2011 Foliar Nitrogen Fertilizer Trial on Lettuce

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Summary: The trials were conducted to evaluate the potential of using foliar nitrogen (N) applications to supply crop growth rather than applying nitrogen to the soil. If successful, applying N to the foliage could potentially reduce nitrate leaching. These trials were conducted on a first crop lettuce field with low levels of residual soil nitrate and a second crop of lettuce with high residual soil nitrate. The reason for this approach were as follows: only low amounts of N can be applied in each foliar application to avoid burning the foliage; as a result, foliar applications are not intended to provide all the N needs of the crop; the goal of this trial was to evaluate the potential of foliar N application to supplement residual soil nitrate in providing the N needs of lettuce. In trial No. 1 there were low levels of residual soil nitrate. In this trial we were not able to statistically separate the yield among treatments, however, there was a strong trend that indicated increased yield with increasing levels of N applied to the crop; the same trend indicated that foliar N applications increased the N concentration in the lettuce crop and the yield by a modest amount. In trial No. 2 there were high levels of residual N in the soil and no statistical difference in yield or trend of increasing yield was observed in any treatments. We can conclude that foliar N applications do increase the concentration of N in lettuce, and may provide a modest increase in yield in situations with moderate amounts of residual soil nitrate.

Methods: ***Trial No. 1:*** The trial was conducted in a commercial lettuce production field near Salinas. The romaine variety 'Sun Valley' was seeded on April 4 in five seedlines on 80-inch wide beds. Preplant application of 300 lbs of 0-0-50 was applied in October, 2010. This was the first crop for this field for the 2011 season and had low residual soil nitrate level in the soil at the beginning of the cropping cycle. The standard treatment received the following fertilizer applications: 39.8 lbs N applied with a tractor on April 29; 37.0, 30.8 and 30.8 lbs N applied through the drip system on May 16, May 24 and June 4, respectively for a total of 138.4 lbs N/A. The foliar fertilizer treatments received the following N applications: 7.3 lbs N applied as a foliar application on May 9, May 20, May 31 and June 6 for a total application of 29.2 lbs N/A; all foliar applications were made in 57 gallons of water per acre. The lettuce was thinned on May 4, the drip tape was installed on May 14 and the crop was harvested on June 17. Each plot was one 80-inch bed wide by 15 feet long and replicated 4 times in a randomized complete block design. The fertilizer from the standard treatment was kept off of the foliar treatments by closing valves and routing the fertilizer treatments around the foliar treatments in polyethylene tubing. The soil at the site was Mocho silt loam. ***Trial No. 2:*** The trial was conducted in a commercial lettuce production field near Espinosa Road north of Salinas. The head lettuce variety 'Steamboat' was seeded on July 22 in two seedlines on 40-inch wide beds. This was a second crop for the 2011 season and broccoli was the prior crop and there were high levels of residual soil nitrate in the soil at the beginning of the cropping cycle. The standard treatment received the following N fertilizer applications: 38.2 lbs N/A applied by tractor on August 22; 30.8, 30.8 and 8.9 lbs N/A were applied on September 12, 19 and 27, respectively for a total of 108.7 lbs N/A. The foliar fertilizer treatments received the following N applications: 7.3 lbs N was applied as a foliar applications on August 25, September 2, 9, 16, 23, 30, and October 7 total application of 51.1 lbs N/A; all foliar applications were made in 57 gallons of water per acre. The lettuce was thinned on September 2, the drip tape was installed on September 10 and the crop was harvested on October 12. Each plot was two 40-inch beds wide by 20 feet long and replicated 4 times in a randomized complete block design. The fertilizer from the standard treatment was kept off of the

foliar treatments by closing valves and routing the fertilizer treatments around the foliar treatments in polyethylene tubing. The soil at the site was Chualar loam.

Results: ***Trial No. 1:*** This treatment received 4 foliar applications over the growth cycle beginning right after thinning and continuing just before harvest. Soil ammonium levels only differed between treatments on the May 23 evaluation date with all treatments having greater ammonium levels than the untreated control (Table 1). Soil nitrate levels varied on all evaluation dates with the untreated control and the Green Feed treatments having lower levels of soil nitrate than the other two treatments on May 16, 23 and June 2. The standard fertilizer treatment consistently had higher levels of soil nitrate than all other treatments on all evaluation dates. There was a clear trend indicating greater yield with increasing amounts of applied N, but no statistical differences were observed between treatments (Table 2). Foliar applications had increase percent N in the tops of the lettuce over the untreated control. The standard fertilizer treatment had higher percent N in the tops and N uptake/A than all other treatments.

Trial No. 2: This treatment received 7 foliar applications over the growth cycle beginning right after thinning and continuing just before harvest. Seven applications was of interest for this experiment and was not intended as a practical approach to foliar fertilizing lettuce. Even with seven foliar N applications, the total N applied was less than half that applied in the standard fertilizer treatment. The soil in this trial had high residual nitrate and all treatments had soil nitrate levels greater than 20 ppm nitrate-N until the September 29 evaluation date (Table 3); on that date the untreated control declined to low soil nitrate-N levels and remained low for the remainder of the growth cycle. The foliar treatments had moderate soil nitrate-N levels through harvest and the standard treatment had robust levels of soil nitrate through harvest. There were no differences in yield among the treatments which was probably due to high levels of soil nitrate (Table 4). The concentration of N in lettuce biomass tissue at harvest showed differences. There was statistically greater N in the tissue of all treatments than the untreated control except for Green Feed. The untreated control had the lowest nitrogen uptake of all the treatments and the standard fertilizer treatment the greatest. The foliar treatments were intermediate to these two extremes, but not significantly different than either.

Trial No. 2 at mid-heading Sept 30.

Slight color difference between foliar treatment on right vs standard fertilizer program on left

Table 1. Trial No. 1. Soil nitrate and ammonium levels in soil over the growing cycle

Treatment	Total N/A applied	May 16	May 23	June 2	June 9	June 14					
			NO_3-N	NH_4-N	NH_4-N	NO_3-N	NH_4-N	NO_3-N	NH_4-N	NO_3-N	NH_4-N
Untreated	0.0		9.6	0.5	0.6	5.4	1.2	1.6	0.6	6.0	0.7
Impact – foliar	29.2		13.6	1.9	1.9	17.5	3.7	4.3	1.0	9.8	1.0
Green Feed - foliar	29.2		8.6	1.5	2.0	6.1	2.5	2.7	1.1	10.3	1.7
Standard fertilizer	138.4		16.9	2.5	1.6	34.3	3.8	17.0	2.2	19.3	1.8
	Pr>treat		0.023	0.150	0.001	0.002	0.142	0.034	0.463	0.040	0.054
	Pr>block		0.730	0.182	0.127	0.237	0.690	0.875	0.487	0.667	0.040
	$LSD_{(0.05)}$		1.5	NS	0.6	2.4	NS	3.3	NS	8.9	NS

Table 2. Trial No. 1. Yield evaluation on June 14 and N uptake by lettuce

Treatment	Total N/A applied	Fresh yield lbs/A	Fresh yield tons/A	Dry biomass lbs/A	Mean head wt lbs	Marketable yield (tons/A)	N in Lettuce %N	Lettuce N uptake lbs N/A
Untreated	0.0	61,804	30.9	4,268	1.47	28.5	1.9	81
Impact – foliar	29.2	67,487	33.7	4,37	1.61	27.6	2.2	95

				6				
Green Feed - foliar	29.2	64,016	32.0	4,219	1.52	27.8	2.2	94
Standard fertilizer	138.4	76,732	38.4	4,621	1.83	32.1	2.7	125
	Pr>treat	0.152	0.152	0.358	0.149	0.388	<0.001	0.004
	Pr>block	0.883	0.883	0.394	0.881	0.906	0.317	0.299
	$LSD_{(0.05)}$	NS	NS	NS	NS	NS	0.3	19

Table 3. Trial No. 2. Soil nitrate and ammonium levels in soil over the growing cycle

Treatment	Total N/A applied	Aug 26	Sept 2	Sept 7		Sept 15		Sept 29	Oct 12						
				NO_3-N	NH_4-N	NO_3-N	NH_4-N	NO_3-N	NO_3-N	NH_4-N	NO_3-N	NH_4-N	NO_3-N	NH_4-N

Untreated	0.0	28.2	1.0	17.8	1.3	25.9	22.0	1.1	6.3	0.8	10.0	1.3
Impact – foliar	51.8	28.2	0.8	19.6	1.1	37.0	21.0	3.2	11.4	1.9	21.7	1.9
Green Feed – foliar	51.1	27.8	0.9	22.3	0.9	26.9	20.6	4.9	16.3	2.8	16.1	1.8
Nitamin – foliar	51.1	27.1	1.6	19.7	1.3	26.1	21.1	5.0	18.3	2.8	16.1	2.1
Standard fertilizer	108.7	37.3	1.2	23.3	0.9	30.2	86.2	1.9	85.7	1.8	32.3	1.3
	Pr>treat	0.033	0.125	0.422	0.111	0.332	<0.001	<0.001	<0.001	0.038	0.066	0.159
	Pr>block	0.084	0.145	0.805	0.070	0.820	0.355	0.047	0.097	0.081	0.443	0.704
	$LSD_{(0.05)}$	6.8	NS	NS	NS	NS	16.8	1.2	12.	1.4	15.1	NS

									4			

Table 4. Trial No. 2. Yield evaluation on October 12 and N uptake by lettuce

Treatment	Total N/A applied	Fresh yield lbs/A	Fresh yield tons/A	Dry bio mass lbs/ A	Mean head wt lbs	Marketable yield (tons/A)	N in Lettuce %N	Lettuce N uptake lbs N/A
Untreated	0.0	68,935	34.5	2,813	2.40	23.4	3.5	97.5
Impact – foliar	51.8	69,977	35.0	2,893	2.43	23.1	3.8	110.3
Green Feed – foliar	51.1	69,400	34.7	2,898	2.41	23.2	3.5	101.8
Nitamin – foliar	51.1	70,004	35.0	2,886	2.43	24.9	3.6	103.2
Standard fertilizer	108.7	70,867	35.4	3,103	2.46	23.5	3.9	120.3
Pr>treat	Pr>treat	0.832	0.832	0.525	0.822	0.192	0.003	0.043
Pr>block	Pr>block	0.292	0.292	0.470	0.277	0.367	0.393	0.588
$LSD_{(0.05)}$	$LSD_{(0.05)}$	NS	NS	NS	NS	NS	0.20	14.8