REPORT TO THE OREGON PROCESSED VEGETABLE COMMISSION, 1992-1993

TITLE: Nitrogen Rates, Timing, Placement, Catch Crops, and Crop Rotations on Yield and Nitrogen Utilization of Vegetable Crops

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PROJECT STATUS: Continuing, expect completion in 1994

FUNDING: $11,100 in 1992-93 from OPVC. Additional funding from CAAR, OSU. Funds expended for fertilizer; ^{15}N-urea; soil and tissue analysis; labor for plot establishment, maintenance, and harvest; travel, Corvallis to Aurora.

OBJECTIVES:

1. Evaluate the effect of timing of N application on broccoli yield.
2. Evaluate N uptake efficiency in broccoli and sweet corn at optimal and suboptimal N rates and continue to refine measurements of nitrate leaching.
3. Evaluate the N-trapping efficiency of catch crops following 1991 and 1992 broccoli crops.
4. Evaluate the effects of N placement on cauliflower and sweet corn yield.
5. Evaluate the potential for leaching of nitrate from cauliflower plantings fertilzed with the optimal rate of N.
6. Evaluate the possibility of interseeding as a means of establishing a catch crop in cauliflower.
7. Evaluate the effect of several N sources on sweet corn yield.
8. Evaluate sweet corn response to catch crops and evaluate the N-trapping efficiency of catch crops following corn with both standard and reduced herbicide inputs.

PROGRESS REPORT:

Broccoli

'Gem' was direct-seeded on 9 June with four rows per 80-inch bed. The initial N application was broadcast immediately after seeding and irrigated in. Depending on treatment, all N was applied at planting; 40 pounds/acre applied at planting and the remainder on 14 July; or 40 pounds were applied at planting, half the remainder on 7 July, and the final application on 27 July (Table 1). Urea was the sole N source. The seedlings were thinned to approximately 10 inches between plants in the row on 26 June. The plots were harvested on 18 and 25 August; only main shoots were cut. After completion of the last harvest and soil sampling for residual N, the four blocks were split and half of each block seeded to 'Wheeler' cereal rye on 3 Sept. after mowing the broccoli and lightly disking the soil surface.

Averaged over timing of N application, yield increased with increasing rate of N to 180 lb N/acre (Table 2). Rates of N application beyond this level had little effect on yield. In previous experiments, yield peaked at 250 lb N/acre, with a definite decrease at 325 lb/acre.

Splitting the N application to provide most of the N nearer the time that the plants experience greatest uptake did not increase yield (Table 3). Even at less than optimal rates of N, yield was greatest when all nitrogen was applied at planting. This was a late-spring planting in a very dry year and with carefully controlled irrigation. Thus, N loss to leaching was probably not a factor. Results may have differed for a planting early in the season when leaching of the early fertilizer application would be more likely.

It is critical to apply N at planting. Even after a dry winter and with significant available N in the soil at planting (5.6 ppm nitrate in the surface six inches of soil), it was necessary to apply N at planting (Table 4). Delaying the first application significantly reduced mean head weight for plants receiving a total of 180 lb N/acre. In the comparison of the single application versus a 2-way or 3-way split, perhaps the split applications would have been more favorable if a greater proportion of the N had been applied at planting.

Four years of results indicate that the optimum N rate for broccoli grown on a Willamette silt loam at a plant density of 30,000 to 40,000/ acre is near 250 lb/acre. Rates in excess of 300 lb/acre leave significant amounts of residual nitrate available for leaching, whereas rates of 250 lb/acre or less are efficiently utilized by the crop. Winter cover crops can catch a large proportion of the residual nitrate. Neither method of placement of nitrogen fertilizer nor the timing of nitrogen application appear to have much effect on the efficiency of nitrogen utilization by broccoli.

Cauliflower

'Snowball Y' was seeded on 3 June and transplanted bare-root on 14 July in rows 2.5 feet apart with 18 inches between plants in the row. The initial application of 40 lb N/acre, as urea, was either broadcast or banded 3 inches to the side and 2 inches deep immediately after transplanting and irrigated in. The remaining urea was broadcast or banded on the appropriate plots on 20 August (Table 5). Plants were harvested on 29 September and 5 and 15 October. In addition to the combination of nitrogen rates and methods of fertilizer placement, one set of plots (Treatment 12) was reserved for sequential sampling of shoot dry matter accumulation and N uptake. Another set of plots (Treatment 11) received its initial application of N in the form of ^{15}N-enriched urea. These plots were harvested separately for refined determinations of N uptake. Two sets of plots (Treatments 13 and 14) were interseeded with 'Wheeler' cereal rye on 3 September. Following the last harvest, soil in treatments 1, 2, 3, 4, 5, and 11 was sampled to 40-inch depth in 10-inch increments. The plots will be maintained through the winter to resample for soil N content and cover crop biomass accumulation.

For the plots receiving only broadcast applications of urea, yield increased with increasing rate of nitrogen to a maximum at 240 lb N/acre (Table 6). The same trend was true for mean head weight and the percentage of Grade No. 1 heads (defect-free). Previous research (Mack and Stang) suggested that the optimum rate of N application to cauliflower is in the range of 150 to 200 lb/acre, in rough agreement with the results obtained in this trial.

Banded versus broadcast application of N at planting had no significant effect on yield or quality (Table 7), although there was a trend toward higher yield and head size with a banded application. Apparently, even with rows 30 inches apart, enough feeder roots establish in the soil between the rows that concentrating the fertilizer near the plant row is not a great advantage. This is in agreement with results obtained on broccoli grown on 16 or 20-inch row spacing.

Banded versus broadcast application of the sidedressed N did result in higher yield and mean head size with a broadcast application. This was true at 240 lb/acre as well as the sub-optimal rate. The single greatest yield was with the combination of banded N at planting, broadcast sidedress fertilizer, and a rate of 240 lb N/acre.

Interseeding cereal rye about four weeks before first harvest did not reduce cauliflower yield (Table 8). This is not surprising, as the stand of rye was sparse (approximately eight plants/square foot) and had not developed beyond the one-true leaf stage at cauliflower harvest.

Results of soil tests for residual fertilizer after harvest, and for N uptake as a function of crop growth are not yet available. The soil and rye will be sampled in the spring as a function of rate of applied N to determine the amount of N leached versus that trapped in the rye shoots.

Sweet Corn N Source and Placement

'Jubilee' was seeded on 19 May on 30-inch rows. Sixty lb/acre of triple superphosphate was banded 2 inches to the side and 2 inches beneath the seed row. Forty lb N/acre as urea, ammonium nitrate, calcium-ammonium nitrate (CAN-17), or urea-ammonium nitrate (UAN-32) were also shanked in at 2 inches beneath and 2 inches to the side of the seed row on all but the zero nitrogen and zero nitrogen at planting treatments (Table 9). 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 seedlings were thinned to approximately 7 inches between plants in the row on 9 June. The remaining nitrogen was shanked in or broadcast to the appropriate plots on 29 June. Plots were harvested on 17 August. The stover was then mowed and left in place on the plots. The plots were sampled for residual soil nitrate and ammonium concentration on 26 August and their identity is being maintained over the winter so that samples can be taken in the spring of 1993.

When all the sidedressed N was banded as urea, yield increased with increasing N rate to a maximum at 180 lb N/acre (Table 10). However, the yields at 120 and 240 lb N/acre were not significantly different than at 180 lb/acre. Mean ear weight and length tended to be greatest at 120 pounds N per acre.

All other combinations of N source and application method were at 60 and 180 lb total N/acre. Comparisons of N utilization are based on banded urea as the standard. Mean yield of corn fertilized at 60 and 180 lb N/acre did not vary significantly with N source (Table 11). However, the plants fertilized with UAN-32 were consistently poorest in terms of number of ears harvested, mean ear weight and length, and degree of tipfill of the ear. Although not statistically significant, yield also tended to be lowest with UAN-32. The greatest number of ears harvested and the greatest yield were with CAN-17, but the greatest mean ear weight, length, and tipfill were with ammonium nitrate.

When comparing only sweet corn fertilized with urea or ammonium nitrate and averaged over method of placement of the sidedressed N, ammonium nitrate appeared slightly superior to urea, but the difference was significant only for mean ear weight (Table 12). Past research at NWREC with urea, ammonium nitrate, and other solid nitrogen sources indicated no consistent differences among nitrogen sources in effects on corn yields.

When comparing a broadcast versus a banded application of sidedressed N (Table 12), there were no significant effects on yield or quality.

Sweet corn production with zero or 60 lb N/acre effectively reduced nitrate concentration in the first 30 inches of the soil profile during the growing season (Table 13). Soil ammonium concentrations were not greatly affected by sweet corn fertilized with these same rates. However, at 120 or more lb N/acre, soil nitrate and ammonium concentrations were greatly elevated in the surface 10 inches of soil. There is very little indication in this experiment of movement of applied nitrogen beyond the root zone. Increased nitrate and ammonium levels were generally confined to the surface 10 inches.

The high levels of residual fertilizer present at rates of N needed for acceptable yields is in contrast to the situation for broccoli and is a cause for concern. Apparently sweet corn is less efficient at taking up applied N than is broccoli. This indicates the need for more research on improving N uptake efficiency in sweet corn.

Cover Crops on Yield and Quality of Sweet Corn

Cover crops of 'Wheeler' cereal rye or rye plus Austrian winter pea were seeded on 20 September, 1991, into plots that had been cropped to broccoli in 1991, with N rates of 0, 125, and 250 lb/acre. No fertilizers or pesticides were applied to the cover crops. Nitrogen rate subplots were determined by the N applied to the broccoli crop. On 7 April, 1992, samples were taken from all subplots for determination of shoot dry weight and nitrogen uptake. The shoots were clipped about 1 inch above ground. The rye and pea plants were counted, weighed, and analyzed separately.

The cover crops were mowed down on 17 April, disked on 27 April, and plowed under on 28 April, 1992. The plots were disked and harrowed in early May. On 19 May, 2.0 pounds EPTC/acre was rototilled into one rye and one rye-pea mixture plot in each of the four blocks ("low input" or reduced herbicide main plots). 'Jubilee' was seeded on 20 May. Triple superphosphate was banded 2 inches to the side and 2 inches beneath the seed row at a rate of 80 lb/acre. Immediately after planting, the remaining rye and rye-pea plot in each block was sprayed with 2.0 lb atrazine and 3.0 lb alachlor/acre ("high input" or high herbicide main plots).

On 21 May, one half of the total N was applied as urea in a surface band at rates of 0, 50, and 200 lb N/acre. These N rate subplots were in the same location as the corresponding N treatments on the previous broccoli crop. The remainder of the urea was sidedressed on 3 July.

On 3 July, the "low input" plots which had been in cereal rye during the winter were interseeded with 'Wheeler' cereal rye at 50 pounds/acre. The "low input" main plots which had been in rye plus pea were interseeded with 'Kenland' red clover. In each case, the seed was broadcast with a fertilizer spreader and scratched in. The interseeding was in preparation for the 1993 experiments, in which one of the objectives will be to determine the value and feasibility of interseeding a cover crop into a standing corn crop. Stalks and ears were harvested on 16 August. Subsamples were taken for determination of dry weight and total N content.

Both increasing the fertilizer rate on the preceding broccoli crop and the presence of peas in the cover crop increased total cover crop yield and N uptake (Figs. 1 and 2). The high or reduced herbicide inputs on the broccoli had no effect on cover crop yield or N uptake, so the results are averaged over herbicide treatment. The rye produced greater biomass in the presence of peas at the low and intermediate rates of residual N. Pea biomass was somewhat reduced at the highest N rate. The peas did not have as much effect on N uptake by the rye; pea N uptake was nearly constant over N rates.

A rough estimate of the amount of residual N leftover 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 Fig. 2. Subtracting the amount of N taken up by the rye grown on non-fertilized subplots from the N taken up at the other two N rates suggests that about 9 lbs N/acre was taken up from the intermediate rate of N and 22 lb from the high rate of N. This nitrogen would have been available for leaching. Of course, an undetermined amount of N may have leached before the cover crops were well established. However, this low rate of recovery of N is further indication of the tremendous efficiency of broccoli in utilizing applied N.

Nitrogen uptake by the cover crop increases from 41 lb/acre for rye only to 76 lb/acre for rye plus pea. A large part of the extra N taken up by the rye plus pea may come from N fixation, but the peas may also have taken up some residual nitrogen that escaped the rye.

The population density of Austrian winter pea plants in the rye plus pea plots was significantly lower in the high than in the reduced herbicide treatment (Figure 3). Interestingly, the herbicide used in 1991 for the "high input" treatment, trifluralin, is registered for use on dry peas and is generally considered safe for the crop.

The herbicide program (or interseeding to rye or clover) had no effect on the number of ears judged harvestable by the pickers (Table 14). However, both increasing rate of applied N and the presence of Austrian peas in the preceding cover crop increased the number of ears judged harvestable. Likewise, ear yield (tons/acre) did not vary with the herbicide program but did increase with increasing N rate nd pea in the cover crop. There were no significant interactions among herbicide program, cover crop, and N rate affecting any component of yield or tipfill; thus, only main effects are given in Table 14. The highest yield of 11.0 tons/acre was for plots with the combination of atrazine-alachlor as herbicide (no interseeding), the highest N rate, and the mixture of rye and pea as cover crop.

Ear length was not affected by cover crop or herbicide program, but mean ear weight was affected by both cover crop and herbicide, as well as N rate. Kernel moisture content was not affected by treatment (data not shown), while stover (stalk) weight increased with increasing N rate (data not shown). Tipfill, was increased by the atrazine-alachlor herbicide program as well as by increasing the rate of applied N.

The most striking feature of these results is the contribution of the cover crop peas to the sweet corn yield, even at a high rate of applied N. It is interesting to note that the 10 tons/acre yield achieved with 50 lb N/acre following a rye + pea cover crop is equivalent to the yield with 200 lb applied N/acre when the cover crop was rye only (Figure 4). In this experiment it was not possible to measure the contribution of the rye-only cover crop to sweet corn yield, as the program of crop rotations did not allow for sweet corn following a winter fallow.

SUMMARY:

The broccoli results are consistent with those obtained in previous years. On a Willamette silt loam with careful management of irrigation, there is no need to apply N rates in excess of 250 lb/acre. Method of fertilizer application and timing of the sidedressed N application did not affect yield. Nevertheless, prudence would still suggest that it is not wise to apply all N at planting, particularly on a spring crop, as heavy rainfall could leach the applied N. We are becoming very comfortable with our tentative conclusion last year that broccoli is a very efficient scavenger of available N in the root zone and that optimally fertilized broccoli leaves little residual nitrate that is available for leaching. Our measurements of leaching following this years's crop and the final planting of broccoli in the long-term NWREC rotation plots in 1993 should complete our understanding of nitrogen management in broccoli and its relationship to nitrate movement to groundwater. We realize that results may differ with other soil types and cultural practices. The sampling we propose to do in grower fields in 1993 will indicate whether our results can be extrapolated to all broccoli fields in the Willamette Valley.

Results in 1992 suggest that sweet corn is comparatively inefficient at taking up applied nitrogen. The elevated soil nitrate levels left at harvest of an optimally fertilzed corn crop indicate strong potential for leaching. This suggests that we need more research on methods to increase N uptake efficiency in sweet corn. It also confirms the importance of using a winter cover crop ("catch crop") or a grain crop after sweet corn to take up some of the residual N and reduce the amount leached by winter rainfall.

Banding sidedressed N appears no more promising as a means to increase N uptake efficiency in cauliflower than it does in broccoli. Results of post-season soil analysis are not yet available, so we do not yet know if cauliflower is comparable to broccoli as a scavenger of N.

We successfully initiated all the objectives of the 1992-93 proposal. However, Objectives 2, 3, 5, 6, and 8 call for completion in the spring of 1993. Data will be analyzed in the spring and summer and included in our 1993 report.

SIGNATURES: Redacted for Privacy

Project Leader ________________

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Table 1. List of N application treatments, 1992 broccoli N utilization trial

No.	Total N applied	At planting	At five weeks	At seven weeks
	--------------------	lb/A	--------------------	
1	0	0	0	0
2	60	40	20	0
3	120	40	80	0
4	180	40	140	0
5	240	40	200	0
6	300	40	260	0
7	60	60	0	0
8	120	120	0	0
9	180	180	0	0
10	240	240	0	0
11	300	300	0	0
12	120	40	40[z]	40
13	180	40	70[z]	70
14	240	40	100[z]	100
15	300	40	130[z]	130
16	180	0	90[z]	90

[z]At 4 weeks rather than 5 weeks.

Table 2. Main effect of nitrogen rate on yield and head size of broccoli, NWREC, 1992

N rate (lb/acre)	Mean head wt., first harvest (g)	Mean head wt., total of two harvests (g)	Total yield (tons/acre)
0	76	52	1.6
60	112	95	3.9
120	167	142	5.5
180	195	167	6.8
240	196	169	6.7
300	205	170	7.4
LSD (0.05)	41	31	1.0

Table 3. Effect of splitting nitrogen application on broccoli head size at several rates of applied nitrogen, 1992

N rate (lb/acre)	Single applic.	Two applics.	Three applics.
	--------------------	g/head	--------------------
60	101	88	--
120	159	137	129
180	177	163	162
240	170	169	168
300	171	164	176
Mean (120-300 lb)	169	158	159

Table 4. Effect of delaying initial nitrogen application until four weeks after planting on broccoli head size, 1992

	g/head
N applied at planting (40 lb) and five weeks (140 lb)	163
N applied at four weeks (90 lb) and seven weeks (90 lb)	148

Table 5. List of treatments, 1992 cauliflower N utilization trial, NWREC

No.	Total N applied	Placement at planting	Placement at sidedress
	------	------lb/A------	------
1	0	0	0
2	80	40 broadcast	40 broadcast
3	160	40 broadcast	120 broadcast
4	240	40 broadcast	200 broadcast
5	80	40 banded	40 broadcast
6	240	40 banded	200 broadcast
7	80	40 broadcast	40 banded
8	240	40 broadcast	200 banded
9	80	40 banded	40 banded
10	240	40 banded	200 banded
11	160	40 broadcast-^{15}N	120 broadcast-^{15}N
12	160	40 broadcast	120 broadcast
13	80	40 broadcast	40 broadcast, interseed
14	240	40 broadcast	200 broadcast, interseed

Table 6. Effect of rate of broadcast nitrogen on yield, head size, and quality of cauliflower, NWREC, 1992

N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
0	430	68.3	4.8
80	678	82.4	7.4
160	751	88.0	7.8
240	815	89.5	8.6
LSD (0.05)	186	10.6	2.2

Table 7. Effect of broadcast versus banded application of initial and sidedressed nitrogen on yield, head size, and quality of cauliflower

Placement at planting	Placement at sidedress	N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
Broadcast	Broadcast	80	678	82.4	7.4
		240	815	89.5	8.6
		Mean	747	85.9	8.0
	Banded	80	633	80.6	6.6
		240	736	90.1	7.7
		Mean	684	85.4	7.2
Banded	Broadcast	80	727	86.2	7.0
		240	1051	90.7	10.9
		Mean	889	88.4	9.0
	Banded	80	549	88.7	6.2
		240	684	83.7	8.6
		Mean	617	86.2	7.4
	Broadcast at planting mean		716	85.7	7.6
	Banded at planting mean		753	87.3	8.2
	Significance, planting		NS	NS	NS
	Broadcast at sidedress mean		818	87.2	8.5
	Banded at sidedress mean		651	85.8	7.3
	Significance, sidedress		**	NS	*

Table 8. Effect of interseeding cereal rye on cauliflower yield, head size, and quality at two rates of nitrogen

Treatment	N rate (lb/acre)	Mean head wt. (g)	Grade No. 1 heads (%)	Total yield (tons/acre)
Interseeded	80	649	81.0	6.4
	240	874	90.2	9.6
	Mean	762	85.6	8.0
Not interseeded	80	678	82.4	7.4
	240	815	89.5	8.6
	Mean	747	86.0	8.0
	Significance	NS	NS	NS

Table 9. List of N application treatments, 1992 sweet corn nitrogen utilization trial

No.	Total N rate (lb/A)	N source	Rate at planting (lb/A)	Sidedress rate and method (lb/A)
1	0	None	0	0
2	60	Urea	40	20 banded
3	120	Urea	40	80 banded
4	180	Urea	40	140 banded
5	240	Urea	40	200 banded
6	60	NH_4NO_3	40	20 banded
7	180	NH_4NO_3	40	140 banded
8	60	CAN-17	40	20 banded
9	180	CAN-17	40	140 banded
10	60	UAN-32	40	20 banded
11	180	UAN-32	40	140 banded
12	60	Urea	40	20 broadcast
13	180	Urea	40	140 broadcast
14	60	NH_4NO_3	40	20 broadcast
15	180	NH_4NO_3	40	140 broadcast
16	180	Urea	0	180 banded

Table 10. Yield, ear size, and tipfill of sweet corn as affected by rate of banded urea, NWREC, 1992

N rate (lb/acre)	No. ears/ acre	Yield (T/acre)	Mean ear wt. (g)	Mean ear length (cm)	Tipfill[z]
0	13,830	3.4	214	22.3	2.3
60	24,070	7.6	278	22.9	2.6
120	27,880	9.3	292	23.8	2.5
180	32,230	10.1	274	22.7	2.6
240	30,060	9.7	287	23.6	2.6
LSD(0.05)	5,920	1.7	29	1.0	NS

[z]A measure of the degree of kernel formation at the silk end of the ear. Five point scale with 5 = kernels filled out to tip of ear, 1 = at least 5 cm of ear without filled kernels.

Table 11. Yield, ear size, and tipfill of sweet corn as affected by rate and source of banded nitrogen fertilizer, NWREC, 1992

N source	N rate (lb/acre)	No. ears/ acre	Yield (T/acre)	Mean ear wt. (g)	Mean ear length (cm)	Tipfill
Urea	60	24,070	7.6	278	22.9	2.6
	180	32,230	10.1	274	22.7	2.6
Mean		28,150	8.9	276	22.8	2.6
NH_4NO_3	60	27,010	8.7	279	22.6	2.8
	180	28,530	9.8	298	23.9	2.7
Mean		27,770	9.2	288	23.2	2.7
CAN-17	60	29,510	8.6	253	22.7	2.7
	180	30,600	10.3	294	23.2	2.3
Mean		30,050	9.5	274	23.0	2.5
UAN-32	60	21,160	7.6	263	22.0	2.3
	180	28,210	9.6	265	22.9	2.1
Mean		24,690	8.6	264	22.5	2.2
LSD(0.05), means		4,890	NS	22	0.7	0.4

Table 12. Yield, ear size, and tipfill of sweet corn as affected by rate and method of placement of sidedressed nitrogen fertilizer, NWREC, 1992

Source	Placement	N rate (lb/acre)	No. ears/ acre	Yield (T/acre)	Mean ear wt. (g)	Mean ear length (cm)	Tipfill
Urea	Band	60	24,070	7.6	278	22.9	2.6
		180	32,230	10.1	274	22.7	2.6
	Mean		28,150	8.9	276	22.8	2.6
	Broadcast	60	27,990	8.0	246	22.1	2.5
		180	29,190	9.6	288	23.4	2.8
	Mean		28,590	8.8	267	22.8	2.6
NH_4NO_3	Band	60	27,010	8.7	279	22.6	2.8
		180	28,530	9.8	298	23.9	2.7
	Mean		27,770	9.2	288	23.2	2.7
	Broadcast	60	26,680	8.3	279	22.5	2.8
		180	30,710	9.9	282	23.2	2.7
	Mean		28,700	9.1	281	22.9	2.7
	Urea mean		28,370	8.8	272	22.8	2.6
	NH_4NO_3 mean		28,240	9.2	285	23.1	2.7
Significance, N source			NS	NS	*	NS	NS
	Banded mean		27,960	9.1	282	23.0	2.7
	Broadcast mean		28,650	9.0	274	22.8	2.7
Significance, placement			NS	NS	NS	NS	NS

Table 13. Effect of rate of banded urea on post-harvest soil nitrate and ammonium concentrations, 26 August, 1992

Sample depth (inches)	Pre-plant	Rate of applied urea, lb/acre 0	60	120	180	240	LSD (0.05)
	----------	----------	----------	ppm	----------	----------	----------
Nitrate							
0-10	5.6	0.5	1.1	22.6	27.1	48.2	24.6
10-20	3.8	0.1	0.9	20.0	2.9	4.8	NS
20-30	3.1	0.3	1.0	5.7	1.6	2.1	NS
30-40	3.8	2.5	2.2	2.2	3.0	3.7	NS
Ammonium							
0-10	4.8	2.9	2.5	30.2	106.7	56.2	49.0
10-20	2.8	2.8	2.5	8.4	6.5	6.0	NS
20-30	5.1	3.0	2.7	3.3	3.7	3.6	NS
30-40	4.4	2.7	2.8	3.3	7.0	3.1	NS

Table 14. Main effects of herbicide and interseeding, preceding cover crop, and rate of applied nitrogen on yield and quality of sweet corn, NWREC, 1992

Treatment	No. ears harvested/A	Ear yield (T/A)	Ear length (inches)	Mean ear wt. (g)	Tipfill[z]
Herbicide and interseeding					
EPTC, interseeded	30,100	8.7	11.1	260	2.8
Atrazine, not interseeded	29,210	9.1	11.2	279	3.1
Significance	NS	NS	NS	*	*
Cover crop					
Rye	27,780	8.1	11.2	258	2.9
Rye + pea	31,530	9.7	11.2	281	3.0
Significance	*	*	NS	*	NS
N rate (lb/A)					
0	25,110	7.2	10.9	251	2.6
50	30,200	9.2	11.2	276	3.1
200	33,650	10.3	11.4	280	3.3
Significance	**	**	**	**	**

[z]Rated on a 5-point scale with 5 = perfect kernel development to the tip of the ear; 1 = at least two inches of undeveloped or shriveled kernels.

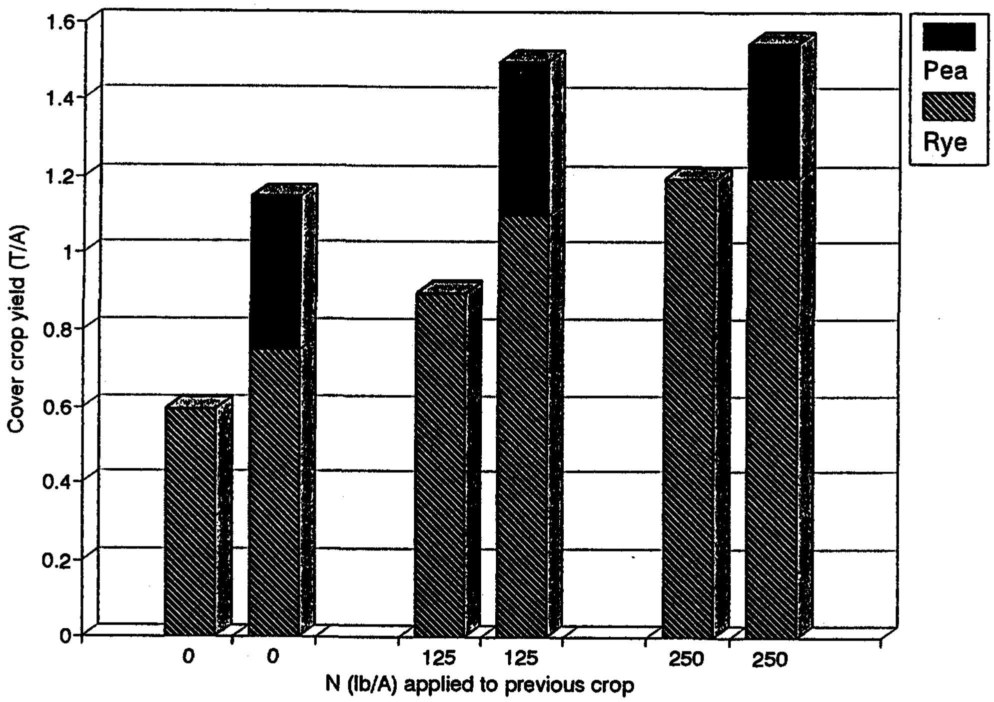

Figure 1. Shoot biomass (dry weight) of cover crops just prior to plowdown in April, 1992, as affected by the rate of nitrogen applied to the previous broccoli crop. Averaged over the high and low herbicide applications to the broccoli crop.

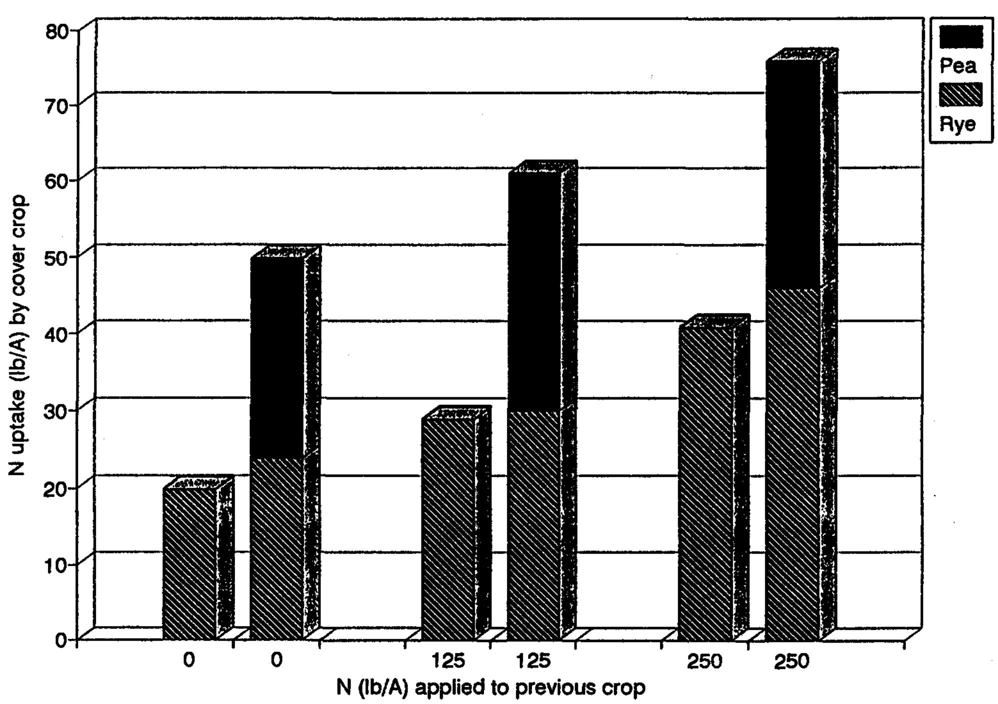

Figure 2. Nitrogen uptake by cover crops just prior to plowdown in April, 1992, as affected by the rate of nitrogen applied to the previous broccoli crop. Averaged over the high and low rates of herbicide application to the previous crop.

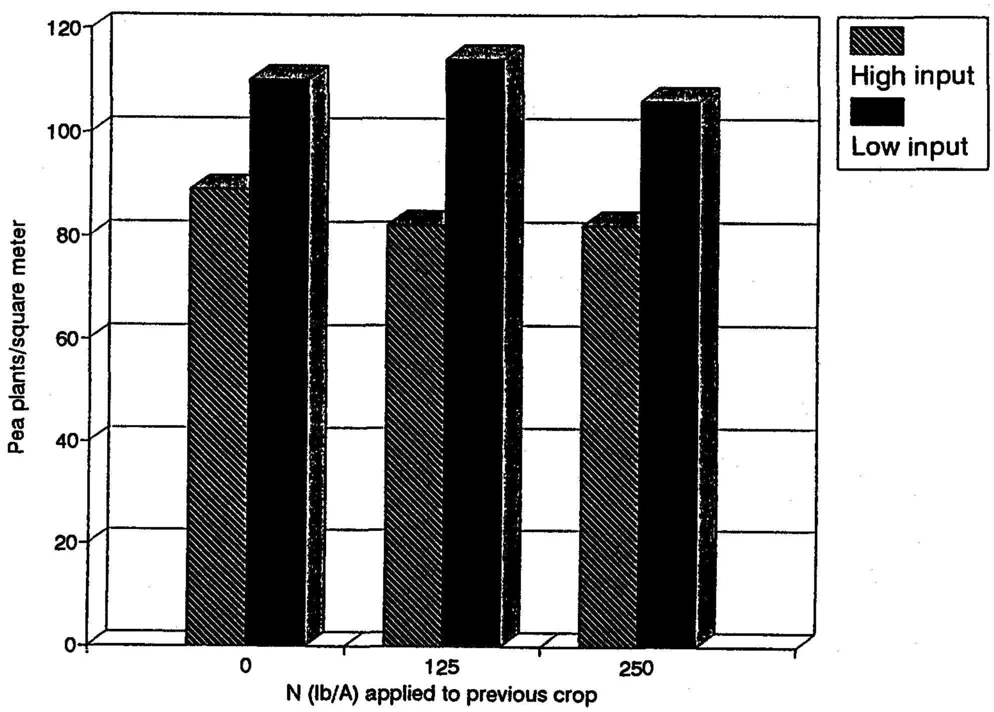

Figure 3. Effect of nitrogen rate and herbicide input level applied to the previous broccoli crop on the population density of Austrian winter pea plants in a rye plus pea cover crop.

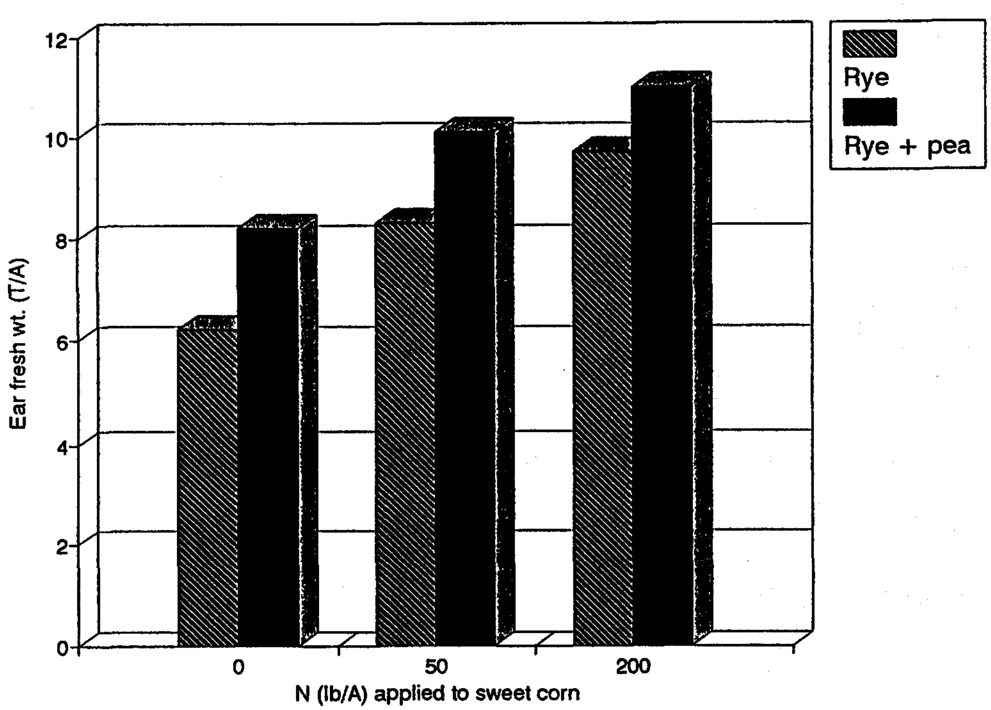

Figure 4. Effect of nitrogen rate and winter cover crop on the fresh weight ear yield of sweet corn, NWREC, 1992.