	
	15 9.3				14.81	-2.91	5.95	117	22.86	4.99	13.93	118	26.03	10.26	18.15	
	19 28.2			120	31.17	15.17	23.17	121	19.77	6.32	13.05	122	17.78	2.10	9.94	
	23 14.1			124	17.19	-2.29	7.45	125	22.95	4.40	13.68	126	27.74	11.19	19.47	
	27 28.4			128	29.87	7.93	18.90	129	29.71	17.38	23.54	130	23.07	15.14	19.10	
	31 20.5			132	14.68	4.09	9.39	133	20.74	7.28	14.01	134	23.57	12.99	18.28	
	35 26.2			136	18.13	7.76	12.94	137	22.80	7.19	14.99	138	28.50	12.89	20.69	
	39 30.0			140	27.36	16.77	22.07	141	25.16	6.87	16.01	142	15.12	5.64	10.38	
1	43 13.1			144	11.06	4.23	7.65	145	17.96	2.06	10.01	146	20.36	6.63	13.50	
1	47 22.2			148	23.11	8.62	15.86	149	26.44	6.24	16.34	150	27.80	8.82	18.31	
1	51 27.9	7 12.61	20.29	152	27.70	9.51	18.60	153	30.07	15.20	22.64	154	24.77	12.55	18.66	
1	55 25.2	7 8.23	5 16.75	156	20.34	8.52	14.43	157	21.04	6.61	13.83	158	19.92	11.70	15.81	
1	59 27.5	3 14.00	20.80	160	29.75	15.64	22.69	161	32.45	15.69	24.07	162	33.78	15.75	24.76	
1	63 33.3	3 15.16	5 24.25	164	26.61	16.01	21.31	165	24.41	14.67	19.54	166	24.23	15.34	19.78	
1	67 20.9	4 16.42	2 18.68	168	26.69	16.89	21.79	169	16.97	4.10	10.53	170	19.50	2.67	11.09	
1	71 20.2	1 3.16	5 11.68	172	15.52	10.84	13.18	173	24.36	14,32	19.34	174	23.82	13.13	18.48	
1	75 21.7	7 10.43	5 16.10	176	21.53	7.32	14.43	177	25.23	6.44	15.84	178	29.18	14.93	22.06	
1	79 23.4	5 10.48	16.97	180	19.74	9.71	14.73	181	30.02	12.47	21.25	182	20.62	13.59	17.10	
1	83 21.4	6 13.14	17.30	184	21.89	10.61	16.25	185	24.26	9.77	17.01	186	25.06	10.04	17.55	
1	87 27.4	2 17.14	22.28	188	29.42	17.54	23.48	189	27.95	15.26	21.60	190	24.27	16.19	20.23	
1	91 22.4	4 14.96	5 18.70	192	25.84	15.50	20.67	193	21.43	13.83	17.63	194	25.58	12.17	18.88	
1	95 23.1	9 15.04	19.11	196	25.25	13.80	19.52	197	25.63	14,23	19.93	198	25.53	13.07	19.30	
1	99 23.9	5 13.44	18.69	200	21.91	11.98	16.94	201	24.93	11.07	18.00	202	16.84	10.60	13.72	
2	03 22.9	9 10.15	6 16.57	204	22.41	11.65	17.03	205	25.76	17.50	21.63	206	27.31	14.27	20.79	
2	07 29.2	3 10.00	) 19.61	208	26.51	14.87	20.69	209	23.58	8.15	15.86	210	24.38	9.64	17.01	4
2	11 26.5	7 10.52	2 18.55	212	29.15	16.97	23.06	213	24.31	12.73	18.52	214	22.67	10.78	16.73	
	15 24.5			216	25.76	10.56	18.16	217	22.24	14.72	18.48	218	24.23	17.95	21.09	
-	19 32.0			220	33.79	22.80	28.30	221	25.69	15.11	20.40	222	26.09	12.15	19.12	1.5
2	23 19.6			224	20.93	8.45	14.69	225	22.89	6.20	14.55	226	23.06	8.73	15.89	÷,
	27 24.1			228	23.18	15.21	19.19	229	25.49	10.55	18.02	230	25.70	9.34	17.52	
	31 26.6			232	26.06	18.73	22.40	233	28.19	18.14	23.17	234	°°.55	18.88	24.22	
2	35 23.6	8 15.58	3 3	236	18.71	11.00	14.85	237	19.32	10.89	15.10	238	.48	10.60	15.54	

239 21.94 10.06 16.00 240 25.98 13.52 19.75 241 20.89 10.69 15.79 242 20.19 7.61 13.90	(KG/HA) (PER PLANT BASIS) (KG/HA) (PER PLANT BASIS) (PLT/HA) (DAY AFTER EMERGENCE)
243 23.49 8.10 15.80 244 24.36 14.74 19.55 245 23.21 9.30 16.25 246 22.63 13.01 17.82	
247 23.47 14.41 18.94 248 22.41 8.83 15.62 249 20.09 7.78 13.94 250 17.93 6.19 12.06	.2000E+05 .1008E+01 .9269E+01 .1000E+05 .1015E+01 .3555E+01 60001
	2563E+00 .2424E-022514E+00 .6459E-02
.35 26.19 14.31 20.25 256 25.06 11.38 18.22 257 24.53 8.61 16.57 258 28.29 13.47 20.88	9117E-057598E-04
259 19.63 11.22 15.42 260 15.11 3.35 9.23 261 18.41 2.26 10.34 262 24.84 10.46 17.65	
263 25.69 8.25 16.97 264 15.25 2.54 8.90 265 21.79 2.66 12.23 266 21.62 11.92 16.77	
267 23.24 10.26 16.75 268 17.43 6.69 12.06 269 22.10 1.69 11.90 270 12.96 -1.01 5.97	ROOTS
271 19.00 -2.74 8.13 272 25.16 5.25 15.20 273 30.00 5.68 17.84 274 32.05 6.94 19.49	
275 23.62 6.59 15.11 276 21.88 5.38 13.63 277 22.69 8.78 15.74 278 15.77 6.77 11.27	ROOT PENETRATION (CM/DAY) SHOOT TO ROOT RATIO (S/R) RATIO OF EXUDATE & SLOUGH ROOT MASS GROWTH STOPS
279 8.25 6.10 7.18 280 9.11 6.14 7.63 281 12.58 8.06 10.32 282 15.11 3.43 9.27	ROOT PENETRATION (CM/DAY) SHOOT TO ROOT RATIO (S/R) RATIO OF EXUDATE & SLOUGH ROOT MASS GROWTH STOPS 0 - 50 DAYS > 50 DAYS INITIAL SLOPE VS TIME TO TOTAL ROOT MASS INCREASE (DAYS PAST EMERGENCE) 2.000 .220 .500 .136 .120 65
283 18.9083 9.03 284 13.05 2.50 7.78 285 11.50 .09 5.80 286 7.76 -2.39 2.68	
287 6.33 -3.24 1.54 288 4.07 -2.99 .54 289 7.18 -3.85 1.66 290 3.23 -7.75 -2.26	2.000 .220 .500 .136 .120 65 🤅
291 4.07 -6.12 -1.02 292 3.67 -1.85 .91 293 12.8560 6.13	
	GROWTH STAGE FRACTION OF ROOTING DEPTH
	(DAY PAST EMERGENCE) ROOT MASS INCREASE AT EMERGENCE
INORGANIC NITROGEN APPLICATIONS	IN TOP 18.0 CM 15.0 CM
DEPTH INTERVAL N15/TOTAL-N ANOUNTS (KG/HA)	0-10.550
DAY (CM) NH4-N NO3-N NH4-N NO3-N UREA	11- 20 .500
	21- 40 -450
150 0- 15 .2247E+03 .0000E+00 .0000E+00	41- 60 -400
ORGANIC APPLICATIONS	AVERAGE PLANT OPTIMAL NITROGEN CONTENT
SPECIFIC RATE OF	GROWTH
DEPTH INTERVAL W15/ DECOMPOSITION (PER DAY)	STAGE N/DRY MASS RATIO OF
RESIDUE NOTE DAY (CM) TOTAL-N C/N LABILE RECALCITRANT S	DAY XXXXXXXXXX RATIO ROOT TO TOP
	N PERCENTAGE
ند. 5, 6 GRASS CLIPPINGS 92 0- 30 40.0 .045 .001 1.000	
AMOUNT INCORPORATED AMOUNT APPLIED TO SURFACE	30 .3000E-01 .1000E+01
	40 .2940E-01 .1000E+01 45 .2700E-01 .1000E+01
(KG C/HA) (KG C/HA) FRACTION Residue Labile Recalcitrant Labile Recalcitrant Coverage	
RESIDUE LABILE RECALCITRANT LABILE RECALCITRANT COVERAUE	
5, 6 ****** .0 .0 .0 .80	55 .2100E-01 .1000E+01 65 .1800E-01 .1000E+01
5, 6 .6 .6 .6	75 .1600E-01 .1000E+01
	90 .1400E-01 .1000E+01
TILLAGE EVENTS	110 .1200E-01 .1000E+01
BULK DENSITY FRACTION FRACTION SATURATED HYDRAULIC DEPRESSION	
DATE DEPTH (CH) HININUM HAXIMUM INCORPORATION COVERAGE CONDUCTIVITY (CM/DAY) STORAGE (CH)	AVERAGE CARBON FRACTION (DRY MASS BASIS): .40
NININUN NAXINUM NININUM MAXINUM	
	DAY = 91 4/1
CROP TOP	
(15 PERCENT WATER CONTENT)	
	' INITIAL CHEMICAL, BIOCHEMICAL, AND PHYSICAL PROPERTIES
DAYS AFTER EMERGENCE TO: DAY OF PLANT FULL CANOPY	(BOTTON SEGMENT INCLUDED)
GRAIN PHYSIOLOGICAL EMERGENCE POPULATION TOP MASS DAYS PAST FRACTION ONSET OF SENESCENCE	
FILLING MATURITY (PLT/HA) (KG/HA) EMERGENCE EVAPORATION DAYS BEFORE MATURITY	WATER ADSORBED SOLUBLE POOL I POOL I
	DEPTH CONTENT NH4-N NH4-N NO3-N UREA-N MICROBIAL MASS HUMADS
50 110 125 <b>75829 .5296E+02</b> 15 .150 10	SEGNENT CM ML/ML PPM N PPM N PPM N PPM N PPM C PPM C

3

4

5

GRAIN YIELD TOP MASS TOP SOIL TEMPERATURE MAXIMUM REGRESSION HAXINUM REGRESSION OPTIMUM TOP MASS PARAMETERS GRAIN YIELD PARAMETERS PLANT POPULATION CONTROLS CROP GROWTH

.

4

.6000E+01 .1000E+03 6.0 .1395E+00 .6705E+00 .7450E-01 .3400E+01 .0000E+00 .0000E+00 .6000E+01 .1000E+03 .7450E-01 .3400E+01 12.0 .1395E+00 .6705E+00 .6000E+01 .5000E+02 18.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .5000E+02 24.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .6000E+01

6 30.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .6000E+01 .5000E+02	H2O
7 36.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .6000E+01 .5000E+02	.1548E+05 .1423E+03 .9115E+04 .0109 .7534E+03 20.545 .1329E+02 .0149
8 42.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .6000E+01 .5000E+02	
9 48.0 .1200E+00 .9000E-01 .1000E-01 .2700E+01 .0000E+00 .6000E+01 .5000E+02	
10 54.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	GROWTH REDUCTION RATIOS
1 60.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
12 66.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	ACTUAL/POTENTIAL ACTUAL/POTENTIAL ACTUAL/POTENTIAL ACTUAL/POTENTIAL ACTUAL/POTENTIAL ACTUAL/REFERENCE ACTUAL/OP
3 72.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	ROOT LENGTH N UPTAKE N PERCENTAGE H20 UPTAKE TEMPERATURE PLANT POPU
4 78.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
15 84.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	CURRENT RUNNING CURRENT RUNNING CURRENT RUNNING CURRENT RUNNING CURRENT RUNNING .LE.1
16 90.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	VALUE AVERAGE VALUE AVERAGE VALUE AVERAGE VALUE AVERAGE VALUE AVERAGE
17 96.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
18         102.0         .9960E-01         .1100E-01         .1400E+01         .0000E+00         .1200E+01         .1000E+02	.100 .100 .220 .539 .909 .879 1.000 1.000 1.000 1.001 1.000
19 108.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
20 114.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
21 120.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	NITROGEN IN PLANT (TOP + ROOT)
22 126.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	
23 132.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	RATIO OF
24 138.0 .9960E-01 .9900E-01 .1100E-01 .1400E+01 .0000E+00 .1200E+01 .1000E+02	N UPTAKE N TO TOTAL PLANT
	FROM SOIL PLANT N DRY MATTER PLANT N15 N15/TOTAL N N GAS LOSS N EXUDATE (ROOT)
	GM N/PLANT GM N/PLANT IN PLANT GM N15/PLANT IN PLANT GM N/PLANT GM N/PLANT
	KG N/HA KG N/HA KG N/HA KG N/HA KG N/HA
	.2076E+01 .2052E+01 .0113 .0000E+00 .2390E-01
* ORGANIC APPLICATION. DAY NUMBER 92.	.1574E+03 .1556E+03 .0000E+00 .1812E+01 *
DEPTHS: .0 TO 30.0 CM (SEGMENTS 2 TO 6).	
AMOUNT, PER SEGMENT, ADDED TO RESIDUE SLOTS 5 AND 6,	
WITH CORRESPONDING CHARACTERISTICS:	DEFICIT IN CROP (ABOVE GROUND + ROOT)
LABILE FRACTION	
CARBON .2730E+05 UG	DEFICIT MOISTURE: .000 CM H20
NITROGEN .6824E+03 UG	DEFICIT MOISTURE: .000 CM H20 Jeficit Nitrogen, Reference - Actual Crop N: 31.334 Kg/HA
NITROGEN .6824E+03 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA
NITROGEN .6824E+03 UG C/N .4000E+02	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA
NITROGEN .6824E+03 UG C/N .4000E+02 Recalcitrant fraction	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA
NITROGEN .6824E+03 UG C/N .4000E+02 Recalcitrant Fraction Carbon .0000E+00 Ug	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA
NITROGEN .6824E+03 UG C/N .4000E+02 Recalcitrant Fraction Carbon .0000E+00 UG Nitrogen .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE
NITROGEN       .6824E+03       UG         C/N       .4000E+02         RECALCITRANT       FRACTION         CARBON       .0000E+00       UG         NITROGEN       .0000E+00       UG         C/N       .4000E+02	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE
NITROGEN       .6824E+03       UG         C/N       .4000E+02         RECALCITRANT       FRACTION         CARBON       .0000E+00       UG         NITROGEN       .0000E+00       UG         C/N       .4000E+02	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150.	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20
NITROGEN       .6824E+03 UG         C/N       .4000E+02         RECALCITRANT FRACTION         CARBON       .0000E+00 UG         NITROGEN       .0000E+00 UG         C/N       .4000E+02         AMOUNT LEFT ON SURFACE:       LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C         * INORGANIC NITROGEN APPLIED. DAY NUMBER 150.         DEPTHS:       .0 TO 15.0 CM (SEGMENTS 2 TO 4).	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 WATER ADSORBED SOLUBLE POOL I POOL I
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT:	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 WATER ADSORBED SOLUBLE POOL I POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 WATER ADSORBED SOLUBLE POOL I POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C 'INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CH2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 WATER ADSORBED SOLUBLE POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS SEGMENT CM ML/ML PPM N PPM N PPM N PPM N PPM N PPM C PPM C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+02
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C 'INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CH2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 WATER ADSORBED SOLUBLE POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS SEGMENT CM ML/ML PPM N PPM N PPM N PPM N PPM N PPM C PPM C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+02
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N HICROBIAL MASS HUMADS SEGMENT CM HL/ML PPM N PPM N PPM N PPM N PPM N PPM C PPM C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1366E+02 .0000E+00 .2864E+03 .4488E+02 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1354E+02 .0000E+00 .2815E+03 .4317E+02
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTMS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CH2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS SEGMENT CH ML/ML PPH N PPH N PPH N PPH N PPH N PPH C PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+02 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1354E+02 .0000E+00 .2864E+03 .4488E+02 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1088E+02 .0000E+00 .2886E+03 .3835E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .0000E+01 .3144E+03 .3616E+02
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C 'INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG CROP HAS REACHED PHYSIOLOGICAL MATURITY: DAY 234; 110 DAYS, DEGREE DAYS PAST EMERGENCE	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H20 FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CH2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N NICROBIAL MASS HUMADS SEGMENT CH ML/ML PPH N PPH N PPH N PPH N PPH N PPH C PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1356E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1000E+00 .2864E+03 .4317E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .0000E+00 .2886E+03 .3835E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .3329E+01 .0000E+00 .3144E+03 .3616E+02 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3329E+01 .0000E+00 .3145E+03 .3409E+00
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG W/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE PON PON N PON N UREA-N MICROBIAL MASS HUMADS SEGMENT CH ML/ML PPN N PPN N PPN N PPN N PPN N PPN N PPN C PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1366E+02 .0000E+00 .2864E+03 .4488E+02 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1364E+02 .0000E+00 .2815E+03 .4317E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1000E+01 .0000E+00 .2815E+03 .4317E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1000E+01 .3144E+03 .3618E+02 5 24.0 .1917E+00 .9000E-19 .1000E-19 .3929E+01 .0000E+00 .3144E+03 .3618E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3449E+01 .3075E+00 7 36.0 .1917E+00 .9000E-19 .1000E+19 .7818E+00 .0000E+00 .3449E+01 .3075E+00 7 36.0 .1917E+00 .9000E-19 .1000E+19 .7818
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VREA .0000E+00 UG VREA .0000E+00 UG AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UC NO3 .0000E+00 UG VREA .0000E+00 UG VREA .0000E+00 UG CROP HAS REACHED PHYSIOLOGICAL MATURITY: DAY 234; 110 DAYS, DEGREE DAYS PAST EMERGENCE 61 DAYS, DEGREE DAYS PAST BEGINNING GRAIN FILLING	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H20 FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I POOL I POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N HICROBIAL MASS HUMADS SEGMENT CM ML/HL PPH N PPM N PPM N PPM N PPM N PPM C PPM C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1354E+02 .0000E+00 .2815E+03 .4317E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1008E+02 .0000E+00 .2886E+03 .3835E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1008E+01 .0000E+00 .3144E+03 .3616E+00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3781E+00 .0000E+00 .3145E+03 .3407E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .783E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .783E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .783E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7632E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7632E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E+19 .7632E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E+19 .7632E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1
<pre>NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VREA .0000E+00 UG</pre>	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TEMP H20 FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I MICROBIAL MASS HUMADS SEGMENT CM ML/ML PPN N NH4-N N03-N UREA-N MICROBIAL MASS PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1366E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1356E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1008E+02 .0000E+00 .2864E+03 .4488E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1088E+02 .0000E+00 .3144E+03 .3616E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .000E+01 .3146E+03 .3409E+00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3144E+03 .3409E+00 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3454E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3454E+01 .3065E+00 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7555E+00 .0000E+00 .2865E+01 .3065E+00
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .000DE+00 UG C 'INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VIRA .0000E+00 UG VIRA .0000E+00 UG VIRA .0000E+00 UG	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TEMP H2O FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS HUMADS SEGMENT CN HL/HL PPN N PPM N PPM N PPM N PPM N PPM N PPH C PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2015E+00 .9000E-19 .1000E-19 .1354E+02 .0000E+00 .2815E+03 .4317E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .0088E+02 .0000E+00 .3144E+03 .3615E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .3929E+01 .0000E+00 .3144E+03 .3416E+00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3144E+03 .3416E+00 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7818E+00 .0000E+00 .3449E+01 .3075E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7852E+00 .0000E+00 .3449E+01 .3075E+00 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7832E+00 .0000E+00 .3449E+01 .3056E+00 10 54.0 .1079E+00 .9000E-19 .1000E-19 .7575E+00 .0000E+00 .2864E+01 .3056E+00 10 54.0 .1079E+00 .9000E-19 .1000E-19 .7575E+00 .0000E+00 .3449E+01 .3056E+00 10 54.0 .1079E+00 .9000E-19 .1000E-19 .7575E+00 .0000E+00 .7286E+01 .7576E+00 10 54.0 .1079E+00 .9000E-19 .1000E-19 .7575E+00 .0000E+00 .7286E+01 .7576E+00
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C 'INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VREA .0000E+00 UG LIVE ROOT MASS NOW ACCESSIBLE TO MICROBIAL ACTIVITY. DAY 235	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP H20 FACTORS): 10.000 KG W/HA NOTE: TO CONVERT UG/CH2 TO KG/HA, DIVIDE UG/CH2 BY 10.; 1.0 CH2 AREA IS ASSUMED UNLESS SPECIFIED OTHERNISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORGED SOLUBLE POOL I DEPTH CONTENT NH4-N NH4-N NO3-N UREA-N MICROBIAL MASS PH C SEGMENT CH ML/ML PPN N PPN N PPN N PPN N PPN N PPN N PPN C PPH C 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+03 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1354E+02 .0000E+00 .2864E+03 .3835E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1000E-10 .2888E+03 .3835E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .0000E+00 .2864E+03 .3463E+03 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3929E+01 .0000E+00 .3144E+03 .36164=00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7332E+00 .0000E+00 .3144E+03 .36164=00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7332E+00 .0000E+00 .31445E+03 .36164=00 6 43.0 .1917E+00 .9000E-19 .1000E-19 .7352E+00 .0000E+00 .31445E+03 .36164=00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7352E+00 .0000E+00 .31445E+03 .36164=00 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7352E+00 .0000E+00 .31445E+03 .3606E+00 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7352E+00 .0000E+00 .31445E+03 .3606E+00 8 42.0 .1917E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .31445E+03 .3605E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .31445E+03 .3605E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .3146E+03 .3605E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .3146E+03 .3605E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .3145E+03 .3605E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .3646E+01 .3075E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .3266E+01 .3055E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .0000E+00 .1286E+01 .7776E+00 10 54.0 .1077E+00 .9000E-19 .1000E-19 .755E+00 .00000E+00 .1286E+01 .7776E+00 10 54.0 .10779E+00 .900
<pre>NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VREA .0000E+00 UG</pre>	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TEMP H20 FACTORS): 10.000 KG W/HA NOTE: TO CONVERT UG/CH2 TO KG/HA, DIVIDE UG/CH2 BY 10.; 1.0 CH2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORGED SOLUBLE POL NOT NOT NUREA-N HICROBIAL MASS PON PON N A1372000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1008E+02 .0000E+00 .2886E+03 .43172+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1008E+02 .0000E+00 .2886E+03 .3351E+00 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1008E+02 .0000E+00 .3144E+03 .3416E+03 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3728E+01 .0000E+00 .3144E+03 .3416E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7531E+00 .0000E+00 .3445E+03 .3405E+00 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7531E+00 .0000E+00 .3445E+03 .3405E+00 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7531E+00 .0000E+00 .3452E+03 .3405E+00 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7531E+00 .0000E+00 .3452E+03 .3405E+01 10 54.0 .1079E+00 .9000E-19 .1000E-19 .7531E+00 .0000E+00 .3452E+01 .3005E+01 .3055E+01 12 66.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1184E+01 .7576E+00 12 66.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1284E+01 .7576E+01 12
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AHOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C * INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENTS 2 TO 4). AHOUNT ADDED TO EACH SEGMENTS: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VREA .0000E+00 UG * CROP HAS REACHED PHYSIOLOGICAL MATURITY: DAY 234; 110 DAYS, DEGREE DAYS PAST EMERGENCE 61 DAYS, DEGREE DAYS PAST BEGINNING GRAIN FILLING * LIVE ROOT MASS NOW ACCESSIBLE TO MICROBIAL ACTIVITY. DAY 235	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TENP N20 FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I MICROBIAL MASS PPON N DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS PPON PPN C PPN C 2 6.0 .1566E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+03 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2886E+03 .4488E+03 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1364E+02 .0000E+00 .2886E+03 .3355F+03 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1362E+01 .0000E+00 .3144E+03 .3616E+02 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3202E+01 .0000E+00 .3144E+03 .3616E+03 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 10 54.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 11 60.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 12 66.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1284E+01 .7577E+00 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1284E+01 .7577E+00 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 14 65.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 15 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 15 72.0 .1079E+00 .9000E-19 .100
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C ** INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENTS: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG VERA .0000E+00 UG ** CROP HAS REACHED PHYSIOLOGICAL MATURITY: DAY 234; 110 DAYS, DEGREE DAYS PAST EMERGENCE 61 DAYS, DEGREE DAYS PAST BEGINNING GRAIN FILLING ** LIVE ROOT MASS NOW ACCESSIBLE TO MICROBIAL ACTIVITY. DAY 235 COP MASS TOP N MASS CROP GRAIN MASS RATIO OF ROOT M RATIO OF ROOT N RATIO OF	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYMB FIXED, POTENTIAL - ACTUAL (TEMP M20 FACTORS): 10.000 KG W/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UMLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY - 293 10/20 MATER ADSORBED SOLUBLE POINT NHA-N NO3-N UREA-N NICROBIAL MASS SECMENT CM NL/NL PPH N 3355e0 2 6.0 .1564E+00 .9000E-19 .1000E-19 .1356E+02 .0000E+00 .2864E+03 .4488E+00 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1364E+02 .0000E+00 .2864E+03 .3835E+00 4 18.0 .1917E+00 .9000E-19 .1000E-19 .4682E+01 .0000E+00 .3145E+03 .3451Fe+03 5 24.0 .1917E+00 .9000E-19 .1000E-19 .4682E+01 .0000E+00 .3144E+03 .3616E+00 6 33.0 .1917E+00 .9000E-19 .1000E-19 .7835E+00 .0000E+0 .3449E+01 .3075E+01 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7835E+00 .0000E+0 .3449E+01 .3075E+01 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7757E+00 .0000E+0 .1284E+01 .3075E+01 1 60.0 .1079E+00 .9000E-19 .1000E-19 .7555E+00 .0000E+0 .1284E+01 .7776E+0 11 60.0 .1079E+00 .9000E-19 .1000E-19 .1532E+00 .0000E+00 .1150E+01 .7776E+0 13 72.0 .1079E+00 .9000E-19 .1000E-19 .1532E+00 .0000E+00 .1150E+01 .7776E+0 13 72.0 .1079E+00 .9000E-19 .1000E-19 .1532E+00 .0000E+00 .1150E+01 .7776E+0 14 78.0 .1079E+00 .9000E-19 .1000E-19 .1323E+00 .0000E+00 .1150E+01 .7776E+0 14 78.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1150E+01 .7776E+0 14 78.0 .1079E+00 .9000E-19 .1000E-19 .753E+00 .0000E+00 .1150E+01 .7776E+0 14 78.0 .1079E+00 .9000E-19 .1000E-19 .753E+00 .0000E+00 .1150E+01 .7776E+0 14 78.0 .1079E+00 .9000E-19 .1000E-19 .753E+00 .0000E+00 .1150E+01 .7776E+0 15 75.0 .1079E+00 .9000E-19 .1000E
NITROGEN .6824E+03 UG C/N .4000E+02 RECALCITRANT FRACTION CARBON .0000E+00 UG NITROGEN .0000E+00 UG C/N .4000E+02 AMOUNT LEFT ON SURFACE: LABILE, .0000E+00; RECALCITRANT, .0000E+00 UG C ** INORGANIC NITROGEN APPLIED. DAY NUMBER 150. DEPTHS: .0 TO 15.0 CM (SEGMENTS 2 TO 4). AMOUNT ADDED TO EACH SEGMENT: TOTAL NH4 .7491E+03 UG NO3 .0000E+00 UG UREA .0000E+00 UG ** CROP HAS REACHED PHYSIOLOGICAL MATURITY: DAY 234; 110 DAYS, DEGREE DAYS PAST EMERGENCE 61 DAYS, DEGREE DAYS PAST BEGINNING GRAIN FILLING ** LIVE ROOT MASS NOW ACCESSIBLE TO MICROBIAL ACTIVITY. DAY 235	JEFICIT NITROGEN, REFERENCE - ACTUAL CROP N: 31.334 KG/HA DEFICIT N SYNB FIXED, POTENTIAL - ACTUAL (TENP N20 FACTORS): 10.000 KG N/HA NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVIDE UG/CM2 BY 10.; 1.0 CM2 AREA IS ASSUMED UNLESS SPECIFIED OTHERWISE TO CONVERT KG/HA TO G/PLANT, MULTIPLY KG/HA BY .13188E-01 DAY = 293 10/20 MATER ADSORBED SOLUBLE POOL I MICROBIAL MASS PPON N DEPTH CONTENT NH4-N NH4-N N03-N UREA-N MICROBIAL MASS PPON PPN C PPN C 2 6.0 .1566E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2864E+03 .4488E+03 3 12.0 .2013E+00 .9000E-19 .1000E-19 .1346E+02 .0000E+00 .2886E+03 .4488E+03 4 18.0 .1917E+00 .9000E-19 .1000E-19 .1364E+02 .0000E+00 .2886E+03 .3355F+03 5 24.0 .1917E+00 .9000E-19 .1000E-19 .1362E+01 .0000E+00 .3144E+03 .3616E+02 6 30.0 .1917E+00 .9000E-19 .1000E-19 .3202E+01 .0000E+00 .3144E+03 .3616E+03 6 30.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 7 36.0 .1917E+00 .9000E-19 .1000E-19 .7532E+01 .0000E+00 .3144E+03 .3616E+03 8 42.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 9 48.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 10 54.0 .1917E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 11 60.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 12 66.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .3144E+03 .3605E+03 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1284E+01 .7577E+00 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1284E+01 .7577E+00 13 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 14 65.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 15 72.0 .1079E+00 .9000E-19 .1000E-19 .7532E+00 .0000E+00 .1160E+01 .7577E+00 15 72.0 .1079E+00 .9000E-19 .100

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17	96.0	.1079E+00	.9000E-19	.1000E-19	.1185E+00	.0000E+00	.8297E+00	.7401E+01	20	114.0	.008	.1739E+0	02 .6254E+01	.9755E+01	.3500E+01	.3339	.0000E+00
18	102.0	.1079E+00	.9000E-19	.1000E-19	.1173E+00	.0000E+00	.7999E+00	.7404E+01	. 21	120.0		.1745E+		.9659E+01	.3548E+01	.3336	
19	108.0	.1079E+00	.9000E-19	.1000E-19	.1195E+00	.0000E+00	.7968E+00	.7631E+01	22	126.0		.1750E+		.9551E+01	.3593E+01	.3362	
20	114.0	.1079E+00	.9000E-19	.1000E-19	.1172E+00	.0000E+00	.7509E+00	.7526E+01	23	132.0		.1757E+I		.9483E+01	.3654E+01	.3137	,
21	120.0	.1079E+00	.9000E-19	.1000E-19	.1161E+00	.0000E+00	.7136E+00	.7478E+01	24	138.0		.1763E+		.9208E+01	.3630E+01	.2929	
22	126.0	.1079E+00	.9000E-19	.1000E-19	.1160E+00	.0000E+00	.6775E+00	.7438E+01		15010	1004		199702.01		150502.01		100002-00
23	132.0	.1079E+00	.9000E-19	.1000E-19	.1161E+00	.0000E+00	.6427E+00	.7390E+01									
24	138.0	.1079E+00	.9000E-19	.1000E-19	.1150E+00	.0000E+00	.6185E+00	.7420E+01		POOL	1	POOI	L <b>II</b>				
										MICROBIA			HADS	RESI	DUES		
			RESIDUE	RESIDUE	RESIDUE	RESIDUE	RESIDUE	RESIDUE		UGN	UG N15	UGN	UG N15	UG C UG		:/N	
	DEPTH	ROOT MASS	(ROOT-SLOUGH	) 5,6	7,8	9,10	11,12	13,14									
SEGMENT	CM	PPM C	PPH C	PPM C	PPH C	PPM C	PPN C	PPM C	.2	385E+04		.2062E+04		.6795E+04 .170	2E+03 .3992E+	02	
2	6.0	.2853E+02	.1094E+00	.1081E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
3	12.0	.2856E+02	.1184E+00	.1052E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00		-	EXCHANG	ES OF WATER A	ND NITROGEN ACROSS	SYSTEM BOUNDARIE	\$		
4	18.0	.2766E+02	.1296E+00	.1216E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
5	24.0	.3350E+02	.1956E+00	.1719E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00	PAN EV	APORATION	.1014E+0	3 CH H2O TO D	ATE				
6	30.0	.1680E+02	.1214E+00	.2061E+03	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
7	36.0	.1119E+02	.5132E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	TRANS	PIRATION	EVAPORATI	DN INFIL	TRATION RUN	IOFF WATER	LEACHED N	LEACHED	N15 LEACHED
8	42.0	.8381E+01	.3731E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	CM H20	TO DATE	CM H2O TO I	DATE CH H20	TO DATE CH H20	TO DATE CH H20	TO DATE UG	N TO DATE	UG N15 TO DATE
9	48.0	.6654E+01	.3174E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.541	8E+02	.5304E+	01 .64	11E+02 .000	0E+00 .82	61E+00	.1350E+00	
10	54.0	.5627E+01	.8506E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
11	60.0	.4777E+01	.7101E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
12	66.0	.4130E+01	.6798E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00				BIOLOGICAL	NITROGEN TRANSFOR	MATIONS			
13	72.0	.3617E+01	.5884E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
14	78.0	.3200E+01	.5614E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00		NET							
15	84.0	.2851E+01	.5246E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	IMMOBI	LIZATION	(<0)			NON-SYMBIOTIC		SYM	BIOTIC
16	90.0	.2547E+01	.4562E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	MINERA	LIZATION (	>0) INNO	BILIZATION	MINERALIZATION	N FIXATION	DENITRIFICATI	ON N FI	ATION
17	96.0	.2281E+01	.3977E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	UG	N TO DAT	E UG I	N TO DATE	UG N TO DATE	UG N TO DATE	UG N TO DATE	UGN	TO DATE
18	102.0	.2044E+01	.3787E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
19	108.0	.1790E+01	.4587E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00		4911E+03	.2	399E+05	.2356E+05	.0000E+00	.1489E+03		
20	114.0	.1546E+01	.3805E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
21	120.0	.1315E+01	.3205E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
22	126.0	.1083E+01	.2633E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	-		TO	P	•••••	R	OOT (BEFORE DEGR	AD)	
23	132.0	.8676E+00	.2089E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00									
24	138.0	.6803E+00	.1730E-01	.0000E+00	.0000E+00	.0000E+00	.0000E+00	.0000E+00	TOP MA	ISS TO	P N MASS	CROP GRAIN MA	SS RATIO OF	ROOT MASS	RATIO OF	ROOT N	RATIO OF
									KG/HA		KG/HA	KG/HA	N TO TOP	KG/HA	SHOOT TO ROOT	MASS	N TO ROOT
		5046710N 05				CUNULATIVE NET			15.5 PE	RCENT		15.5PERCENT	DRY MATTER	15.5 PERCENT		KG/HA	DRY MATTER
		FRACTION OF	CUMULATIVE	CUNULATIVE	CUMULATIVE	INHOBILIZATION (	-	CUMULATIVE	H20	)		H20		H20			
OF OMENT	DEPTH	TOTAL ROOTS	N UPTAKE	INHOBILIZATION		MINERALIZATION (>			. 1548E	+05 .	1423E+03	.9115E+04	.0109	.7534E+03	20.545	,1329E+02	.0149
SEGMENT	CM	PER SEGMENT	UG N/SEG	UG N/SEG	UG N/SEG	UG N/SEG	CM/SEG	UG N/SEG									
2	6.0	. 139	.1473E+03	.5283E+04	.5189E+04	1305E+03	.5637E+01	.1063E+03									
3	12.0	. 139	.1801E+03	.5041E+04	.4971E+04	1006E+03	.5511E+01	.4035E+02				GR(	OWTH REDUCTION RAT	105			
5	18.0	. 139	.1520E+03	.4813E+04	.4702E+04	1132E+03	.5178E+01	.2228E+01									
5	24.0	. 168	.9046E+02	.4448E+04	.4306E+04	1421E+03	.4854E+01	.0000E+00		/POTENTIA	-	POTENTIAL	ACTUAL/POTENTIAL	-		REFERENCE	ACTUAL/OPT INUN
6	30.0	.084	.3395E+02	.4161E+04	.4025E+04	1353E+03	.3054E+01	.0000E+00	ROOT	LENGTH	NU	JPTAKE	N PERCENTAGE	H20 UPTAK	E TEMPE	RATURE	PLANT POPULATION
7	36.0	.056	.1899E+03	.4654E+02	.7221E+02	.2567E+02	.2104E+01	.0000E+00									
8	42.0	.042	.2418E+03	.4322E+02	.6883E+02	.2561E+02	.1601E+01	.0000E+00		T RUNNIN		T RUNNING	CURRENT RUNNING			RUNNING	.LE.1.
9	48.0	.033	.1830E+03	.4099E+02	.6642E+02	.2542E+02	.1329E+01	.0000E+00	VALUE	AVERAG	E VALUE	AVERAGE	VALUE AVERAGE	VALUE AVE	RAGE VALUE	AVERAGE	
10	54.0	.029	.7844E+02	.1023E+02	.1382E+02	.3594E+01	.1116E+01	.0000E+00				E 70		4 000 -			
10	60.0	.025	.4657E+02	.9560E+01	.1326E+02	.3697E+01	.1011E+01	.0000E+00	.100	.100	.220	.539	.909 .879	1.000 1.	000 1.000	1.001	1.000
12	66.0	.022	.2109E+02	.8747E+01	.1229E+02	.3546E+01	.7112E+00	.0000E+00									
13	72.0	.019	.1750E+02	.8338E+01	.1194E+02	.3600E+01	.5717E+00	.0000E+00				NITRO		100T)			
14	78.0	.017	.1742E+02	.7862E+01	.1141E+02	.3543E+01	.5412E+00	.0000E+00				WITROGE	N IN PLANT (TOP +	KUUI)			
15	84.0	.015	.1732E+02	.7503E+01	.1103E+02	.3527E+01	.4894E+00	.0000E+00					05				
16	90.0	.013	.1752E+02	.7326E+01	.1093E+02	.3607E+01	.4785E+00	.0000E+00	$\checkmark$		-	RATIO					
17	96.0	.012	.1763E+02	.7198E+01	.1089E+02	.3697E+01	.4984E+00	.0000E+00		N UPTAK		N TO TO		NAE /70741 /	PLANT		
18	102.0	.011	.1758E+02	.6955E+01	.1064E+02	.3682E+01	.4723E+00	.0000E+00		FROM SOI						N EXUDATE (RO	
19	108.0	.009	.1726E+02	.6321E+01	.9706E+01	.3385E+01	.3267E+00	.0000E+00							GM N/PLANT	GH N/PLANT	
										KG N/HA	KU #/#/	•	KG N15/HA		KG N/HA	KG N/HA	

.2076E+01 .2052E+01 .0 .1574E+03 .1556E+03	0113	.0000E+00 .0000E+00	.2390E-01 .1812E+01		INITIAL WATER CURRENT WATER CHANGE IN WATE	CONTENT			.14	96E+02 376E+02 799E+01	OF WHICH	.0000E+00C <b>H</b>	ARE PONDED	
DEFICIT MOISTURE: .000 CM H2O	I CROP (ABOVE GROUND + ROOT)				TOTAL WATER IN TOTAL EVAPORAT TOTAL TRANSPIR	IPUT FION RATION			.64 .53 .54	511E+02 504E+01 518E+02	OF WHICH		FROM WATER TA	NBLE
DEFICIT NITROGEN, REFERENCE - ACTUAL CR Deficit n symb fixed, potential - Actua		HA			TOTAL H2O LEAG TOTAL RUNOFF TOTAL DRAIN	CHED			.0	261E+00 000E+00 000E+00				
NOTE: TO CONVERT UG/CM2 TO KG/HA, DIVID TO CONVERT KG/HA TO G/PLANT, MULI		MED UNLESS SPECI	FIED OTHERWISE		TOTAL WATER MO SYSTEM I	OVEMENT TH BOUNDARIES			.3	<b>799</b> E+01				
DAY = 293 10/20				1	DIFFERENCE BET AND	IWEEN GLOB D BOUNDARY			8	702E-04				
				·										
				F	INAL CONDITIONS	S PER SOIL	HORIZON:							
	NITROGEN MASS BALANCE				G	RAVIMETRIC	:		POOL	1	POC	DL [1		
	TOTAL N N15						IT TOTAL NH4	NO3	PPN			PM N		
	(UG PER SQUARE CM)			НО		(ML/GM)						RECALCITRANT		
INITIAL INORGANIC N	.4640E+03				1 12.0	.115		13.499 4		2.562	.000	44.024		
INITIAL POOL I+II N	.7295E+03				2 48.0	.120		3.932 2		2.843	.000	19.634		
INITIAL TOTAL N	.1193E+04				3 144.0	.065	.000	.128	.019	.127	.000	.750		
JRRENT INORGANIC N	.4967E+03													
CURRENT POOLI+II N	.4447E+04							c	ARBON					
CURRENT RESIDUE N	.1702E+03						DEPTH		G C/HA					
CURRENT PLANT RESIDUAL ROOT N	.9736E+02					HORIZON	CM	LABILE	RECALCITR	ANT C/N	RATIO			
CURRENT PLANT TOP N	. 1423E+04													
CURRENT TOTAL N	.6634E+04				TOP (DRY)	-	-	1412.65	<b>3819.</b>	59	36.8			
TOTAL CHANGE OF NITROGEN					RESIDUES 1, 2		12.0	3.23	49.8		19.4	.00000		
CONTENT IN SYSTEM	.5441E+04				(ROOT RESIDUAL		48.0	6.15	93.8		19.4	.00000		
,						3	138.0	3.82	34.3	8	20.9	.00000		
TOTAL INORGANIC N APPLIED	.2247E+04				RESIDUES 3, 4	1	12.0	.00	.2	1	20.9	.00000		
TOTAL ORGANIC N APPLIED	.3412E+04				(ROOT SLOUGH	) 2	48.0	.00	.5		20.5	.00000		
TOTAL N LEACHED	.1350E+00					3	138.0	.00	.6		21.5	.00000		
TOTAL N NON SYMB FIXATION	.0000E+00													
TOTAL N DENITRIFICATION	.1489E+03						SURFACE	.00	.0	)				
TOTAL N GAS LOSS FROM PLANT	.0000E+00				RESIDUES 5, 6		12.0	198.36	.0		40.0	.00000		
TOTAL N LOSS IN DRAIN	.0000E+00				-	2	48.0	479.70	.0		40.0	.00000		
TOTAL N GAIN FROM WATER TABLE TO PLANT	.0000E+00					3	138.0	.00	.0	)	.0	.00000		
TOTAL MOVEMENT OF NITROGEN														
THROUGH SYSTEM BOUNDARIES	.5510E+04													

DIFFERENCE BETWEEN GLOBAL CHANGE

,

AND BOUNDARY FLUXES

-

----- WATER MASS BALANCE (CM) ------

.6906E+02

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## Section 5. Factor relationship testing.

This section demonstrates the models responsiveness to changes in individual inputs under the user's control. Each factor is adjusted up or down, while all other factors are held constant. The following is a summary of the response in terms of yield:

Variable	<u>change</u>	yield impact
Planting date	earlier later	decrease decrease
Seed rate	increase decrease	no change no change
Harvest	earlier later (harvest beyond las	no change error st day of input data)
C:N ratio	decrease increase	increase decrease
Apply residue	earlier later	increase decrease
Residue amount	decrease increase	increase decrease
Residue Incorporation	none shallow	increase decrease
N form (act	all forms cual amount of N inpu	no impact at regardless of form)
N date	earlier later	decrease decrease
N amount	increase decrease	increase decrease
N application	surface deep	decrease increase
Rainfall	dry wet	decrease decrease
Air-temp	hot cold	decrease decrease
Soil type	sand clay	decrease decrease

Menu						•
èë [±] ëëëëëëëë	**************	ëë Simulatio	n eeeeeeeeeeee		ééé£	
¤ Name Farmer	Tom Field Sout	h 40		Rainfall	п	
¤			Form	( ) Dry	n	
n	C:N Ratio		) Ammon. Nitrate		a	
¤ Crop		- 20:1 ( )		() Wet	Ξ.	
¤ () Corn			iquid Nitrogen		a	
= ( ) Future			Anhydrous Ammon	•	n	
II ( ) Future	( ) Wood	- 150:1 ()	) Ammon. Sulfate	( ) Hot	n	
α				() Average	n	
# Plant on APR	28 Apply on A	PR 2 App	oly on NAY 30	( ) Cold	11	
<b>a</b>					n	
	700 Rate Ton/Ac	20 NR	ate (lb/ac) 200	Soil Type	a	
n				() Sand	п	
	12 Incorporati		ply Method	() Loam	п	
n	() None		) Surface	( ) Clay	n	
n	( ) Shallow		Shallow [0-6"]		п	
n	() Deep [0-	12"] ()	Deep [0-12"]	% total N 99	п	
¤				N init ppm 99		
D					<b>n</b>	
n n					а п	
-		***********	ëë Ok Éëëëë	******	-	BREELINE
Alt-X Exit			CG UK ECCCO		CCCCT	
ALL-A GAIL						
Menu						
. Menu èë (±) ëëëëëëëëë			******		() #£	
	***********		***************	*******	() ë£	
èë [±] ëëëëëëëë ¤			ittiettettettettettettettettettettettett	***********		
èë [±] ëëëëëëëë ¤				************	a	
èë[±]ëëëëëëëë ¤ ¤ unt N le ¤		49.75		***********	a a	
èë[±]ëëëëëëëë ¤ ¤ unt N le ¤	ft in the residue	49.75	(lb/ac)		а а а	
کی (±) 55555555555555555555555555555555555	ft in the residue	49.75	(lb/ac)	*********	2 2 2	
کی (±) 55555555555555555555555555555555555	oft in the residue worganic N leached	49.75	(lb/ac) (lb/ac)	********	11 12 12 12 12	
è∉[±]ëëëëëëëëë □ □ □ ↓ unt N le □ □ □ ↓ Net immobil(	oft in the residue worganic N leached	49.75 .01 -43.71	(lb/ac) (lb/ac)	*******	11 12 12 12 12 12 12 12 12 12 12 12 12 1	
èε[1]seeseesee π π Junt N Le π In π Net immobil( π	oft in the residue worganic N leached )/mineralizat(+)	49.75 .01 -43.71	(lb/ac) (lb/ac) (lb/ac)	*******	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
èéiri éééééééééé II Aunt N Le II In II In II Net immobil ( II II I	oft in the residue worganic N leached )/mineralizat(+)	49.75 .01 -43.71 13.25	(lb/ac) (lb/ac) (lb/ac)	******	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
èéiri éééééééééé II Aunt N Le II In II In II Net immobil ( II II I	oft in the residue worganic N leached )/mineralizat(+) Denitrification	49.75 .01 -43.71 13.25	(lb/ac) (lb/ac) (lb/ac) (lb/ac)	******		
<pre>èei±jeëëëëëëë</pre>	oft in the residue worganic N leached )/mineralizat(+) Denitrification	49.75 .01 -43.71 13.25 13776.67	(lb/ac) (lb/ac) (lb/ac) (lb/ac)			
<pre>èei±jeëëëëëëë</pre>	organic N leached -)/mineralizat(+) Denitrification op mass @ 15.5 H20	49.75 .01 -43.71 13.25 13776.67	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
eefsjeeeeeee π	organic N leached -)/mineralizat(+) Denitrification op mass @ 15.5 H20	49.75 .01 -43.71 13.25 13776.67 .00	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdizi desessessi 	off in the residue worganic N leached )/mineralizat(+) Denitrification op mass @ 15.5 H2O re deficit in crop en deficit in crop	49.75 .01 -43.71 13.25 13776.67 .00 27.89	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdizi desessessi 	organic N leached -)/mineralizat(+) Denitrification op mass @ 15.5 H20 re deficit in crop	49.75 .01 -43.71 13.25 13776.67 .00 27.89	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdizi desessessi 	off in the residue worganic N leached )/mineralizat(+) Denitrification op mass @ 15.5 H2O re deficit in crop en deficit in crop	49.75 .01 -43.71 13.25 13776.67 .00 27.89	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
eeixjeeeeeeee α	off in the residue worganic N leached )/mineralizat(+) Denitrification op mass @ 15.5 H2O re deficit in crop en deficit in crop	49.75 .01 -43.71 13.25 13776.67 .00 27.89 330.85	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
eeixjeeeeeeee α	organic N leached -)/mineralizat(+) Denitrification op mass @ 15.5 H2O re deficit in crop on deficit in crop crogen pool CHANGE panic N in profile	49.75 .01 .43.71 13.25 13776.67 .00 27.89 330.85 44.20	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdiai de centre de la companya de la	organic N leached 	49.75 .01 -43.71 13.25 13776.67 .00 27.89 330.85 44.20 Quit É	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdizjeeeeeeee 	organic N leached 	49.75 .01 -43.71 13.25 13776.67 .00 27.89 330.85 44.20 Quit É 00000000	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			
èdizjeeeeeeee 	organic N leached 	49.75 .01 -43.71 13.25 13776.67 .00 27.89 330.85 44.20 Quit É 00000000	(lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			

(Percent total N and initial N variables are not operational.)

Name Farmer Tom	Field South 40		Rainfall	n
н		N Form	( ) Dry	n
ι	C:N Ratio	( ) Ammon. Nitrate	() Average	n
Crop	( ) Grass - 20:1	( ) Urea	() Wet	D
() Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
() Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	п
() Future	() Wood - 150:1	() Ammon. Sulfate	() Hot	-
			() Average	п
Plant on APR 2	Apply on APR 2	Apply on MAY 30	( ) Cold	
SeedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	0 0
			() Sand	π
Harvest OCT 12	Incorporation	Apply Method	() Loam	π
	( ) None	( ) Surface	( ) Clay	n
	( ) Shallow [0-6"]	() Shallow [0-6"]		α
	() Deep [0-12"]	( ) Deep [0-12"]	% total N 99	π
,			N init ppm 99	Π
				n
				п
				α

# PLANT SOQUER

#### Menu

. èë		ëëëëëë 0 ëë	*************	***********
п				
п	unt N left in the residue	76.96	(lb/ac)	
n				1
π	Inorganic N leached	3.03	(lb/ac)	
п				1
n	Net immobil(-)/mineralizat(+)	-78.55	(lb/ac)	1
n				1
n	Denitrification	9.34	(ib/ac)	1
n				1
α	Top mass @ 15.5 H2O	11173.84	(lb/ac)	1
				1
n	Moisture deficit in crop	8.36	(inches)	I
n				I
	Nitrogen deficit in crop	50.52	(lb/ac)	I
п _	0			r
ם ם	Organic Nitrogen pool CHANGE	355.47	(lb/ac)	I
0	Inorgania II in profile	70.00		r
	Inorganic N in profile	32.90	(lb/ac)	Ľ
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		Quit É 6666666		n
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¤ untNleft in the residue 105.06 (lb/ac) n
۵ م
Inorganic N Leached 19.38 (Lb/ac) N
а <b>Б</b>
¤ Net immobil(-)/mineralizat(+) -66.62 (lb/ac) ۲۵
□ Denitrification 15.50 (Lb/ac) □
а а
π Top mass @ 15.5 H2O 13287.92 (lb/ac) π
п п
m Moisture deficit in crop .00 (inches) m
a a
¤ Nitrogen deficit in crop 31.06 (lb/ac) π
-
u Organic Nitrogen pool CHANGE 337.30 (lb/ac) m
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¤ Inorganic N in profile 2.85 (lb/ac) π
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n	unt N left in the residue	49.75	(lb/ac)	
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n	Inorganic N leached	.01	(lb/ac)	
n				
n	Net immobil(-)/mineralizat(+)	-43.71	(lb/ac)	
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n	Denitrification	13.25	(lb/ac)	:
a				:
n	Top mass @ 15.5 H20	13776.67	(lb/ac)	1
n n	Noisture definite in			1
	Moisture deficit in crop	.00	(inches)	1
	Nitrogen deficit in crop	27.89	(16/22)	I
<b>D</b>	artrogen derrere in crop	21.09	(lb/ac)	ı
π	Organic Nitrogen pool CHANGE	330.85	(lb/ac)	1
n		550.05	(()) 807	1
п	Inorganic N in profile	44.20	(lb/ac)	
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•	() Grass -			() Wet	α	
() Corn ( ) Future			) Liquid Nitrogen		n	
	() Leaves -		() Anhydrous Ammor		n	
( ) Future	() Wood -	150:1	( ) Ammon. Sulfate		n	
Diant an ADD 28				() Average	n	
Plant on APR 28	Apply on AP	R 2	Apply on MAY 30	( ) Cold	π	
Readbase TT7004	D				n	
SoodRate 33700	TRATE TON/AC	20	Rate (lb/ac) 200	Soil Type	a	
No	•			() Sand	n	
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<pre>E(1) ####################################</pre>		Menu         ##[:]2000000000000000000000000000000000000	
E(1) BECCONCENTER OF CONCENTS		Wenu         Weil         a         xunt N left in the residue       330.85 (lb/ac)         a       Inorganic N leached       44.20 (lb/ac)         a       Inorganic N leached       44.20 (lb/ac)         a       Denitrification       (lb/ac)         a       Denitrification       (lb/ac)         a       Top mass @ 15.5 H20       (lb/ac)         a       Moisture deficit in crop       (lb/ac)         a       Nitrogen deficit in crop       (lb/ac)         a       Organic Nitrogen pool CHANGE       (lb/ac)         a       Inorganic N in profile       (lb/ac)	

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Π	ount N left in the residue	330.85	(lb/ac)	Π
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Π	Inorganic N leached	44.20	(lb/ac)	
n				n
п	Net immobil(-)/mineralizat(+)		(lb/ac)	π
π				g
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n	Top mass @ 15.5 H2O		(lb/ac)	n
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I Name Farmer Tom Field South 40 Rainfall n п N Form () Dry n n C:N Ratio () Ammon. Nitrate () Average m ¤ Crop () Grass - 20:1 () Urea () Wet ¤ () Corn () Leaves - 40:1 () Liquid Nitrogen n ¤ ( ) Future () Leaves - 70:1 () Anhydrous Ammon Air-temp = ( ) Future () Wood - 150:1 () Ammon. Sulfate () Hot n () Average n Plant on APR 28 Apply on APR 2 Apply on MAY 30 () Cold n n m SeedRate 30700 Rate Ton/Ac 20 NRate (lb/ac) 200 Soil Type п () Sand # Harvest OCT 12 Incorporation Apply Nethod () Loam Π () None ( ) Surface () Clay ( ) Shallow [0-6"] () Shallow [0-6"] () Deep [0-12"] ( ) Deep [0-12"] % total N 99 m N init ppm 99 n Accesses of the second se

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#### Menu

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n п. ount N left in the residue 29.45 (lb/ac) n n Inorganic N leached 1.66 (lb/ac) n Π Net immobil(-)/mineralizat(+) 82.35 (lb/ac) r Denitr Top mass a

			п
Denitrification	9.15	(lb/ac)	n
			¤
Top mass @ 15.5 H2O	15218.43	(lb/ac)	¤
			n
Moisture deficit in crop	.00	(inches)	n
· .			a
Nitrogen deficit in crop	.24	(lb/ac)	α
			α
Organic Nitrogen pool CHANGE	81.74	(lb/ac)	a
			Π
Inorganic N in profile	145.07	(lb/ac)	α

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#### Nenu Rainfall I Name Farmer Tom Field South 40 n N Form () Dry ( ) Ammon. Nitrate () Average C:N Ratio 77 m ¤ Crop () Grass - 20:1 () Urea () Wet () Leaves - 40:1 () Liquid Nitrogen m () Corn () Leaves - 70:1 () Anhydrous Ammon Air-temp m ( ) Future m ( ) Future () Average ¤ Plant on APR 28 Apply on APR 2 Apply on MAY 30 () Cold п Soil Type m SeedRate 30700 Rate Ton/Ac 20 NRate (lb/ac) 200 () Sand п Apply Method () Loam # Harvest OCT 12 Incorporation () Clay () None ( ) Surface ( ) Shallow [0-6"] () Shallow [0-6"] () Deep [0-12"] ( ) Deep [0-12"] % total N 99 N init ppm 99 Е Ok Éĕëëëëëëëëëëëëëëëëëëë Alt-X Exit

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n	wunt W left in the residue	114.99	(lb/ac)	-
n			(	¤
	Inorganic N leached	.01	(lb/ac)	п
π				¤
n	<pre>Net immobil(-)/mineralizat(+)</pre>	-132.29	(lb/ac)	п
n				п
n	Denitrification	8.32	(lb/ac)	Π
n				Π
0	Top mass 🖨 15.5 H2O	10339.21	(lb/ac)	¤
Π				n
n	Moisture deficit in crop	.00	(inches)	n
n				п
Ċ	Nitrogen deficit in crop	71.41	(lb/ac)	п
α				a
n	Organic Nitrogen pool CHANGE	270.64	(lb/ac)	α
Π				п
n	Inorganic N in profile	4.08	(lb/ac)	
n 	Ok É	Quit É		а п
2 2	• •	0000000		
12			***************************************	
ae A	t-X Exit			ecceed I
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Name Farmer Tom	Field South 40		Rainfall	r
1		N Form	( ) Dry	r
I	C:N Ratio	( ) Ammon. Nitrate	() Average	n
I Crop	( ) Grass - 20:1	( ) Urea	()Wet	r
x () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
i ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	π
i ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	Ľ
1			() Average	π
Plant on APR 28	Apply on MAR 2.	Apply on MAY 30	( ) Cold	r
1	and the second s	2 2		r
SeedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	r
L Contraction of the second			() Sand	r
Harvest OCT 12	Incorporation	Apply Method	() Loam	n
1, ·	( ) None	( ) Surface	( ) Clay	r
1	( ) Shallow [0-6"]	() Shallow [0-6"]		n
1	() Deep [0-12"]	( ) Deep [0-12"]	% total N · 99	Π
1				r
1			N init ppm 99	Ľ
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n			π
💷 🗧 wount N left in the residu	.19	(lb/ac)	α
¤			α
m Inorganic N leache	id .00	(lb/ac)	n
п			n
<pre>m Net immobil(-)/mineralizat(+</pre>	) 26.26	(lb/ac)	n
¤			п
¤ Denitrificatio	n .94	(lb/ac)	n
Δ.			n
¤ Top mass Ձ 15.5 H2	0 15232.65	(lb/ac)	n
			n
m Moisture deficit in cro	p.00	(inches)	n
α			n
n Nitrogen deficit in cro	p.00	(lb/ac)	n
, a			n
¤ Organic Nitrogen pool CHANG	E -21.67	(lb/ac)	n
п			n
≖ Inorganic N in profil	e 98.61	(lb/ac)	п
Π			n
¤ Ok É	Quit É		п
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Alt-X Exit

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¤ Name Farmer Tom	Field South			Rainfall				
			Form	() Dry	-			
<b>n</b>	C:N Ratio		) Ammon. Nitrate	() Average	Ξ			
ш Сгор	( ) Grass	-		() Wet	_			
¤ () Corn		-	Liquid Nitrogen	( )	<u>ш</u>			
II ( ) Future			Anhydrous Ammon	Air-temp	- n			
II ( ) Future			) Ammon. Sulfate	() Hot	<u></u>			
ц , , , , , , , , , , , , , , , , , , ,	•••			() Average	n			
I Plant on APR 28	Apply on H	AY Z & Ap	olyon MAY 30	() Cold	π			
<b>D</b>		asta.		•••	α			
¤ SeedRate 30700	Rate Ton/Ac	20 NR	ate (lb/ac) 200	Soil Type	n			
				() Sand	п			
II Harvest OCT 12	Incorporati	on Ap	ply Method	() Loam	n			
	() None		) Surface	() Clay	p			
п	() Shallow	(0-6") ()	Shallow [0-6"]		n			
n	() Deep [0-		Deep [0-12"]	X total N 99	đ			
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à*******************	*****	ëëëëëëëëëë	ëë Ok Éëëëë		<b></b>	<b>MADIA</b>	residue	ATOP
Alt-X Exit						••		
Menu								
èë [±] ëëëëëëëëëëëëëë	***********	888888 O 88	***************	*****	c) He			
n		•			đ			
≖ ∞unt N left i	n the residue	72.52	(lb/ac)		<b>XX</b>			
n					X2			
n Inorga	nic N Leached	.01	(lb/ac)		q			
α					12			
¤ Net immobil(-)/m	ineralizat(+)	-79.49	(lb/ac)		α			
α					α			
n De	nitrification	11.46	(lb/ac)		n			
п					đ			
¤ Top ma	ss @ 15.5 H2O	11807.71	(lb/ac)		n			
п					ti			
¤ Moisture de	ficit in crop	.00	(inches)		n			
a					α			
¤ Nitrogen de	ficit in crop	52.40	(lb/ac)		п			
п					α			
n Organic Nitroge	n pool CHANGE	357.44	(lb/ac)		α			
п	*				n			
¤ Inorganic	N in profile	34.73	(lb/ac)		n			
a					Ħ			
¤	Ok É	Quit É			g			
¤ 00	000000	00000000			n			

Alt-X Exit

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Name Farmer Tom	Field South 40		Rainfall	n
I		N Form	( ) Dry	n
r	C:N Ratio	( ) Ammon. Nitrate	() Average	n
x Crop	( ) Grass - 20:1	( ) Urea	() Wet	п
I () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
1 ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	n
I ( ) Future	( ) Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	n
t			() Average	п
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	n
t	A			a
SeedRate 30700	Rete Ton/Ac 10	NRate (lb/ac) 200	Soil Type	n
I.	A standard and a standard and the standard		() Sand	n
Harvest OCT 12	Incorporation	Apply Method	() Loam	п
r	( ) None	( ) Surface	( ) Clay	n
1	( ) Shallow [0-6"]	() Shallow [0-6"]		n
I	() Deep [0-12"] (	) Deep [0-12"]	% total N 99	п
t				n
I			N init ppm 99	α
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## 1855 RESIDUE

#### Alt-X Exit

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α				
Π	ount N left in the residue	19.14	(lb/ac)	
n				
n	Inorganic N leached	.20	(lb/ac)	
n				
n N	<pre>let immobil(-)/mineralizat(+)</pre>	-14.25	(lb/ac)	1
n				:
Π	Denitrification	9.72	(lb/ac)	:
n				1
α	Top mass @ 15.5 H2O	15218.43	(lb/ac)	1
n				1
п	Moisture deficit in crop	.00	(inches)	1
n				1
n	Nitrogen deficit in crop	.24	(lb/ac)	1
n				1
α	Organic Nitrogen pool CHANGE	161.41	(lb/ac)	1
•				1
α	Inorganic N in profile	49.35	(lb/ac)	1
α				1
α	Ok É	Quit É		1
α	00000000 0	0000000		1

Alt-X Exit

#### Menu

IName Farmer Tom	Field South 40		Rainfall	r
1 Contraction of the second seco		N Form	( ) Dry	r
1	C:N Ratio	( ) Ammon. Nitrate	() Average	π
I Crop	( ) Grass - 20:1	( ) Urea	()Wet	r
ı () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
ı ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	π
x ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	r
1			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	r
L Contraction of the second				T
SeedRate 30700	Rate Ton/Ac 30	NRate (lb/ac) 200	Soil Type	r
1	AND A CONTRACTOR OF CONTRACTOR		( ) Sand	r
Harvest OCT 12	Incorporation	Apply Method	() Loam	n
I IIII	( ) None	( ) Surface	( ) Clay	1
L	( ) Shallow [0-6"]	() Shallow [0-6"]		n
l i i i i i i i i i i i i i i i i i i i	() Deep [0-12"]	( ) Deep [0-12"]	% total N 99	n
1				r
ι .			N init ppm 99	I
I				T
r				r
				x

MORE RESIDE

#### Nenu Junt N left in the residue 82.47 (lb/ac) Inorganic N leached .01 (lb/ac) Net immobil(-)/mineralizat(+) -62.77 (lb/ac) Denitrification 14.75 (lb/ac) Top mass @ 15.5 H20 10869.75 (lb/ac) Moisture deficit in crop .00 (inches) Nitrogen deficit in crop 58.45 (lb/ac) Organic Nitrogen pool CHANGE 491.64 (lb/ac) Inorganic N in profile 54.21 (lb/ac) Ok É Quit É 00000000 00000000

Alt-X Exit

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Name Farmer Tom	Field South 40		Rainfall	n
1		N Form	( ) Dry	α
r	C:N Ratio	( ) Ammon. Nitrate	() Average	n
a Crop	( ) Grass - 20:1	( ) Urea	() Wet	n
i () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		π
I ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	π
I ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	() Hot	n
1			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	() Cold	D
I				
seedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	D
I			() Sand	
Harvest OCT 12	Incorporation	Apply Method	() Loam	п
I	() None	( ) Surface	() Clay	п
1	( ) Shallow [0-6"]	() Shallow [0-6"]		n
I	( ) Deep [0-12"]	() Deep [0-12"]	% total N 9	9 ¤
1				n
I			N init ppm 99	n
ı –				
ι				n
ц - <sup>1</sup>				n
	***********************	ëëëëë Ok Éëëëëë	*************	

# 10 INCORPORATION

#### Menu

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¤				
π	🐛ount N left in the residue	51.75	(lb/ac)	
п				n
α	Inorganic N leached	.00	(lb/ac)	п
ш				n
п	Net immobil(-)/mineralizat(+)	-17.80	(lb/ac)	п
n				π
п	Denitrification	4.16	(lb/ac)	Π
а				n
Π	Top mass @ 15.5 H2O	15210.15	(lb/ac)	п
	·			a
n	Moisture deficit in crop	.00	(inches)	a
n				n
п	Nitrogen deficit in crop	.32	(lb/ac)	n
п				8
a	Organic Nitrogen pool CHANGE	295.36	(lb/ac)	п
n				n
n	Inorganic N in profile	51.65	(lb/ac)	п
п	-1 4			n
α		Quit É		п
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n	Sunt N left in the residue	43.22	(lb/ac)	¤
¤				p
¤	Inorganic N leached	.00	(lb/ac)	
п				π
п	Net immobil(-)/mineralizat(+)	-39.73	(lb/ac)	n
n				n
n	Denitrification	12.87	(lb/ac)	n
п				¤
n	Top mass @ 15.5 H20	13715.32	(lb/ac)	n
π				a
п	Moisture deficit in crop	.00	(inches)	p
n				ρ
12	Nitrogen deficit in crop	27.72	(lb/ac)	
n				=
Π	Organic Nitrogen pool CHANGE	324.63	(lb/ac)	n
Π				π
Π	Inorganic N in profile	48.40	(lb/ac)	¤
n				n
п	Ok É 🛛	Quit É		¤
n	0000000 0	0000000		п
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A	t-X Exit			

Alt-X Exit

Name Farmer Tom	Field South 40		Rainfall	1
a		N Form	( ) Dry	r
a	C:N Ratio	( ) Ammon. Nitrate	() Average	п
a Crop	( ) Grass - 20:1	() Urea 🔰	() Wet	π
I () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		a
1 ( ) Future		( ) Anhydrous Ammon	Air-temp	r
I ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	() Hot	r
I			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	() Cold	I
SeedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	r r
			( ) Sand	E
Harvest . OCT 12	Incorporation	Apply Method	() Loam	п
I	() None	( ) Surface	( ) Clay	D
I	( ) Shallow [0-6"]	() Shallow [0-6"]		n
	() Deep [0-12"] (	( ) Deep [0-12"]	% total N 99	α
				n
			N init ppm 99	D
				a
				п

CHANGE N FORM

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Alt-X Exit

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n				
n	Sunt N left in the residue	49.75	(lb/ac)	2
n				a
Π	Inorganic N leached	.01	(lb/ac)	
n				n
п	Net immobil(-)/mineralizat(+)	-43.71	(lb/ac)	
n				n
п	Denitrification	13.25	(lb/ac)	a
n				α
n	Top mass @ 15.5 H20	13776.67	(lb/ac)	a
n				n
n	Moisture deficit in crop	.00	(inches)	n
n				n
п	Nitrogen deficit in crop	27.89	(lb/ac)	π
n				n
n	Organic Nitrogen pool CHANGE	330.85	(lb/ac)	Π
n				π
D	Inorganic N in profile	44.20	(lb/ac)	n
n				n
n		Quit É		n
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.75	(lb/ac)	п	
		п	
.01	(lb/ac)	<b>n</b>	
		n	
.71	(lb/ac)	Ξ	
25		n	
.25	(lb/ac)		
.67	(lb/ac)	a	
.07	((D/ac)	B	
00	(inches)	¤	
	(Inclies)	<b>¤</b>	
89	(lb/ac)	<b>-</b>	
	((0) 00)	n	
85	(lb/ac)	<b>n</b>	
-			
20	(lb/ac)		

n Name Farmer Tom. n	Field South			Rainfall	α	
		N	Form	( ) Dry	п	
D	C:N Ratio	(	) Ammon. Nitrate		¤	
¤ Crop	( ) Grass -			() Wet	'n	
¤ () Corn			Liquid Nitrogen		<b>n</b>	
¤ ( ) Future			) Anhydrous Ammon	Air-temp	п	
¤ ( ) Future			) Ammon. Sulfate	() Hot	n	
	•••		,	() Average	п.	
¤ Plant on APR 28	Apply on AF	R 2	MAY 15			
0					π	
¤ SeedRate 30700	Rate Ton/Ac	20 N	Rate (lb/ac) 200	Soil Type		
0				() Sand	-	
m Harvest OCT 12	Incorporatio	an A	pply Method	() Loam		
	() None		) Surface	() Clay		
- ¤	() Shallow	-	) Shallow [0-6"]	. ,,		
8	() Deep [0-1		) Deep [0-12"]	X total N	99 ¤	
<b>D</b>	() 5000 (0				л <u>п</u>	
- B				N init ppm		
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Δοσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσ	accesses and the residue	588888 0 8 46.92	(lb/ec)			٩٩٩
Alt-X Exit Alt-X Exit Henu de[1]#888888888888888888888888888888888888	******	588888 0 8 46.92	(lb/ec)			App
ABEEFEETERERERERER Alt-X Exit Henu Abi(1) feederererererererererererererererererer	ettereture n the residue nic N leached	46.92 .01	essessess (lb/ec) (lb/ec)		ی پی پی پی پی پی پی پی	Appl
A BEEFERENE AND AND A AND AND AND AND AND AND AND A	ettereture n the residue nic N leached	46.92 .01	essessess (lb/ec) (lb/ec)		***()*£ ***()*£ ¤ ¤ ¤ ¤ ¤ ¤ ¤ ¤	App
A BEEFEELEEREEREEREEREEREEREEREEREEREEREEREERE	statestatestate n the residue nic N leached ineralizat(+)	46.92 .01 -46.56	Ub/ac) (lb/ac) (lb/ac) (lb/ac)			Appl
A BEEFEELEELEELEELEELEELEELEELEELEELEELEELE	ettereture n the residue nic N leached	46.92 .01	Ub/ac) (lb/ac) (lb/ac) (lb/ac)			٩٩٩
ABEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE	n the residue nic N leached ineralizat(+) nitrification	46.92 .01 -46.56 12.93	essessessess (lb/ac) (lb/ac) (lb/ac) (lb/ac)			٩٩٩
a         a           b         a           Alt-X Exit         Menu           b         a           b         a           a         cunt N left i           a         a           a         a           a         Net immobil(-)/m           a         De           a         Top ma	statestatestate n the residue nic N leached ineralizat(+)	46.92 .01 -46.56 12.93	essessessess (lb/ac) (lb/ac) (lb/ac) (lb/ac)			App
Alt-X Exit Menu Alt-X Exit Menu Alt-X Exit Menu a ount N left i a Inorga a Net immobil(-)/m a De a Top ma	n the residue nic N leached ineralizat(+) nitrification as @ 15.5 H2O	46.92 .01 -46.56 12.93 12390.05	excenteration (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			App
A BEEFERENE SE	n the residue nic N leached ineralizat(+) nitrification	46.92 .01 -46.56 12.93	excenteration (lb/ac) (lb/ac) (lb/ac) (lb/ac) (lb/ac)			App
A BEEFERENE AND AND A AN	n the residue nic N leached ineralizat(+) nitrification as @ 15.5 H2O ficit in crop	46.92 .01 -46.56 12.93 12390.05 .00	<pre>####################################</pre>			App
A BEEFERENE ALLES ALLES EXIL Menu A E(1) E E E E E E E E E E E E E E E E E E E	n the residue nic N leached ineralizat(+) nitrification as @ 15.5 H2O	46.92 .01 -46.56 12.93 12390.05 .00	<pre>####################################</pre>		****** *** ** ** ** ** ** ** ** ** ** *	Appl
A BEEFERENE AND A LEVEN ALT-X Exit Menu Abi(1) HEEFERENE AND A LEVEN a ount N left i a Inorga a Net immobil(-)/m a Dec a Top ma a Noisture de a Nitrogen de	n the residue nic N leached ineralizat(+) nitrification as @ 15.5 H20 ficit in crop	46.92 .01 -46.56 12.93 12390.05 .00 39.27	<pre>####################################</pre>			مهرم
A BEEFERENE AND AND A AN	n the residue nic N leached ineralizat(+) nitrification as @ 15.5 H20 ficit in crop	46.92 .01 -46.56 12.93 12390.05 .00 39.27	<pre>####################################</pre>		***:** ***:** ***:** ***:** *** *** ***	App
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Alt-X Exit

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Henu ¤ Name Farmer Tom Field South 40 Rainfall п N Form () Dry п m C:N Ratio ( ) Ammon. Nitrate () Average п () Grass - 20:1 () Urea ¤ Crop () Wet n ¤ () Corn () Leaves - 40:1 ( ) Liquid Nitrogen m ( ) Future ( ) Leaves - 70:1 () Anhydrous Ammon Air-temp () Wood - 150:1 () Ammon. Sulfate () Hot ¤ ( ) Future () Average II Plant on APR 28 Apply on APR 2 Apply on JUN 15 ( Cold n SeedRate 30700 Rate Ton/Ac 20 NRate (lb/ac) 200 Soil Type n () Sand ¤ Harvest OCT 12 Incorporation Apply Method () Loam () None ( ) Surface () Clay ( ) Shallow [0-6"] () Shallow [0-6"] n () Deep [0-12"] ( ) Deep [0-12"] % total N 99 N init ppm 99 Alt-X Exit

Apply N LATER

Menu

п п ount N left in the residue 42.46 (lb/ac) п Inorganic N leached .01 (lb/ac) п Net immobil(-)/mineralizat(+) -36.19 (lb/ac) Denitrification n 18.73 (lb/ac) Π Top mass @ 15.5 H20 13034.55 (lb/ac) п п Moisture deficit in crop .00 (inches) п α Nitrogen deficit in crop 34.19 (lb/ac) Π n Organic Nitrogen pool CHANGE 326.46 (lb/ac) п

Inorganic N in profile 52.55 (lb/ac) Ok É Quit É 00000000 00000000 

Alt-X Exit

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#### Nenu

×Name Farmer Tom	Field South 40		Rainfall	r
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1			() Average	n
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Harvest OCT 12	Incorporation	Apply Method	() Loam	π
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#### Menu

Alt-X Exit

п n wunt N left in the residue 42.19 (lb/ac) Inorganic N leached (lb/ac) .06 Д . multiple multipl -46.31 (lb/ac) Denitrification 16.17 (lb/ac) Top mass @ 15.5 H20 15218.43 (lb/ac) Moisture deficit in crop .00 (inches) π Nitrogen deficit in crop п .24 (lb/ac) n Organic Nitrogen pool CHANGE 336.70 n (lb/ac) n Inorganic N in profile 61.00 (lb/ac) Quit É Ok É 00000000 00000000 

Alt-X Exit

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u Name Farmer Tom	Field South 40		Rainfall	
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a Crop	( ) Grass - 20:1	( ) Urea	() Wet	a
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a SeedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	r
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SUPFACE Apply N

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Alt-X Exit

¤ Name Farmer Tom	Field South 40		Rainfall	n
a		N Form	( ) Dry	n
a	C:N Ratio	( ) Ammon. Nitrate	() Average	п
a Crop	( ) Grass - 20:1	( ) Urea	()Wet	п
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DEEP Apply N

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¤ N	et immobil(-)/mineralizat(+)	-42.87	(lb/ac)	ш
п	·			n
n	Denitrification	8.41	(lb/ac)	<b>=</b>
n				п
п	Top mass @ 15.5 H2O	14423.56	(ib/ac)	B
п				п
n	Moisture deficit in crop	.00	(inches)	п
n				n
n	Nitrogen deficit in crop	20.81	(lb/ac)	¤
n				¤
ш	Organic Nitrogen pool CHANGE	331.34	(lb/ac)	n
п				π
n	Inorganic N in profile	42.80	(lb/ac)	¤
n				п
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#### Alt-X Exit

#### Menu I Name Farmer Tom Field South 40 Rainfall п N Form at () Dry C:N Ratio п () Ammon. Nitrate () Average п ¤ Crop () Grass - 20:1 () Urea () Wet II () Corn () Leaves - 40:1 ( ) Liquid Nitrogen ¤ ( ) Future () Leaves - 70:1 () Anhydrous Ammon Air-temp () Wood - 150:1 () Ammon. Sulfate () Hot = ( ) Future n () Average = Plant on APR 28 Apply on APR 2 Apply on MAY 30 () Cold п III SeedRate 30700 Rate Ton/Ac 20 NRate (lb/ac) 200 Soil Type п () Sand # Harvest OCT 12 Incorporation Apply Method () Loam n () None ( ) Surface () Clay ( ) Shallow [0-6"] ( ) Shallow [0-6"] π () Deep [0-12"] () Deep [0-12"] % total N 99 N init ppm 99 п n Alt-X Exit Menu n

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π	ount N left in the residue	405.47	(lb/ac)	π
π				a
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			(12) 20)	a
	Net immobil(-)/mineralizat(+)	-147 33	(lb/ac)	
		- 147.33		
	<b>b</b>	7.45	<i>d</i>     <i>d</i> = - 1	a
n	Denitrification	3.15	(lb/ac)	8
n				a
п	Top mass @ 15.5 H2O	6352.76	(lb/ac)	n
π				D
n	Moisture deficit in crop	37.32	(inches)	Π
n				¤
Π	Nitrogen deficit in crop	111.87	(lb/ac)	π
Π				n
ø	Organic Nitrogen pool CHANGE	326.63	(lb/ac)	
a				n
'n	Inorganic N in profile	34.68	(lb/ac)	п
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I () Corn 🧳	() Leaves -	40:1 (	) Liquid Nitrogen	ر مدر عدم عالمه کارلوم <b>المحمد ال</b>	۲. D
a ( ) Future	( ) Leaves	- 70:1	() Anhydrous Ammor	Air-temp	Π
I ( ) Future	() Wood	- 150:1	( ) Ammon. Sulfate	e ()Hot	1
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	II () Corn () Leaves - 40:1 ( ) Liqu	id Nitrogen
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	# Plant on APR 28 Apply on APR 2 Apply	on MAY 30 () Cold
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Alt-X Exit

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IN Name Farmer Tom Field South 40

C:N Ratio

( ) Surface ( ) Clay "] () Shallow [0-6"] () Deep [0-12"] X total N 99 N init ppm 99 ëëëëëëë 51.95 (lb/ac) .00 (lb/ac) 44.35 (lb/ac) Denitrification 7.37 (lb/ac) Top mass @ 15.5 H20 15296.73 (lb/ac) Moisture deficit in crop .00 (inches) Nitrogen deficit in crop 18.96 (lb/ac) Organic Nitrogen pool CHANGE 333.38 (lb/ac) Inorganic N in profile 40.53 (lb/ac) Ok É Quit É 00000000 00000000 

() Grass - 20:1 () Urea

N Form

Rainfall

() Dry

() Wet

( ) Ammon. Nitrate () Average

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Alt-X Exit

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Organic Nitrogen pool CHANGE 324.71

Inorganic N in profile

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¤Ngme Farmer Tom	Field South 40		Rainfall	п
I		N Form	( ) Dry	п
I	C:N Ratio	( ) Ammon. Nitrate	() Average	n
I Crop	( ) Grass - 20:1	( ) Urea	( ) Wet	n
I () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		α
i ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	¤
1 ( ) Future	( ) Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	¤
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n	No ount N left in the residue	46.09	(lb/ac)	
п				•
n	Inorganic N leached	.81	(lb/ac)	a
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п	Net immobil(-)/mineralizat(+)	-43.67	(lb/ac)	Π
α				<b>n</b>
	Denitrification	9.29	(lb/ac)	ū
п				a
n	Top mass @ 15.5 H2O	11558.70	(lb/ac)	
п				0
α	Moisture deficit in crop	.00	(inches)	n
n				п
п	Nitrogen deficit in crop	39.74	(lb/ac)	n
п				n
n	Organic Nitrogen pool CHANGE	331.74	(lb/ac)	п
п				n
п	Inorganic N in profile	59.26	(lb/ac)	п
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a Name Farmer Tom	Field South 40		Rainfall	p
2		N Form	( ) Dry	n
3	C:N Ratio	( ) Ammon. Nitrate	() Average	π
a Crop	( ) Grass - 20:1	( ) Urea	() Wet	
a () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		Ξ
ı ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	π
I ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	D
r			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	n
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seedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	b
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Harvest OCT 12	Incorporation	Apply Method	() Loam	
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α	unt N left in the residue	335.06	(lb/ac)	
α				п
α	Inorganic N leached	50.62	(lb/ac)	2
α				n
a Net	t immobil(-)/mineralizat(+)	-87.52	(lb/ac)	n
α				n
α	Denitrification	1.44	(lb/ac)	n
α				n
α	Top mass @ 15.5 H2O	12730.50	(lb/ac)	n
α				n
a	Moisture deficit in crop	12.66	(inches)	п
a				п
a	Nitrogen deficit in crop	41.17	(lb/ac)	n
α				п
	ganic Nitrogen pool CHANGE	284.71	(lb/ac)	n
α				n
a	Inorganic N in profile	1.83	(lb/ac)	p
1				X.
1		Quit É		n
r	0000000 0	0000000		n

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¤ Name Farmer Tom	Field South 40		Rainfall	n
n		N Form	( ) Dry	n
n	C:N Ratio	( ) Ammon. Nitrate	() Average	n
¤ Crop	( ) Grass - 20:1	( ) Urea	() Wet	п
¤ () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		π
¤ ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	a
¤ ( ) Future	( ) Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	n
n			() Average	n
<pre>     Plant on APR 28 </pre>	Apply on APR 2	Apply on MAY 30	( ) Cold	α
<b>D</b>				n
¤ SeedRate 30700	Rate Ton/Ac 20	NRate (lb/ac) 200	Soil Type	π
n			() Sand	n
¤ Harvest OCT 12	Incorporation	Apply Method	()Loam -	n
n	() None	( ) Surface	() Clay	n
¤	( ) Shallow [0-6"]	( ) Shallow [0-6"]		Π
Π.	() Deep [0-12"]	() Deep [0-12"]	% total N 99	n
n				п
n			N init ppm 99	n
¤				π
¤				a
n				n
<b>A</b> eeeeeeeeeeeeeeeeeee	*****************	eeee Ok Éeeee	************	ëëë¥
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#### Menu

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Moisture deficit in crop

unt N left in the residue n 27.28 (lb/ac) п n Inorganic N leached 1.83 (lb/ac) n let immobil(-)/mineralizat(+) -21.68 (lb/ac) Denitrification 11.85 (lb/ac) Top mass @ 15.5 H20 13484.02 (lb/ac)

Nitrogen deficit in crop 22.15 n (lb/ac) n Organic Nitrogen pool CHANGE п 312.80 (lb/ac) n Inorganic N in profile 77.41 (lb/ac) Ok É Quit É n 00000000 00000000 п

.00

(inches)

Section 6. Becker simulations and trial results.

This section contains the results for the eight treatments of residue and nitrogen used at Becker. The table below shows that the model fails to accurately predict the trial results.

#### Yield results and model estimates

Tre	atments	Corn	Yield	
Residue	Nitrogen	Becker	Model	
(tons)	(lbs/acre)	(lbs	/acre)	
0	0	6704	6715	
20	0	8165	5494	
40	0	10147	5494	
80	0	10856	5494	
0	200	15237	15233	
20	200	16358	13777	(baseline)
40	200	16491	8850	
80	200	16444	6758	

Among the reasons for this prediction failure may be:

-- the model does not begin soon enough; the residue was actually applied in the fall, not in the spring as the model assumes. This may be particularly significant, since the residue was almost immediately covered with a 30 inch blanket of insulating snow.

-- a single C:N ratio may not accurately reflect the amount of (labile) nitrogen available to the plant. With the tremendous amounts of residue applied, it is reasonable to assume a good deal more N was immediately available than the model is currently allowing with a single C:N ratio.

-- while the impact may not be significant, the model has no mechanism for seeds that fail to germinate. Consequently, the model kept the initial planting population of 30,700, while the field results showed final populations ranging from 26,463 to 28,859.

\* Becker results are estimated from data in the report, "Land Spreading of Yard Waste", by Carl Rosen, Thomas Halbach, Jean Molina, Dave Birong, Jennifer Weiszel.

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a Proce Farmer Tom	Field South 40		Rainfall	1
a		N Form	( ) Dry	1
a	C:N Ratio	( ) Ammon. Nitrate	() Average	a
a Crop	( ) Grass - 20:1	( ) Urea	() Wet	1
a () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		π
¤ ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	ū
a ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	,
a			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	I
a				,
seedRate 30700	E Mille Tary to R	MRate (1b/ac) 0	Soil Type	1
a			() Sand	1
a Harvest OCT 12	Incorporation	Apply Method	() Loam	n
a	( ) None	( ) Surface	( ) Clay	1
<b>a</b> .	( ) Shallow [0-6"]	() Shallow [0-6"]		n
a	() Deep [0-12"]	( ) Deep [0-12"]	% total N 9	9 п
۰. ۲				1
a			N init ppm 9	9 1
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Ξ,				n
יתי, מ	ount N left in the residue	.08	(lb/ac)	n
α				n
π	Inorganic N Leached	.00	(lb/ac)	п
α				n
🗆 Net	<pre>immobil(-)/mineralizat(+)</pre>	26.06	(lb/ac)	8
α				n
α	Denitrification	.86	(lb/ac)	n
n				n
n	Top mass @ 15.5 H20	6715.66	(lb/ac)	
n				
n	Moisture deficit in crop	.00	(inches)	a
a	•			μ
α	Nitrogen deficit in crop	108.50	(lb/ac)	n
n	······			
	ganic Nitrogen pool CHANGE	-23.87	(lb/ac)	
п с.,			(12, 20,	-
	Inorganic N in profile	6.98	(lb/ac)	-
n	morganie i in protite	0.70	((0) 00)	-
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#### Menu

I Name Farmer Tom Field South 40 Rainfall п α N Form

a		N Form	( ) Dry	n
	C:N Ratio	( ) Ammon. Nitrate	() Average	π
¤ Crop	( ) Grass - 20:1	( ) Urea	( ) Wet	Π
¤ () Corn	() Leaves - 40:1 (	( ) Liquid Nitrogen		α
💷 ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	n
¤ ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	() Hot	n
Π			() Average	α
□ Plant on APR 28	Apply on APR 2	Apply on MAY 30	() Cold	a
8		to the Karana		
🛙 SeedRate 30700		The second second second	Soil Type	π
n			() Sand	α
# Harvest OCT 12	Incorporation	Apply Method	() Loam	π
<b>n</b>	( ) None	( ) Surface	( ) Clay	×
α	( ) Shallow [0-6"]	() Shallow [0-6"]		α
<b>u</b>	() Deep [0-124]	( ) Deep [0-12"]	X total N 99	u
n				a
ш			N init ppm 99	
a				a
<b>n</b>	•			a
•				Π
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a de la constante de la consta		n
III Junt N left in the residue 7	8.12 (lb/ac)	n
D		n
Inorganic N Leached	.01 (lb/ac)	2
D I I I I I I I I I I I I I I I I I I I		n
<pre>multiple ====================================</pre>	8.56 (lb/ac)	α
<b>u</b>		8
n Denitrification	.72 (lb/ac)	п
Ξ		
Top mass 8 15.5 H20 549	3.81 (lb/ac)	×
		n
Moisture deficit in crop	.00 (inches)	
α		
-	2.13 (lb/mc)	8
<b>D</b>		π
III Organic Nitrogen pool CHANGE 272	2.52 (lb/ac)	п
Π		u
- •	5.24 (ib/ac)	n
п 		Π
¤ Ok É Quit	-	ta
<b>x</b> 0000000 000000		Ħ
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# Pine Farmer Tom	Field South 40		Rainfall	n
D		N Form	( ) Dry	Π
a	C:N Ratio	( ) Ammon. Nitrate	() Average	n
🗆 Crop	( ) Grass - 20:1	( ) Urea	( ) Wet	n
¤ () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
🗉 ( ) Future	() Leaves - 70:1	() Anhydrous Ammon	Air-temp	α
¤ ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	π
<b>D</b>			() Average	n
= Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	n
Π				π
III SeedRate 30700	Tanile 40%	Wate (Lb/ee) 0	Soil Type	n
n	A A A A A A A A A A A A A A A A A A A		() Sand	π
# Harvest OCT 12	Incorporation	Apply Nethod	() Loam	×
α	() None	( ) Surface	( ) Clay	
a	( ) Shallow [0-6"]	() Shallow [0-6"]		n
п	() Deep [0-12"]	( ) Deep [0-12"]	% total N 99	a a
α				α
n			N init ppm 99	
n				n
α.				α
п				n
Aceececcecceccecce	***************	icece Ok É <b>eses</b>	***********	ëëëë¥

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#### Menu n n ` .unount N left in the residue 165.83 (lb/ac) Inorganic N Leached .01 (ib/ac) m Net immobil(-)/mineralizat(+) 11.82 (lb/ac) n Denitrification .73 (lb/ac) Top mass @ 15.5 H20 5493.81 (lb/ac) Moisture deficit in crop .00 (inches) n Nitrogen deficit in crop 132.37 (lb/ac) Organic Nitrogen pool CHANGE 546.17 (lb/ac) α Inorganic N in profile 16.74 (lb/ac) Quit É Ok É 00000000 00000000 n

#### Menu

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# Prme Farmer Tom	Field South 40		Rainfall	Π
n		N Form	( ) Dry	α
<b>D</b>	C:N Ratio	( ) Ammon. Nitrate	() Average	α
п Сгор	( ) Grass - 20:1	( ) Urea	() Wet	α
¤ () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		ū
¤ ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	Π
= ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	n
<b>D</b>			() Average	
m Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	¤
n	na - ma vez trategia i la initiativa traterio da	وسيونو والمراجع		п
n SeedRate 30700		Male Lines	Soil Type	•
a			( ) Sand	n
m Harvest OCT 12	Incorporation	Apply Method	() Loam	π
Π	( ) None	( ) Surface	( ) Clay	a
<b>D</b>	( ) Shallow [0-6"]	() Shallow [0-6"]		α
D	() Deep [0-12"]	( ) Deep [0-12 <sup>H</sup> ]	X total N 99	Π
n				•
a			N init ppm 99	n
				n
п				n
a				n
<b>\~~~~~~~~~~~~~~~~~</b>		ieeee Ok Éééééé	***************	<del>lëëë</del> ¥
Alt-X Exit				

Nenu Π wount N left in the residue 342.50 (lb/ac) Inorganic N Leached .01 (lb/ac) x Net immobil(-)/mineralizat(+) 19.43 (lb/ac) Denitrification .91 (lb/ac) Top mass @ 15.5 H20 5493.81 (lb/ac) Moisture deficit in crop .00 (inches) π Nitrogen deficit in crop 132.47 (lb/ac) n Organic Nitrogen pool CHANGE 1091.96 (lb/ac) π Inorganic N in profile 24.26 (lb/ac) Ok É Quit É 00000000 **00**0000000 π Acceleterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterecenterec

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	Field South 40		Rainfall	r
α		N Form	( ) Dry	Ţ
α	C:N Ratio	( ) Ammon. Nitrate	() Average	п
¤ Crop	() Grass - 20:1	( ) Urea	() Wet	r
¤ () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
¤ ( ) Future	() Leaves - 70:1	() Anhydrous Ammon	Air-temp	n
¤ ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	() Hot	r
a			() Average	n
¤ Plant on APR 28	Apply on APR 2	Apply on MAY 30	() Cold	r
<b>n</b> .				r
¤ SeedRate 30700	Rate Ton/Ac 0	NRate (lb/ac) 200	Soil Type	c
α .			() Sand	c
¤ Harvest OCT 12	Incorporation	Apply Method	() Loam	п
a	( ) None	( ) Surface	( ) Clay	r
<b>.</b> .	( ) Shallow [0-6"]	() Shallow [0-6"]	•	п
a	() Deep [0-12"]	( ) Deep [0-12"]	% total N 99	п
D		•		E
n			N init ppm 99	n
a				E
a				n
α				
	ecccccccccccccccccccccccccccccccccccccc	eeeee Ok Éeeeee		
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	11] eccccccccccccccccccccccccccccccccccc	eecee u ee	.eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee	eccceccccccccccccccccccccccccccccccccc
n				n
n	nount N left in the residue	. 19	(lb/ac)	α
п				a
n	Inorganic N leached	.00	(lb/ac)	п
n				n
n	Net immobil(-)/mineralizat(+)	26.26	(lb/ac)	¤
α				a
n	Denitrification	.94	(lb/ac)	D
Π				α
	Top mass @ 15.5 H20	15232.65	(lb/ac)	u
п				a
n	Moisture deficit in crop	,00	(inches)	α
а				n
α	Nitrogen deficit in crop	.00	(lb/ac)	ü
п				п
n	Organic Nitrogen pool CHANGE	-21.67	(lb/ac)	a
n				n
п	Inorganic N in profile	98.61	(lb/ac)	п
п				п
a		Quit É		п
п		Ôi		п
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□ Prme Farmer Tom	Field South 40		Rainfall	Π
n		N Form	( ) Dry	п
n	C:N Ratio	( ) Ammon. Nitrate	() Average	Π
¤ Crop	() Grass - 20:1	( ) Urea	( ) Wet	n
¤ () Corn	() Leaves - 40:1 (	( ) Liquid Nitrogen		n
¤ ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	n
🗆 ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	n
n			() Average	n
<b>¤ Plant on APR 28</b>	Apply on APR 2	Apply on MAY 30	( ) Cold	n
α				n
¤ SeedRate 30700	Rate Ton/Ac 20	NRat <b>e (lb/ac) 200</b>	Soil Type	n
a			() Sand	n
¤ Harvest OCT 12	Incorporation	Apply Method	() Loam	α
n	( ) None	( ) Surface	( ) Clay	п
D	( ) Shallow [0-6"]	() Shall <b>ow [0-6"]</b>		п
D	() Deep [0-12")	( ) Deep [0-12"]	% total N 99	п
п				¤
n			N init ppm 99	a
n				n
n				n
a				¤
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# BASELINE

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#### Menu

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п Π .nount N left in the residue 49.75 (1b/ac) п п n п Inorganic N leached .01 (lb/ac) Π π -43.71 (lb/ac) п **Denitrificati**on 13.25 (lb/ac) п Top mass @ 15.5 H20 13776.67 (lb/ac) п n п Hoisture deficit in crop .00 (inches) п Nitrogen deficit in crop 27.89 (1b/ac) п π Organic Nitrogen pool CHANGE 330.85 (1b/ac) п Π Inorganic N in profile 44.20 (lb/ac) Π n Ok É Quit E n 00000000 n Alt-X Exit

『바~~ Farmer Tom	Field South 43		Rainfall	n
ı ·		N Form	( ) Dry	n
I	C:N Ratio	( ) Ammon. Nitrate	() Average	n
Сгор	( ) Grass - 20:1	( ) Urea	( ) Wet	n
() Corn	() Leaves - 40:1 (	) Liquid Nitrogen		a
( ) Future	( ) Leaves - 72:1	() Anhydrous Ammon	Air-temp	п
( ) Future	( ) Wood - 1-0:1	( ) Ammon. Sulfate	( ) Hot	n
			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	п
				n
SeedRate 30700	Rate Ton/Ac 40	NRate (lb/ac) 200	Soil Type	α
			() Sand	a
Harvest OCT 12	Incorporation	Apply Method	() Loam	α
	( ) None	( ) Surface	( ) Clay	п
	( ) Shallow [0-6"]	() Scallow [0-6"]		n
	() Deep [0-1]	( ) b sp [0-12"]	% total N 99	n
				n
			N init ppm 99	n
				n
				n
				n

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èë	[±] eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee	0 čë	ineeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee	]ë£
п				α
n	aount N left in the residue	° ° . 39	(lb/ac)	π
п				π
n	<b>inorganic N lea</b> ched	.91	(lb/ac)	α
α				n
a	Net immobil(-)/mineralizat(+)	74.91	(lb/ac)	n
n				n
n	<b>Denitrificat</b> ion	34.51	(lb/ac)	a
п				n
п	Top mass @ 15.5 H20	.2.87	(lb/ac)	α
п				n
n	Moisture deficit in crop-	. 00	(inches)	a
Π				n
п	Nitrogen deficit in creation	. 74	(lb/ac)	п
п				α
п	Organic Nitrogen pool CHANGE	1.12	(lb/ac)	ц
п				a
п	Inorganic N in profile	11.12	(lb/ac)	n
u				π
n	Ok É 🔅	: :		a
n	<b>0000000</b> (·	ú.		n
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	t-X Exit			

#### Menu

I Prme Farmer Tom	Field South		Rainfall	α
I		N Form	( ) Dry	n
	C:N Ratio	( ) Ammon. Nitrate	() Average	π
a Crop	() Grass - 20:1	( ) Urea	()Wet	· n
a () Corn	() Leaves - 40:1 (	) Liquid Nitrogen		n
a ( ) Future	( ) Leaves - 70:1	() Anhydrous Ammon	Air-temp	п
a ( ) Future	() Wood - 150:1	( ) Ammon. Sulfate	( ) Hot	п
a			() Average	n
Plant on APR 28	Apply on APR 2	Apply on MAY 30	( ) Cold	п
a				n
🛙 SeedRate 🛛 30700	Rate Ton/Ac 80	NRate (lb/ac) 200	Soil Type	n
α			( ) Sand	n
a Harvest OCT 12	Incorporation	Apply Method	() Loam	n
<b>a</b>	( ) None	( ) Surface	( ) Clay	D
a	( ) Shallow [0-6"]	() Shallow [0-6"]		п
a	() Deep ["-12"]	( ) Deep [0-12"]	% total N 99	n
α				0
a			N init ppm 99	D
α				0
α				1
a				α
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n			n			
<b>m</b>	291.65	(lb/ac)	a			
п			p			
m Inorganic N leached	.01	(lb/ac)	n			
n			n			
<pre>m Net immobil(-)/mineralizat(+)</pre>	-87.83	(lb/ac)	п			
<b>D</b>			n			
n Denitrification	1 1.50	(lb/ac)	п			
¤			Π			
π Top mass @ 15.5 HC h	£75 £ <b>.13</b>	(lb/ac)	n			
¤			n			
m Hoisture deficit in cr.	.00	(inches)	п			
a			п			
π Nitrogen deficit in ω →	1001.06	(11-1-10)	Ø			
<b>¤</b>			a			
n Organic Nitrogen pool CHA.	1201.06	(11:1-1)	п			
n			п			
<b>π Inorganic N in p</b> rofite	71.01	(1b/ a)	n			
a			n			
¤ Ok É	nuit .		п			
<b>π</b> 0000000	. 1		n			
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