REPORT TO THE OREGON PROCESSED VEGETABLE COMMISSION, 1994-1995

TITLE: Nitrogen Management in Vegetable Crops and Their Rotations

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PROJECT STATUS: Continuing

FUNDING: $11,470 in 1994-95 from OPVC. Additional funding from OSU, Unocal, and Oregon DEQ. Funds spent for fertilizers; soil and tissue analysis; sample collection; labor for plot establishment, maintenance and harvest; travel, Corvallis to Aurora.

OBJECTIVES FOR 1994:

Cauliflower

1. To evaluate effects of timing of N application and N source on cauliflower yield, quality, N uptake, and residual soil N.
2. To further evaluate the potential for leaching of nitrate from cauliflower plantings fertilized with the optimal rate of N.

Sweet Corn

1. To further evaluate the effect of several N sources on sweet corn yield.
2. To evaluate N uptake efficiency in sweet corn at both optimal and suboptimal N rates and measure nitrate leaching.
3. To evaluate the effect of splitting N applications on sweet corn yield.
4. To evaluate the effect of several winter cover crops, including cereal rye (both drilled and overseeded), rye plus pea, overseeded clover, and a clover green manure crop, on sweet corn yield, quality, N uptake efficiency, and leaching of nitrate.

Table Beets

1. To establish small yield vs. N rate trials to use in comparison with grower soil survey results.
2. To estimate N uptake efficiency at recommended N application rate.

All Crops

1. To collect and analyze soil samples to 48-inch depth before and after crops of sweet corn, table beet, cauliflower, and broccoli. Survey growers to determine nitrogen application, soil type, field history, and relevant cultural practices.

PROGRESS REPORT:

Nitrogen Rate, Source, and Timing on Cauliflower Yield

'Snowball Y' cauliflower was bare-root transplanted on 20 July in rows 2.5 feet apart with 18 inches between plants in the row. Plot size was three rows, 20 feet long. All three rows were harvested.

The initial application of 40 pounds N/acre was either broadcast as urea or banded as calcium-ammonium nitrate solution (CAN-17) three inches to the side of the row immediately after transplanting. The remaining N was broadcast or banded on the appropriate plots on 24 August, or on 24 August and 21 September, depending on the treatment (Table 1). Sidedress N source was either urea, calcium nitrate (CN), or CAN-17. The plots were harvested on 10 and 21 October. Two sets of plots (Treatments 6 and 7) were overseeded with 'Wheeler' cereal rye on 1 September to determine the feasibility of interseeding in cauliflower as a means of establishing a winter nitrogen catch crop.

For the plots receiving only broadcast applications of urea, yield and mean head weight increased with increasing rate of nitrogen to a maximum at 180 pounds N/acre (Table 2). This is in contrast to 1992 and 1993, in which 240 pounds N/acre was needed for maximum yield. Curd quality did not vary significantly with N rate.

Overseeding cereal rye about seven weeks before first harvest did not reduce cauliflower yield (Table 3). This is consistent with results obtained in 1992 and 1993.

Use of calcium nitrate, rather than urea, as the source for the sidedressed nitrogen had no effect on yield for the sum of the two harvests when averaged over two rates and timings of application (Table 4). This is consistent with results obtained in 1993. Splitting the sidedressed nitrogen application such that half the sidedressed N was not applied until nine weeks after transplanting had no effect on yield or quality (Table 4), when averaged over two N rates and two sources. This is also consistent with previous results. However, there was a significant interaction of N source x timing of application affecting mean head weight and gross yield (Table 4): splitting the sidedress N application decreased yield with urea as N source, but increased it with calcium nitrate. Further testing would be needed to determine if this effect is reproducible and biologically significant. Number of heads harvested at either harvest was not affected by N source or by splitting the sidedress N application, indicating these factors did not affect maturity (data not shown).

Calcium-ammonium nitrate, compared to urea, had no effect on yield or head size (Table 5).

<u>Cover Crop N Uptake</u>

In the long-term crop rotation study, winter cover crops of cereal rye, rye plus Austrian pea, and red clover were either overseeded (July 15, 1993) into a standing crop of broccoli (rye, clover) or were seeded (Oct. 7, 1993) into plots after the broccoli residue was plowed under (rye, rye+pea). The broccoli had been fertilized with either 0, 125, or 250 lb N/acre.

Both increasing the fertilizer rate on the preceding broccoli crop and the presence of peas in the cover crop increased cover crop N uptake (Fig. 1). The dry matter yield of overseeded rye or overseeded clover was approximately one-half that of drilled rye. This is in contrast to 1993, when the overseeded crops yielded about the same as the drilled cover crops. N uptake by a clover seed crop which had been harvested for seed in 1993 and allowed to regrow over the winter (rattoon clover) was comparatively poor, due to a poor stand of the seed crop. Nitrogen uptake was greatest for the rye plus pea cover crop, and least for overseeded rye. Nitrogen uptake by rye increased with increasing rate of nitrogen applied to the previous broccoli crop, particularly for the high rate of nitrogen. Nitrogen uptake of the overseeded clover did not vary with rate of applied N.

A rough estimate of the amount of residual fertilizer N left over from the broccoli crop that was recovered by the rye cover crop can be obtained by examining the rye-only uptake at the three fertilizer rates as shown in Figure 1. Subtracting the amount of N taken up by the drilled rye grown on non-fertilized subplots from the N taken up at the other two N rates suggests that about 20 pounds N/acre (6 pounds for overseeded rye) was taken up from the intermediate rate of N and 28 pounds/acre (29 for overseeded rye) from the high rate of N. This nitrogen would have been available for leaching. Of course, an undetermined amount of nitrogen may have leached before the cover crops were well established. The overseeded rye did not achieve much germination or growth until after the broccoli was mowed down and the onset of fall rains. Stands were poor. Thus, it is not surprising that the yield and N uptake for the overseeded rye are less than for the drilled rye. Cover crop N recovery in 1993 was similar, except that stands of overseeded covers were better and yield and N uptake were about equal at all N rates.

Cover Crops on Sweet Corn Yield

'Jubilee' sweet corn was seeded on 23 May. Plots which had been in overseeded rye or clover were treated with EPTC at 3.0 pounds/acre, which was incorporated before planting. All other plots received a broadcast application of 2.0 pounds atrazine and 3.0 pounds alachlor/acre immediately after planting.

On 6 June, nitrogen was applied as urea at rates of one-half the total N rates of 0, 50, and 200 pounds/acre. Subplots of the clover seed crop plots received only the 0 and 200 pound rates of total N. All N rate subplots were in the same location as the corresponding N treatments on the previous vegetable crops. The remainder of the urea was sidedressed on 1 July, at which time the EPTC-treated plots were again overseeded with rye or clover, using a whirly-bird fertilizer spreader. The seed was scratched in with a garden rake. This overseeding was in preparation for the 1995 experiments, in which one of the objectives will, again, be to determine the value and feasibility of overseeding a cover crop into the standing vegetable crop. EPTC-treated plots were hand-hoed as necessary before overseeding. Harvest was on 31 August.

Sweet corn yield varied significantly with both cover crop and N rate (Table 6). There were no significant interactions of cover crop and N rate affecting any component of yield or quality, so only main effects of cover crop and N rate are shown. Yield from plots which had been in drilled rye was depressed compared to any other treatment except the overseeded rye. This is consistent with results obtained in 1990 and 1992 for sweet corn and also consistent with results for broccoli following cereal rye. Among possible explanations are the possibility of allelopathy from the rye residue, immobilization of mineral N by the decomposing rye straw, or an adverse effect of cereal rye on soil tilth. The combination of cereal rye and winter pea produced yield equal to that following winter fallow and the greatest mean ear weight, while overseeded clover or a spring-plowed clover seed crop significantly increased yield compared to winter fallow, presumably due to the nitrogen contribution from the clover.

Yield, number of ears harvested, ear length, tipfill, and mean ear weight all increased with each increase in rate of applied N, regardless of cover crop treatment. This is consistent with results obtained in 1990 through 1992 for sweet corn and broccoli. However, in 1993, broccoli yield did not increase from the intermediate to the highest rate of N. In 1994, the greatest yield (8.8 tons/acre), number of ears harvested (28,170/acre), tipfill (3.5), and mean ear weight (284 g) were with the combination of overseeded clover and the greatest rate of applied N.

The contribution of a cover crop legume to sweet corn yield can best be appreciated by comparing yield at zero applied N (Figure 2). The difference in yield between corn on fallowed plots with no applied N and that from fallowed plots with 50 pounds fertilizer N/acre was 4.0 tons/acre. The plots which had been in overseeded clover, but which received no fertilizer, produced 3.5 tons/acre greater yield than did the unfertilized fallowed plots. Assuming linear response to available N over this range, the yield increase of 3.5 tons/acre indicates 44 pounds N/acre were provided by the overseeded clover. Similarly, the spring-plowed clover seed crop provided an estimated 34 pounds N/acre. The rye or rye-pea cover crops did not appear to provide N to the sweet corn crop.

Nitrogen Rate, Source, and Timing on Sweet Corn Yield

'Jubilee' sweet corn was seeded on 25 May. Plot preparation included a broadcast and incorporated application of potassium sulfate at 250 pounds per acre, disking and cultimulching. Triple superphosphate was banded at 130 pounds/acre, two inches to the side and two inches beneath the seed row on all plots. Forty pounds of nitrogen per acre as urea, ammonium nitrate, calcium-ammonium nitrate (CAN-17), or urea-ammonium nitrate (UAN-32) was also shanked in at 2 inches beneath and 2 inches to the side of the seed row on all but the zero nitrogen treatment (Table 7). The prilled urea and ammonium nitrate were applied in the same band as the superphosphate. The liquid CAN-17 and UAN-32 were applied with separate shanks mounted behind the superphosphate shanks. The remaining nitrogen was broadcast (dry fertilizers) or dribbled-banded (liquids) to the appropriate plots at planting or on 29 June (split application). Plots were harvested on 2 September.

Plots receiving a split application of urea were sampled for soil nitrate and ammonium concentration on 12 July. Ten entire shoots were collected on 29 June, just before the sidedress N application, from selected treatments and analyzed for total nitrogen concentration. Ten of the most recently-matured leaves were collected from selected treatments on 13 July and 1 August and analyzed for total N. Following completion of harvest, plots were sampled for residual soil nitrate and ammonium concentration on 14 September, before the onset of fall rains.

When all the sidedressed nitrogen fertilizer was banded as urea (Treatments 1-5, Table 7), yield increased with increasing rate of N to a maximum at 180 pounds N/acre (Table 8), consistent with results obtained in 1992 and 1993. However, the yields at 60, 120 and 240 pounds N/acre were not significantly different than at 180 pounds/acre. Mean ear weight, ear length, and tipfill were also greatest at 180 pounds N/acre. Kernel moisture concentration at harvest did not vary significantly with treatment.

The other combinations of N source and application method were at 120 and 180 pounds total N/acre. Comparisons of N utilization are based on banded urea at planting and broadcast urea sidedress, with a split application, as the standard. Mean yield and quality parameters of corn fertilized at 120 pounds N/acre did not vary significantly with nitrogen source (Table 9). This is consistent with results obtained in 1992 and 1993. At 180 pounds total N/acre, the yield of corn fertilized with urea-ammonium nitrate solution was less than that with dry urea or dry ammonium nitrate (Table 10). Both mean ear weight and the number of ears harvested tended to be reduced with urea-ammonium nitrate, but these effects were not statistically significant. Past research at NWREC with urea, ammonium nitrate, and other solid nitrogen sources, indicated no consistent effect of N sources on corn yield.

When comparing the effect of the timing of the sidedressed urea and ammonium nitrate applications, and averaged over two rates of N application, a split or delayed application of the sidedressed N appeared slightly superior to applying all fertilizer at planting for yield, number of ears harvested, and ear weight, but the differences were not significant (Table 11). This is consistent with results obtained in 1993. An effect of split application might have been expected in 1993 because of the greater than normal precipitation (15.3 cm) and, thus, leaching potential, during the interval between planting and the delayed sidedress application. However, in 1994, precipitation was only 4.5 cm during the interval between planting and the delayed sidedress, indicating little potential for leaching.

Within the subset of treatments representing the dry fertilizers, rates of 120 and 180 pounds N/acre, and either all N at planting or a split application, mean ear weight was greater for ammonium nitrate than for urea as N source (Table 11). This may be due to the smaller number of ears harvested from the ammonium nitrate-fertilized plots.

Leaf nitrogen concentration increased with increasing rate of applied N (Table 12) at the three growth stages tested. Source affected leaf N only at the first sampling date and at 40 pounds/acre applied N, with significantly greater concentration with ammonium nitrate as N source compared to the other three sources. Timing of the sidedress application did not affect leaf N concentration when sampled two or more weeks after the delayed sidedress.

Soil ammonium and nitrate concentration increased with increasing rate of applied N when measured two weeks after sidedressing (Table 13). Since yield was greatest at 180 pounds N/acre, it appears that a soil nitrate plus ammonium concentration of around 30 ppm in the surface foot of soil at mid-season is adequate for good yield. This information will be useful in attempting to devise a predictive model for sweet corn response to soil N levels.

In contrast to previous years, rate of applied N had relatively little effect on post-harvest soil concentrations of ammonium and nitrate (Table 14). Soil nitrate content tended to be slightly elevated in the surface 12 inches of soil at the optimal N rate of 180 pounds/acre, but the effect was not significant and there was no effect at all at suboptimal rates of N. At the greatest rate of applied N, soil nitrate, but not ammonium levels, were significantly increased, but to a lesser extent than in previous years. Any effect of N rate at greater depth was masked by the greater-than-normal nitrate concentrations that existed at time of planting. There was a small but significant effect of treatment on soil ammonium concentration at 36 to 48 inches. The form of applied N had no effect on soil nitrate concentrations at harvest, but there was, again, a small effect on soil ammonium at 36 to 48-inch depth.

Table Beet Response to Nitrogen

Plot preparation included a broadcast and incorporated application of potassium sulfate at 250 pounds per acre, disking and cultimulching. Pre-plant soil samples for nitrate and ammonium were obtained to four-foot depth, in one-foot increments, on 21 April. The N source was urea. The first 40 lb N/acre was broadcast at planting; the remaining N was broadcast on 10 June. 'Detroit Dark Red' table beets were seeded on 5 May and harvested on 25 July. Post-harvest soil samples were obtained on 14 September from areas which had been harvested.

Beet yield increased with each increment of N (Fig. 3), indicating an optimum for yield of at least 240 lb/acre. This is consistent with results obtained by Hemphill and Jackson in the late 70s, and with grower experience. Residual soil mineral N tended to increase with N rate but the levels were quite low (Table 16).

Post-Harvest Mineral Nitrogen Status in Grower Fields

Soil samples were taken to a depth of 5 feet both before and after crops of beans, beets, broccoli, carrot, cauliflower, and sweet corn, for determination of mineral nitrogen (ammonium-N and nitrate-N) content. Thirty-four fields were sampled, representing 15 growers, 4 counties, and 7 soil types. The growers were interviewed to determine field history and cropping and fertilization intentions and were asked to keep records of fertilizer applications. Results for broccoli, cauliflower, sweet corn, and table beets are reported here.

Samples were taken from 5 beet, 8 broccoli, 4 cauliflower, and 9 corn fields. We had planned a post-harvest sample from one additional cauliflower field, but the record rains in late October prevented sampling one field.

The average pre-plant nitrate and ammonium concentrations are seen in Figures 4 and 5. In order to preserve anonymity, only averages are presented in this report. Nitrate and ammonium concentrations in the surface foot of soil were nearly identical to those found in 1993, but nitrate levels were slightly higher in 1994 at greater depth. As in 1993, most cases of higher levels of nitrate or ammonium could be explained by a past history of manure application or by the presence of a legume cover crop.

Not surprisingly, much greater differences among fields existed at harvest. Not all the samples have been analyzed yet, but average nitrate and ammonium levels at harvest vary both with crop and with grower cultural practices (data not shown). For example, in top foot of the soil, nitrate concentrations were greater for sweet corn than for the other crops (Fig. 5). This is in agreement with our results indicating that sweet corn is relatively inefficient in taking up N. Nitrate levels were generally elevated, not only in the surface foot of soil, but also at greater depths. This contrasts with our experience at NWREC and may indicate that improvements could be made in irrigation practices. Post-harvest ammonium concentrations varied much less between pre-season and post-harvest sampling than did nitrate (Fig. 4). The grower cooperators will be mailed a copy of the data from their fields along with the average for all fields.

SUMMARY

We feel that this year's results nicely confirm the data obtained for sweet corn and cauliflower during the last two years. We have confirmed that the appropriate rate of nitrogen application to sweet corn, assuming no history of manure application or preceding legume crop, is just less than 200 pounds/acre. Cauliflower yields appear to peak at between 200 and 240 pounds N/acre. Other than rate of application, neither crop responds greatly to fertilization practices that the grower can manipulate, e.g. source of N, timing of N application (except early sweet corn plantings), or the method of application of sidedressed N. Data from grower fields continues to indicate the need for increased efficiency of N uptake in corn. Possible approaches include the use of winter cover crops, which we need to continue to research, and a predictive test for sidedress N applications, based on the amount of N present in the soil or plant at mid-season. Our objectives of testing methods to refine N applications to broccoli, cauliflower, and sweet corn have been met. It is now time to focus on methods to reduce the impact of residual mineral N and to improve the predictability of sweet corn response to sidedressed N.

Table 1. List of treatments, 1994 cauliflower N utilization trial, NWREC

No.	Total N applied	Placement at planting	Rate, placement, timing, and N source of sidedress
	-----------------	lb/A	-----------------
1	0	0	0
2	60	40 broadcast, urea	20 broadcast, 5 weeks, urea
3	120	40 broadcast, urea	80 broadcast, 5 weeks, urea
4	180	40 broadcast, urea	140 broadcast, 5 weeks, urea
5	240	40 broadcast, urea	200 broadcast, 5 weeks, urea
6	120	40 broadcast, urea	80 broadcast, overseed, urea
7	240	40 broadcast, urea	200 broadcast, overseed, urea
8	120	40 broadcast, urea	80 broadcast, calcium nitrate
9	180	40 broadcast, urea	140 broadcast, calcium nitrate
10	120	40 broadcast, urea	40 bcast, 5 weeks; 40 bcast 9 weeks, CN
11	180	40 broadcast, urea	70 bcast, 5 weeks; 70 bcast 9 weeks, CN
12	120	40 broadcast, urea	40 bcast, 5 weeks; 40 bcast 9 weeks, urea
13	180	40 broadcast, urea	70 bcast, 5 weeks; 70 bcast 9 weeks, urea
14	180	40 banded, CAN-17	140 banded, 5 weeks, CAN-17

Table 2. Effect of rate of broadcast urea nitrogen on yield, head size, and quality of cauliflower, sum of two harvests, NWREC, 1994

N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
0	580	41.1	6.3
60	740	60.2	8.2
120	856	56.7	10.1
180	1046	66.5	12.3
240	1043	61.2	12.1
LSD (0.05)	162	NS	2.2

Table 3. Effect of overseeding cereal rye on cauliflower yield, head size, and quality at two rates of nitrogen, NWREC, 1994

Treatment	N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
Overseeded	120	898	60.7	10.4
	240	1025	60.0	11.6
	Mean	962	60.4	11.0
Not overseeded	120	856	56.7	10.1
	240	1043	61.2	12.1
	Mean	950	59.0	11.1
	Significance	NS	NS	NS

Table 4. Effect of sidedressed nitrogen source and timing on cauliflower yield, head size, and quality at two rates of nitrogen, NWREC, 1994

N source	Timing	N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
Urea	early	120	856	56.7	10.1
		180	1045	66.5	12.3
		Mean, early	951	61.6	11.2
	late	120	783	61.9	9.1
		180	951	62.0	10.9
		Mean, late	867	61.9	10.0
		Mean, urea	909	60.0	10.6
Calcium nitrate	early	120	849	61.5	9.6
		180	966	64.2	11.1
		Mean, early	908	62.9	10.4
	late	120	904	65.5	10.4
		180	1092	55.1	13.4
		Mean, late	998	60.3	11.9
		Mean, CN	953	61.6	11.1
Significance,	N rate		**	NS	**
	N source		NS	NS	NS
	Timing		NS	NS	NS
	Source x Timing		**	NS	**
	Other interactions		NS	NS	NS

Table 5. Effect of urea versus CAN-17 as N source on cauliflower, head size, and quality at 180 pounds N/acre, NWREC, 1994

N source	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
Urea	1045	66.5	12.3
CAN-17	1063	61.4	12.3
Significance	NS	NS	NS

Fig. 1. Interaction of Cover Crop and N Rate on Cover N Uptake, NWREC, 1994

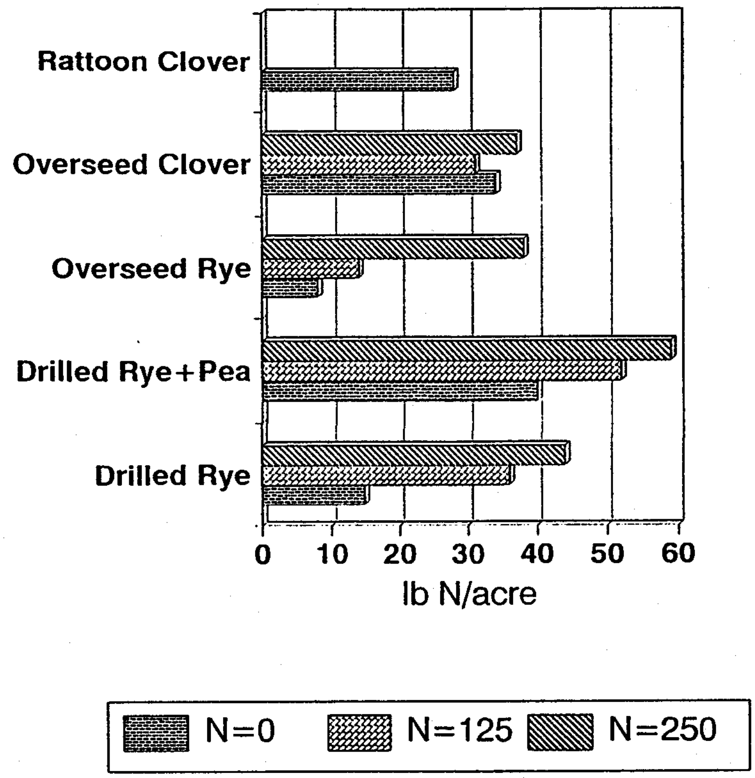

Fig. 2. Cover Crops on Sweet Corn Yield with No Applied N

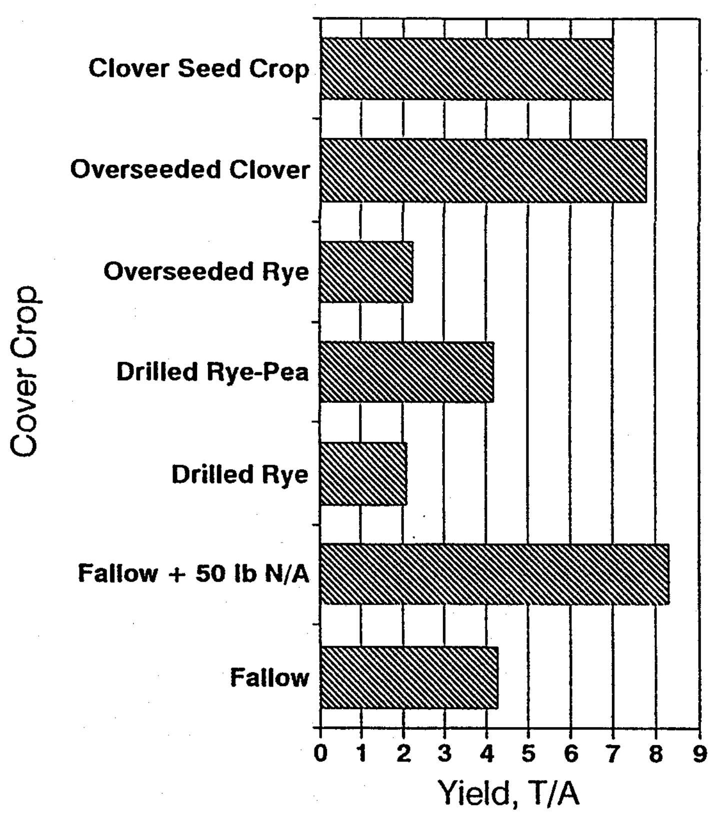

Table 6. Main effects of preceding cover crop and rate of applied nitrogen on yield and quality of sweet corn, NWREC, 1994

Treatment	Yield (T/A)	No. ears harvested/A	Mean ear wt. (g)	Ear length (inches)	Tipfill
Cover crop					
Fallow	5.1	22120	205	8.0	2.7
Fallow, clover in 1992	5.1	23090	201	7.8	2.6
Rye	3.7	18050	177	7.6	2.2
Rye + pea	5.2	23620	256	8.4	2.9
Overseeded rye	4.4	20720	172	7.5	2.1
Overseeded clover	7.1	24880	192	8.0	2.4
Fall-plowed clover	5.8	21930	228	8.4	2.9
Spring-plowed clover	6.3	23670	230	8.4	2.8
LSD (0.05)	1.1	2460	37	0.5	0.5
N rate (lb/A)					
0	3.3	18000	156	7.4	1.9
50	5.2	23380	211	8.0	2.5
200	7.1	25830	253	8.6	3.3
LSD (0.05)	0.7	2590	18	0.3	0.3

Table 7. List of N application treatments, sweet corn nitrogen utilization trial, NWREC, 1994

No.	N rate (lb/A)	N source	Banded at seeding (lb/A)	Broadcast at seeding (lb/A)	Sidedress[z] rate, method (lb/A)
1	0	None	0	0	0
2	60	Urea	40	0	20 broadcast
3	120	Urea	40	0	80 broadcast
4	180	Urea	40	0	140 broadcast
5	240	Urea	40	0	200 broadcast
6	120	NH_4NO_3	40	0	80 broadcast
7	120	CAN-17	40	0	80 banded
8	120	UAN-32	40	0	80 banded
9	120	Urea	40	80	0
10	120	NH_4NO_3	40	80	80 banded
11	180	Urea	40	140	0
12	180	NH_4NO_3	40	140	80 banded
13	180	NH_4NO_3	40	None	140 broadcast
14	180	CAN-17	40	None	140 dribble band
15	180	UAN-32	40	None	140 dribble band

[z]Nitrogen sidedressed on 29 June.

Table 8. Effect of rate of urea-nitrogen[z] on the yield of sweet corn, NWREC, 1994

N rate (lb/A)	Yield (T/A)	No. ears per acre	Ear wt. (g)	Ear length (inches)	Tipfill[y]	Moisture (%)
0	7.2	33320	198	8.6	3.0	73.6
60	10.6	37370	263	9.4	3.8	72.9
120	11.6	38990	271	9.3	3.9	71.7
180	12.5	42040	275	9.5	4.2	71.3
240	10.5	35830	268	9.4	3.8	73.9
LSD (0.05)	2.1	NS	50	0.3	0.5	NS

[z]Forty pounds N/acre banded at planting, remainder broadcast five weeks later.
[y]Five point scale with 5=perfect fill.

Table 9. Effect of four nitrogen sources, at 120 pounds N/acre[z], on the yield of sweet corn, NWREC, 1994

N source	Yield (T/A)	No. ears per acre	Ear wt. (g)	Ear length (inches)	Tipfill
Urea	11.6	38990	271	9.3	3.9
NH_4NO_3	11.3	33210	307	9.5	4.1
CAN-17	11.2	39970	267	9.4	4.1
UAN-32	11.1	40030	266	9.2	3.7
LSD (0.05)	NS	NS	NS	NS	NS

[z]Forty pounds N/acre banded at planting, 80 pounds N/acre banded five weeks later.

Table 10. Effect of four nitrogen sources, at 180 pounds N/acre[z], on the yield of sweet corn, NWREC, 1994

N source	Yield (T/A)	No. ears per acre	Ear wt. (g)	Ear length (inches)	Tipfill	Moisture (%)
Urea	12.5	42040	275	9.5	4.2	71.3
NH_4NO_3	12.2	39750	284	9.3	4.2	71.4
CAN-17	11.7	42250	253	9.5	3.8	74.2
UAN-32	10.6	37350	256	9.4	4.1	73.6
LSD (0.05)	1.6	NS	NS	NS	NS	NS

[z]Forty pounds N/acre banded at planting, 140 pounds N/acre banded five weeks later.

Table 11. Interaction of nitrogen source and timing of sidedress nitrogen[z] application on the yield of sweet corn, NWREC, 1994

N source	Timing	Yield (T/A)	No. ears per acre	Ear wt. (g)	Ear length (inches)	Tipfill
Urea	planting	11.2	38880	264	9.3	3.9
Urea	5 weeks	12.0	40510	273	9.4	4.1
NH_4NO_3	planting	11.2	35070	292	9.4	4.2
NH_4NO_3	5 weeks	11.8	36480	295	9.4	4.2
LSD (0.05)		NS	NS	21	NS	NS

[z]Mean of nitrogen applications of 120 and 180 pounds/acre. Sidedress application average of 80 and 140 pounds/acre.

Table 12. Effect of rate and source of nitrogen on corn leaf nitrogen concentration, NWREC, 1994

Treatment	N rate (lb/A)	N Source	29 June[z]	13 July[y]	1 Aug.[y]
				%	
1	0	Urea	3.1	2.8	2.2
2	40		3.6	NA	NA
2	60		NA	3.7	2.9
3	120		NA	3.8	3.1
4	180		NA	3.9	3.4
11	180		4.0	3.6	3.2
5	240		NA	4.0	3.1
13	40	NH_4NO_3	4.2	NA	NA
12	180		4.0	3.6	3.4
13	180		NA	3.6	3.5
14	40	CAN-17	3.7	NA	NA
14	180		NA	3.6	3.5
15	40	UAN-32	3.5	NA	NA
15	180		NA	3.6	3.3
		LSD (0.05)	0.5	0.4	0.4

[z]NA: not applicable, full amount of nitrogen not applied until after this sampling.
[y]Not applicable, this application rate existed only up to 29 June.

Table 13. Effect of rate of urea nitrogen applied to corn on soil nitrate and ammonium concentrations in the surface foot of soil, NWREC, 12 July, 1994

N rate (lb/acre)	Nitrate (ppm)	Ammonium (ppm)
0	8.3	1.8
60	13.0	2.1
120	25.6	5.9
180	25.7	8.4
240	45.7	29.9

Table 14. Effect of rate of nitrogen on post-harvest soil nitrate and ammonium concentrations, 9 September, 1994

Sample depth (inches)	Rate of applied urea, lb/acre 0	60	120	180	240	LSD (0.05)	Pre-plant
	ppm						
Nitrate							
0-12	0.3	0.4	0.8	4.6	10.9	8.6	0.6
12-24	1.4	3.0	1.5	8.7	7.9	NS	8.2
20-36	9.2	7.6	3.8	9.7	6.2	NS	14.0
36-48	8.7	8.7	5.0	7.1	8.0	NS	2.3
Ammonium							
0-12	2.1	2.2	2.5	2.2	5.4	NS	2.1
12-24	2.1	2.4	2.8	2.2	5.2	NS	1.8
24-36	2.5	2.3	2.9	2.3	6.5	NS	1.8
36-48	2.0	2.2	2.4	1.6	4.0	1.4	1.6

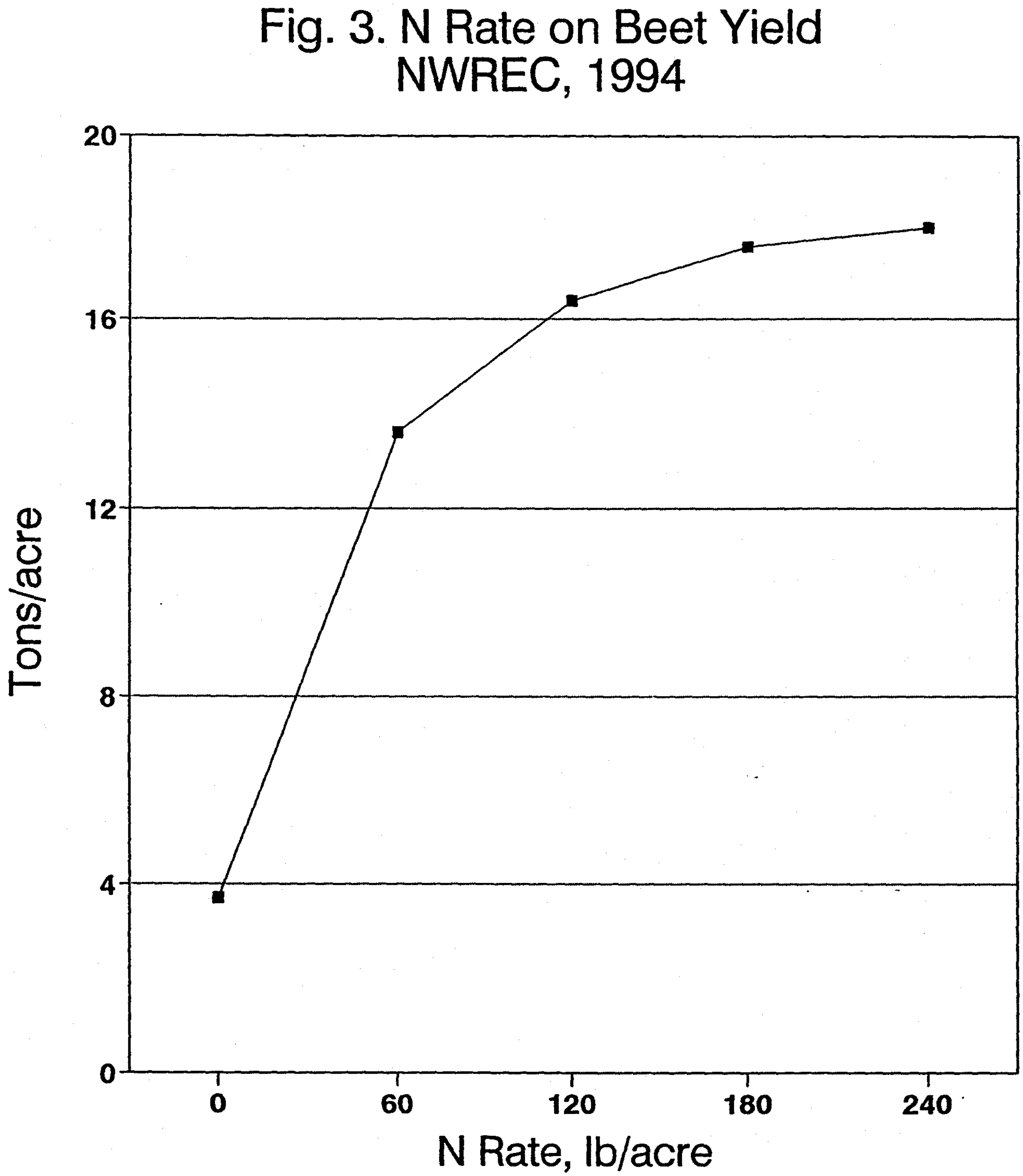
Fig. 3. N Rate on Beet Yield
NWREC, 1994
Tons/acre
0
4
8
12
16
20
0
60
120
180
240
N Rate, lb/acre

Fig. 4. Crop on Post-Harvest Ammonium
1994 Grower Survey

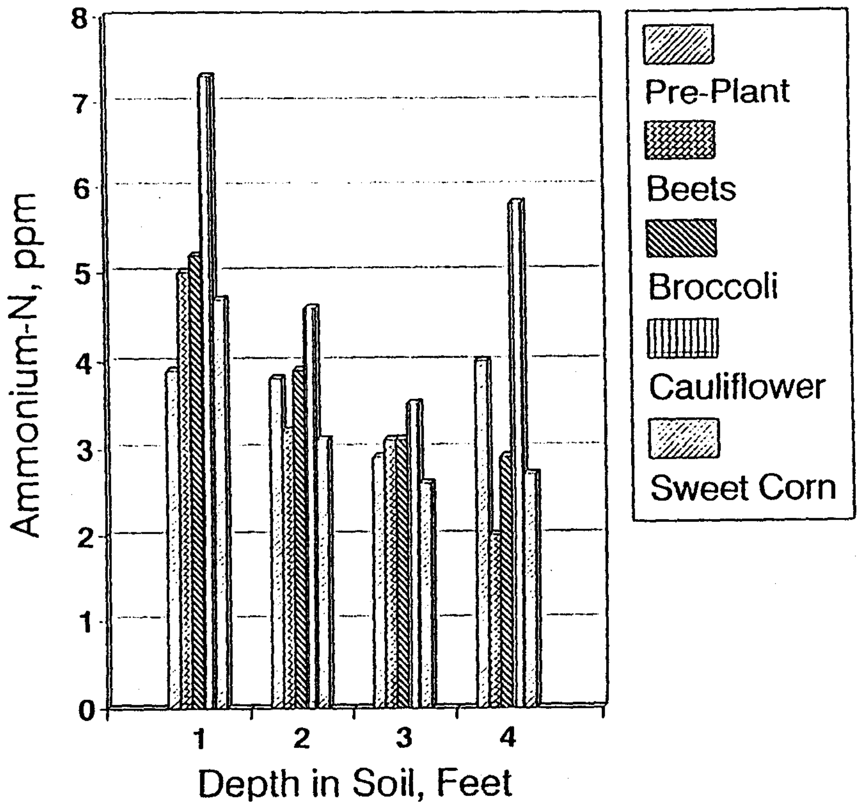

Fig. 5. Crop on Post-Harvest Nitrate
1994 Grower Survey

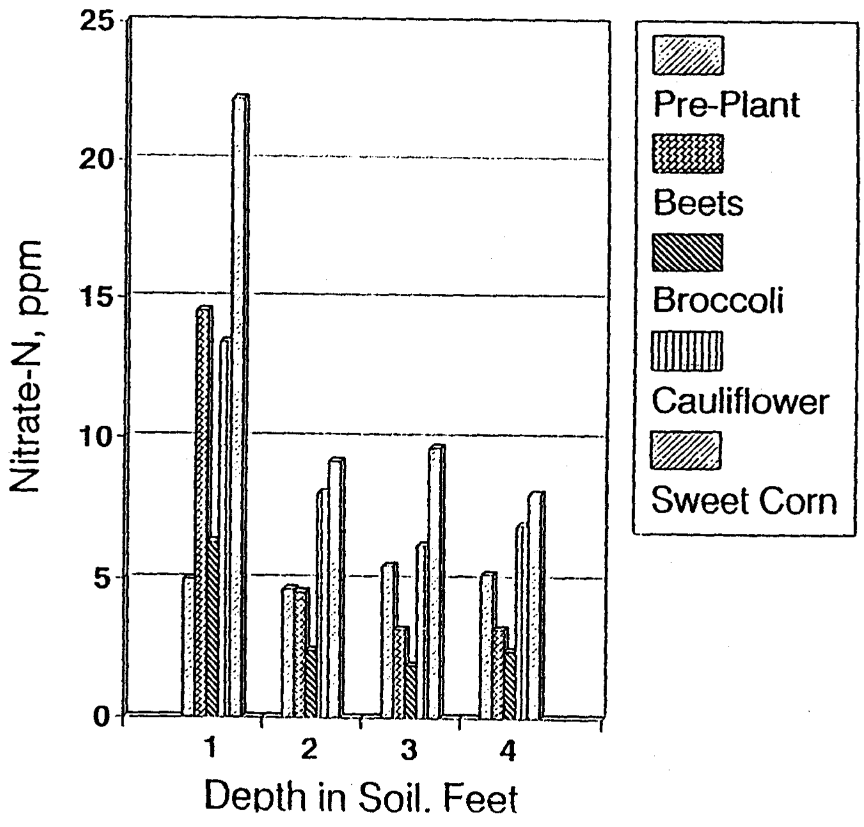

Table 15. Effect of nitrogen source on post-harvest soil nitrate and ammonium concentrations at 180 pounds applied N/acre, 9 September, 1994

Sample depth (inches)	N source				
	Urea	NH_4NO_3	CAN-17	UAN-32	LSD (0.05)
	ppm				
Nitrate					
0-12	4.6	0.4	0.8	4.6	NS
12-24	8.7	3.0	1.5	8.7	NS
20-36	9.7	7.6	3.8	9.7	NS
36-48	7.1	8.7	5.0	7.1	NS
Ammonium					
0-12	2.2	3.5	3.0	3.8	NS
12-24	2.2	3.0	3.5	2.6	NS
24-36	2.3	2.8	2.8	2.8	NS
36-48	1.6	3.5	2.7	2.5	1.4

Table 16. Effect of rate of broadcast nitrogen on soil nitrate and ammonium concentrations (ppm) at four depths following beet harvest, NWREC, 1994

Sample depth (inches)		N rate, lb/A					
		0	40	80	120	160	LSD(0.05)
	Pre-plant	Post-harvest					
Nitrate							
0-12	1.5	0.8	1.4	3.0	6.6	3.9	1.7
12-24	1.2	0.3	0.6	1.0	1.9	1.6	0.6
24-36	1.1	0.9	1.2	2.0	1.6	1.9	NSD
36-48	1.0	1.9	2.9	3.3	2.2	4.4	1.9
Ammonium							
0-12	0.8	2.6	3.0	5.3	6.1	4.1	NSD
12-24	2.7	3.1	2.5	3.2	5.5	3.2	NSD
24-36	3.7	3.2	2.4	3.6	4.2	2.0	NSD
36-48	3.3	3.3	2.4	3.8	2.7	2.0	NSD

SIGNATURES

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Project Leaders

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Department Heads

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