2005 Phosphorus Fertilizer Trials on Head Lettuce

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Objective: As a result of last years trials, we decided to examine "lower" application rates of phosphorus (P) applied at planting in order to bring P application rates into line with P removal rates by the crop (i.e. for lettuce 10 – 15 lbs P/A).

Summary: Three phosphorus fertilizer trials were conducted this year on sites that varied in soil P levels and in planting date. No yield advantage was seen at two sites with initial soil P levels of 45 and 68. The site with 45 ppm P in the soil was planted in the summer and indicates that this level of P in the soil is sufficient when the soils are warm (i.e. planted June 3). The site with 68 ppm P in the soil was planted on April 18 when the soils were warming, but probably still cool. Tim Hartz, Extension Specialist, UC, Davis observed a response to P fertilization at a site with 55 ppm P in the winter indicating that on cold soils, lettuce may respond to P fertilization with soil P values <55 ppm. The third test was conducted at a site that had soil P levels of 30 ppm. We observed a response to P applied as low-application (i.e. 20 lb P_2O_5) rates of P made at planting. The low, at planting applications gave improved yield over the grower preplant application of higher P rates (i.e. 60 lbs P_2O_5). These trials confirmed that 68 ppm soil P is sufficient for cold soils and that soils with 45 ppm may be sufficient for warm soils. Low applications rates of P made at planting gave improved yield over preplant applications. This indicates that in situations where growers feel the need to fertilize with P, low rates of P applied at planting suffice to improve yields and may reduce P loading of soils and thereby reduce water quality risks from vegetable production fields.

Methods: ***Trial No. 1:*** Conducted at the Wallace Ranch Block 3W in Chualar in early spring . Soil type was Chualar loamy sand (pH = 7.3 and organic matter = 0.90). 300 lbs of 0-0-50 was applied in the fall at listing. Olsen extractable P at the initiation of the trial: sample 1 = 68.9, sample 2 = 66.7 and mean = 67.8 ppm. Each plot was four 40-inch beds wide by 25 feet long and replicated four times in a randomized complete block design. The preplant application was shanked into the bed on March 21 with a small-plot experimental applicator. All at-planting treatments applied immediately after seeding on April 18 on two 5 inch wide bands over the seedlines. The sprayed on treatments included: Actagro 7-21-0 (@10.9 lbs/gal); Ortho Phos 12-58-0 solutionized @ 1lb material/1gal water; 10-34-0 (11.8 lbs/gal) + 1% Avail (carboxalic acid); 7-7-0-7 (10.44 lbs/gal). The materials were applied with a CO_2 backpack sprayer using an 8008E nozzle and applied in 74 gallons of water per acre. The field was switched to drip irrigation on May 30. *Crop maintenance:* Kerb: @ 3.0 lbs material/A; Water Max @ 32 ounces/A; 15 lbs N/A as AN 20. Plots were fertilized with 80 lbs N/A as a top dress application of ammonium nitrate on May 17 and 24. The field was seeded with the variety Sniper. Harvest evaluations were made of 40 heads cut at random from the plots. The heads were stripped to the wrapper leaves and weighed. Total nutrient uptake estimates were made of 10 unstripped heads which were quartered and a subsample weighed, dried and sent to the DANR analytical laboratory for nutrient analysis.

Trial No. 2: Conducted in cooperation with Ed Mora of D'Arrigo Brothers at the Ranch 6 Block 45 in west of Gonzales. Soil type was Metz loamy sand (pH = 7.3 and organic matter = 0.5%). Olsen extractable P at the initiation of the trial: rep 1 = 29.5, rep 2 = 29.1

rep 3 = 29.9 and mean = 29.5 ppm. The trial was established in an area not treated with preplant fertilizer. The remainder of the field had 400 lbs of 15-15-15 applied at listing on April 25. Each plot was two 40-inch beds wide by 25 feet long and replicated three times in a randomized complete block design. All treatments except grower practice were sprayed on the shaped beds prior to planting on April 29 on two 5 inch wide bands over the seedlines). The materials were applied with a CO_2 backpack sprayer using an 8008E nozzle and applied in 74 gallons of water per acre. The at-planting liquid materials were the same as listed above. The trial was seeded on April 30 with the variety Sniper. Harvest was conducted as described above.

Trial No. 3: Conducted at the USDA Spence Research Station south of Salinas in early summer (?). No phosphorus was applied prior to planting. Soil type was Chualar loamy sand. Olsen extractable P at the initiation of the trial: rep 1 = 41.9; rep 2 = 46.6; rep 3 = 43.3; rep 4 = 47.5 ppm and mean = 44.8 ppm. Each plot was four 40-inch beds wide by 35 feet long and replicated four times in a randomized complete block design. Preplant applications were shanked into peaked beds on May 31 with a small-plot experimental applicator (Ortho Phos was solutionized at the rate of 1lb of material/1gal water and injected into the beds). At planting applications were made on June 2 by spraying two 5-inch wide bands over the seedlines. The materials were applied with a CO_2 backpack sprayer using an 8008E nozzle and applied in 74 gallons of water per acre. The first water was applied by sprinkler irrigation on June 3. *Planting maintenance:* Kerb: @ 3.0 lbs material/A. Fifty five pounds of N as ammonium nitrate were broadcast onto the bed tops on June 6, just prior to irrigation. Field was cultivated and sidedressed with 60 lbs N/A as ammonium sulfate on June 30. A total of 45 lbs of N was injected into the drip irrigation system on four occasions from July 7 to July 27. The crop was thinned on July 1 and drip irrigation was installed on July 5 and was used for the remainder of the crop cycle. The crop was weeded on July 21 and sprayed with 2 lbs Maneb + 1 lb Agree Bt on July 22. The crop was harvested on August 5. A commercial harvest crew harvested the middle 25 feet of the middle two rows from each plot. The lettuce was sized into 24's, 30's and unmarketable. The 24's and 30's were boxed, counted and weighed. See tables for treatments as well as sampling and harvest dates.

Results: ***Trial No. 1:*** None of the treatments increased the concentration of midrib phosphate, total leaf tissue P or soil P over the untreated at mid-growth (Table 1). Ortho Phos, 10-34-0 + 1% Avail and 7-7-0-7 increased soil P levels over the untreated at harvest, but none of the treatments increased the mean head weight or tonnage of lettuce over the untreated. ***Trial No. 2:*** There were weak to no differences in midrib phosphate and soil P at the midgrowth stage (Table 2). Actagro had the highest soil P at harvest, but there were no differences in P uptake per acre. Actagro and 10-34-0 + 1% Avail had higher mean head weight and tonnage of lettuce than the grower practice and untreated control ($P = 0.10$). Trial No. 3: There were no differences in tissue or soil P levels at any sampling date (Table 3). None of the treatments increased the number of 24 count boxes over the untreated control (Table 4).

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Table 1. Trial No. 1. Tissue and soil P analyses, nutrient uptake at harvest and yield data.

Treatment	P/Acre lbs	P_2O_5/acre lbs	Application	Mid-Stage			Harvest					
				Midrib PO_4^- (ppm)	Leaf Tissue Total P (%)	Soil P (ppm)	Soil P (ppm)	Nutrient Uptake (Lbs/Acre)			Mean Head Wt. (Lbs)	Mean Wt./Acre (Tons)
								N	P	K		
Untreated	----	----	----	1,877.5	0.43	57.2	56.8	79.9	13.7	101.3	1.65	27.24
Standard 0-45-0	35	80	Preplant	2,102.5	0.45	64.0	59.4	80.2	12.0	92.1	1.63	26.78
Actagro 7-21-0	9	20	at planting[1]	1,767.5	0.40	58.5	59.5	75.7	12.0	86.9	1.47	24.18
Ortho Phos 12-58-0	9	20	at planting[1]	1,902.5	0.42	61.4	62.4	86.3	14.5	107.1	1.70	28.02
10-34-0 + 1% Avail	9	20	at planting[1]	1,710.0	0.43	60.5	63.9	73.5	12.3	91.6	1.58	26.06
7-7-0-7	9	20	at planting[1]	1,822.5	0.44	59.9	64.7	79.3	12.5	90.4	1.66	27.34
LSD α=0.05				*NS*	*0.03*	*NS*	*4.1*	*NS*	*NS*	*NS*	*0.125*	*2.07*

1 – Applied in two 5 inch wide bands over the seedline

Table 2. Trial No. 2. Tissue and soil P analyses, nutrient uptake at harvest and yield data.

Treatment	P/acre lbs	P_2O_5/acre lbs	Application	Mid Stage		Harvest					
				Tissue Total P (%)	Soil P (ppm)	Soil			P Uptake (Lbs/Acre)	Mean Head Wt. (Lbs)	Mean Wt./Acre (Tons)
						Nitrate (ppm)	Olsen-P (ppm)	X-K (ppm)			
Untreated	----	----	----	0.313	35.5	91.6	34.17	148.0	11.3	1.09	29.57
Actagro 7-21-0	9	20	at planting[1]	0.300	35.9	100.9	39.57	150.3	12.1	1.18	32.93
Ortho Phos 12-58-0	9	20	at planting[1]	0.277	35.0	106.3	36.73	153.7	11.8	1.10	30.33
10-34-0 + 1% Avail	9	20	at planting[1]	0.287	37.6	78.6	36.93	145.3	11.9	1.20	32.77
7-7-0-7[2]	9	20	at planting[1]	0.297	35.5	72.7	34.37	137.3	11.9	1.17	32.20
Grower Practice 15-15-15	27	60	Preplant	0.277	36.1	102.3	34.03	145.7	10.7	1.04	28.90
LSD, α=0.05				*0.026**	*NS*	*NS*	*3.29*	*NS*	*NS*	*NS*	*NS*
LSD, α=0.10				*0.021*	*NS*	*NS*	*2.68*	*NS*	*NS*	*0.09*	*2.86*

1 – Applied in two 5 inch wide bands over the seedline; *marginally significant: p=0.0577

Table 3. Trial No. 3. Tissue and soil P analyses, nutrient uptake at harvest

Treatment	P/acre lbs	P_2O_5/acre lbs	Application	Tissue Nutrients @ Thinning			Mid-Stage			Harvest	
				Total N (%)	Total P (%)	K (%)	Midrib PO_4^- (ppm)	Leaf Tissue Total P (%)	Soil P (ppm)	Leaf Tissue Total P (%)	Soil P (ppm)
Untreated	----	----	----	5.15	0.58	7.10	3605.0	0.44	42.1	10.1	45.5
Standard 0-45-0	35	80	Preplant	5.12	0.58	7.17	3802.5	0.45	46.4	10.5	49.5
Standard 0-45-0	18	40	Preplant	5.16	0.59	7.38	3630.0	0.43	53.5	11.3	47.7
Standard 0-45-0	9	20	Preplant	5.14	0.58	7.00	3715.0	0.44	44.6	10.4	46.5
Actagro 7-21-0	18	40	at planting[1]	5.19	0.59	7.24	3475.0	0.43	46.7	11.2	46.6
Actagro 7-21-0	9	20	at planting[1]	5.41	0.57	6.91	3665.0	0.42	46.9	9.2	47.7
Ortho Phos 12-58-0	18	40	Preplant	5.14	0.57	7.03	3812.5	0.48	46.3	10.1	46.8
Ortho Phos 12-58-0	9	20	Preplant	5.12	0.55	6.80	3410.0	0.42	48.2	10.8	45.0
10-34-0 + 1% Avail	18	40	at planting[1]	5.09	0.58	6.87	3627.5	0.41	47.4	10.1	43.0
10-34-0 + 1% Avail	9	20	at planting[1]	5.06	0.57	6.93	3605.0	0.43	46.8	10.6	47.2
7-7-0-7	18	40	at planting[1]	5.24	0.58	7.19	3185.0	0.40	43.8	10.8	46.0
7-7-0-7	9	20	at planting[1]	5.07	0.56	6.81	3387.5	0.40	44.3	10.5	44.0
LSD α=0.05				*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*

1 – Applied in two 5 inch wide bands over the seedline

Table 4. Trial No. 3. Yield data.

Treatment	P/acre lbs	P_2O_5/acre lbs	Application	24s			30s		Number marketable Heads per acre	Total No. boxes per acre
				No. boxes per acre	Total Wt/acre (Tons)	Mean Head Wt (Lbs)	No. boxes per acre	Total Wt/acre (Tons)		
Untreated	----	----	----	851	18.18	1.78	239	4.58	27611	1090
Standard 0-45-0	35	80	Preplant	851	19.40	1.90	196	3.85	26305	1047
Standard 0-45-0	18	40	Preplant	702	15.88	1.88	368	8.38	27872	1069
Standard 0-45-0	9	20	Preplant	696	14.83	1.77	392	7.97	28460	1088
Actagro 7-21-0	18	40	at planting[1]	957	21.03	1.85	191	3.73	28721	1148
Actagro 7-21-0	9	20	at planting[1]	794	18.10	1.87	290	6.43	27763	1084
Ortho Phos 12-58-0	18	40	Preplant	841	18.00	1.80	264	4.73	28111	1105
Ortho Phos 12-58-0	9	20	Preplant	1036	21.68	1.75	111	2.25	28198	1147
10-34-0 + 1% Avail	18	40	at planting[1]	925	20.73	1.85	148	3.03	26632	1073
10-34-0 + 1% Avail	9	20	at planting[1]	990	21.20	1.78	126	2.40	27546	1116
7-7-0-7	18	40	at planting[1]	985	22.40	1.90	139	3.05	27807	1124
7-7-0-7	9	20	at planting[1]	963	21.13	1.83	154	3.45	27742	1117
LSD α=0.05				*206*	*NS*	*NS*	*171*	*3.69*	*NS*	*NS*

1 – Applied in two 5 inch wide bands over the seedline