

Response of Cucumber to Meister Controlled-Release Fertilizers 97-01

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Abstract

Cucumbers were grown in Gainesville, FL with two Meister (Helena Chemical Co.) polymer-coated controlled-release fertilizers providing N at 75, 125, 175, 225, and 275 lbs per acre. Results showed that cucumber fancy and total marketable yields leveled off after 125 lbs N per acre provided from controlled-release N, and that this response was equivalent to N from soluble N at 175 lbs per acre. Controlled-release N could be applied either banded in a wide band on the bed surface or incorporated in the soil in the bed.

Introduction

Cucumbers are grown in 14,000 acres in Florida with a crop value of \$42 million. Fertilizer is a major cost input accounting for about 5% of total costs of production. Current University of Florida nitrogen recommendations are 150 lbs N and K₂O per acre for each crop. Both N and K can leach in the sandy soils of Florida. Methods to control the amount of N risked to leaching during the season are of benefit to the grower's profitability and to minimize groundwater contamination with N. One method to manage N and K availability to the crop is with controlled-release fertilizers. Most work with controlled-release fertilizers has been done with tomato, pepper, melons, and strawberry. The objective of this study was to evaluate fall cucumber response to Meister polymer-coated fertilizers.

Materials and Methods

Cucumbers were grown at Gainesville, Florida to evaluate yield response to Meister controlled-release fertilizer products. The soil, an Arrendondo fine sand, was plowed and disced, and preplant fertilizer was applied in a 10-inch wide band on the surface of the bed; then the beds were fumigated with methyl bromide and re-pressed with a minimal disturbance of the fertilizer band. Following bedding, white-on-black polyethylene mulch was applied to the beds and a drip irrigation tube was laid on the bed surface for irrigation.

Fertilizer treatments consisted of a factorial arrangement of two Meister (Helena Chemical Co., Memphis, TN) products, a 15-5-15 (N-P₂O₅-K₂O) and a 19-5-14 fertilizer, each material applied at 75, 125, 175, 225, and 275 lbs N per acre. All Meister fertilizer

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was applied in a 10-inch wide band on the surface of the bed. In addition, a zero-fertilizer check, a soluble (ammonium nitrate) fertilizer at 175 lbs N per acre, and a Meister 15-5-15 at 175 lbs per acre but incorporated in the bed were included among the treatments. Fertilizer rates were calculated based on beds on six-foot centers even though beds were spaced on four-foot centers. Fertilization and bedding was completed on 15 August 1996.

On 22 August, seeds of 'Dasher II' cucumber were planted through holes punched in the mulch in two rows on each bed. Rows were 12 inches apart on the bed and plants were 12 inches apart in the row. Beds were on four-foot centers. Hills were thinned to one plant per hill on 3 September 1996. Crop culture was according to recommended practices (Hochmuth and Maynard, 1996). Irrigation was applied by drip irrigation to keep a tensiometer at -10 cb at six inches deep in the soil.

Cucumbers were harvested seven times beginning 1 October 1996 and continuing through 28 October 1996. Fruits were graded into Fancy, US No. 1, and cull fruits by US Department of Agriculture grade standards for cucumber (USDA, 1963).

Yield data were analyzed by analysis of variance and means compared by least significant difference. Main effects of N rate were further tested with regression analysis.

Results

Fancy Fruits. Fertilizer treatment affected yield of fancy cucumber (highest value) fruits for most harvest dates and for the combined season yield (Table 1). Highest early yields were obtained with low (75 to 100 lb N) rates of either Meister fertilizer applied in the wide band and with the 15-5-15 (N-P₂O₅-K₂O) Meister applied broadcast in the bed. Yields with all soluble fertilizer were poor compared with the better controlled-release treatments. Total-season yields of fancy fruits also were affected by fertilizer treatment. Best yields were with the broadcast controlled-release treatment and with any controlled-release treatments at 125 lbs N per acre or higher, and with the soluble N. Use of controlled-release N provided equivalent yields with 125 lbs N per acre compared to higher N rates with soluble N or with higher rates of controlled-release N. Successful cucumber production with 125 lbs N per acre means a possible reduction in N use with controlled-release N compared to the current N recommendation of 150 lbs per acre.

There were no differences between the two Meister fertilizer blends (Table 1). Analysis of the main effects for N rate showed that response in yields of fancy cucumber leveled off after 125 lbs N per acre (Table 1).

US No. 1 fruits. The portion of total fruit yield comprised of US No. 1 fruits (fruits of lesser quality compared to fancy, i.e. shorter or slightly curved) was small, averaging

between 10 and 15%. There were very few effects of fertilizer treatments in yield of US No. 1 fruits (Table 2).

Cull fruits. Fertilizer treatment did not affect yield of cull (non-marketable) cucumber fruits (Table 3). Portion of cull fruits of total was about 5%.

Total marketable yield. Yields of total-season marketable fruits (combined yields of fancy and US No. 1 fruits) was very high, especially for a fall crop in Florida. The trends for response to fertilizer for the total-season marketable yields followed the trends for the fancy fruits. Highest marketable yields were obtained with 125 lbs N or higher (Table 4). There were no differences between the two Meister products for yield, although leaf responses were due to nitrogen nutrition because that was the only leaf nutrient affected by rates of Meister products (Table 5).

Summary

Results of this cucumber study with slow-release fertilizer showed that:

1. General responses to N rate leveled off near the recommended rate of 150 lbs N per acre.
2. Use of controlled-release N at 125 lbs N per acre resulted in the same yields as soluble N fertilizer at 175 lbs N per acre.
3. Controlled-release fertilizer applied broadcast and incorporated in the bed resulted in same or better yields as controlled-release fertilizer applied in a wide band on the surface of the bed.

Literature Cited

- Hochmuth, G. J., and D. N. Maynard (eds.) 1996. *Commercial Vegetable Production Guide for Florida*. Fla. Coop. Ext. Serv. Circ. SP170.
- Hochmuth, G. (ed.) 1998. *Cucumber Production Guide for Florida*. Fla. Coop. Ext. Serv. Circ. 101E.
- Hochmuth, G. J. and E. A. Hanlon. 1995. *IFAS Standardized Fertilization Recommendations for Vegetable Crops*. Fla. Coop. Ext. Serv. Circ. 1152
- USDA. 1958. *United States Standards for Grades of Cucumber*. US Department of Agriculture. Washington, DC.

Table 1. Response of cucumber to Meister controlled-release fertilizer, Gainesville, FL, Fall 1996.

Trtmt	Fertilizer	N Rate lb/acre ^y	Fancy ^z fruit yield (50 lb ctn/A by harvest)							Season
			1	2	3	4	5	6	7	
1	15-5-15	75	336	282	218	83	157	22	81	1180
2		125	258	229	237	115	198	103	128	1268
3		175	204	243	215	119	250	95	190	1317
4		225	254	287	224	146	127	71	204	1313
5		275	196	304	248	159	179	105	224	1418
6	19-5-14	75	329	195	215	110	141	55	53	1099
7		125	332	270	151	110	197	100	93	1253
8		175	273	292	202	155	244	56	177	1400
9		225	184	211	328	149	184	76	216	1347
10		275	216	266	201	104	241	88	161	1277
11	Check	0	0	5	62	22	23	36	76	225
12	Soluble ^x	175	152	286	271	153	235	97	135	1329
13	15-5-15 BC ^w	175	320	223	210	155	199	128	186	1421
LSD.05 ^w			143	139	NS	76	105	NS	104	200

Main effects:

	15-5-15		250	269	228	124	182	80	165	1300
	19-5-14		267	247	219	126	201	75	140	1275
	Signif. ^v		NS	NS	NS	NS	NS	NS	NS	NS
		75	333	239	216	96	149	39	67	1140
		125	295	249	194	113	197	102	110	1260
		175	240	268	209	137	247	76	183	1360
		225	220	249	276	148	156	74	210	1330
		275	206	285	224	131	210	98	192	1350
	Regression ^v		L**	NS	NS	NS	NS	NS	L**	L**Q*

^z Fruit graded by USDA grade standards for slicing cucumber.

^y Acre was considered to consist of beds on 6-ft. centers for fertilizer calculations.

^x Soluble fertilizer was mixture of ammonium nitrate and potassium nitrate.

^w Treatment13 was 15-5-15 Meister fertilizer broadcast and incorporated in bed. Remaining treatments were a wide-band application on surface of bed as prescribed by Meister manufacturer.

^v Treatment effects were significant at 1%(*) or 5% (**) probability level or were not significant (NS). Regression equations contained linear (L) or quadratic (Q) terms.

Table 2. Response of cucumber to Meister controlled-release fertilizer, Gainesville, FL. Fall 1996.

Trtmt	Fertilizer	N Rate lb/acre ^y	US No. 1 ^z fruit yield (50 lb ctn/A by harvest)							Season
			1	2	3	4	5	6	7	
1	15-5-15	75	32	38	21	34	50	18	3	197
2		125	41	41	7	60	19	34	20	222
3		175	18	28	18	29	27	10	11	141
4		225	12	47	27	51	48	31	14	230
5		275	15	66	27	25	44	34	30	240
6	19-5-14	75	19	12	29	27	19	27	7	141
7		125	55	45	12	27	39	29	0	205
8		175	26	36	52	22	61	14	27	239
9		225	13	42	0	28	20	44	14	161
10		275	11	56	30	29	25	36	18	205
11	Check	0	4	16	11	7	0	9	0	47
12	Soluble ^x	175	30	38	51	45	39	33	16	253
13	15-5-15 BC ^w	175	19	13	24	80	10	39	27	211
LSD.05 ^w			31	NS	NS	NS	NS	NS	NS	112
Main effects:										
	15-5-15		24	44	20	40	38	25	16	206
	19-5-14		25	38	25	26	33	30	13	190
	Signif. ^v		NS	NS	NS	NS	NS	NS	NS	NS
		75	26	25	25	31	35	22	5	169
		125	47	43	10	43	29	31	10	213
		175	22	32	35	26	44	12	19	190
		225	13	44	13	39	34	37	14	195
		275	13	61	28	27	34	35	24	223
	Regression ^v		L*	NS	NS	NS	NS	NS	NS	NS

^z Fruit graded by USDA grade standards for slicing cucumber.
^y Acre was considered to consist of beds on 6-ft. centers for fertilizer calculations.
^x Soluble fertilizer was mixture of ammonium nitrate and potassium nitrate.
^w Treatment13 was 15-5-15 Meister fertilizer broadcast and incorporated in bed. Remaining treatments were a wide-band application on surface of bed as prescribed by Meister manufacturer.
^v Treatment effects were significant at 1%(*) or 5% (**) probability level or were not significant (NS). Regression equations contained linear (L) or quadratic (Q) terms.

Table 3. Response of cucumber to Meister controlled-release fertilizer, Gainesville, FL. Fall 1996.

Trtmt	Fertilizer	N Rate lb/acre ^y	Cull ^z fruit yield (50 lb ctn/A by harvest)							
			1	2	3	4	5	6	7	Season
1	15-5-15	75	9	34	5	0	7	0	27	82
2		125	6	22	5	0	0	5	18	57
3		175	4	14	10	3	0	7	15	52
4		225	13	20	5	6	8	1	34	88
5		275	10	21	0	0	12	0	26	68
6	19-5-14	75	3	17	4	7	18	0	65	114
7		125	6	8	8	0	20	2	19	64
8		175	0	5	0	5	0	0	16	25
9		225	7	9	8	0	9	7	25	66
10		275	12	12	3	15	0	12	10	64
11	Check	0	0	3	0	8	19	8	61	99
12	Soluble ^x	175	0	29	3	8	5	10	23	78
13	15-5-15 BC ^w	175	6	0	9	4	12	0	37	67
LSD.05 ^w			NS	NS	NS	NS	NS	NS	NS	NS
Main effects:										
	15-5-15		8	22	5	2	5	3	24	69
	19-5-14		6	10	5	5	9	4	27	67
	Signif. ^v		NS	NS	NS	NS	NS	NS	NS	NS
		75	6	26	5	4	12	0	46	98
		125	6	15	6	0	10	4	18	60
		175	2	9	5	4	0	3	15	38
		225	10	15	7	3	9	4	30	77
		275	11	16	2	7	6	6	18	66
	Regression ^v		NS	NS	NS	NS	NS	NS	NS	NS
^z Fruit graded by USDA grade standards for slicing cucumber. ^y Acre was considered to consist of beds on 6-ft. centers for fertilizer calculations. ^x Soluble fertilizer was mixture of ammonium nitrate and potassium nitrate. ^w Treatment13 was 15-5-15 Meister fertilizer broadcast and incorporated in bed. Remaining treatments were a wide-band application on surface of bed as prescribed by Meister manufacturer. ^v Treatment effects were significant at 1%(*) or 5% (**) probability level or were not significant (NS). Regression equations contained linear (L) or quadratic (Q) terms.										

Table 4. Response of cucumber to Meister controlled-release fertilizer, Gainesville, FL. Fall 1996.

Trtmt	Fertilizer	N Rate lb/acre ^y	Total marketable ^z fruit yield (50 lb ctn/A by harvest)							
			1	2	3	4	5	6	7	Season
1	15-5-15	75	369	321	239	117	208	40	84	1377
2		125	299	270	244	175	217	137	148	1490
3		175	223	271	233	148	278	105	201	1458
4		225	266	334	251	197	176	102	218	1543
5		275	211	370	275	184	223	142	253	1658
6	19-5-14	75	349	207	244	137	160	82	61	1240
7		125	387	314	163	136	235	129	93	1458
8		175	299	328	254	177	306	71	204	1638
9		225	197	353	328	177	204	119	230	1508
10		275	227	322	230	133	266	125	179	1482
11	Check	0	4	21	74	29	23	45	76	272
12	Soluble ^x	175	182	324	322	198	274	130	152	1582
13	15-5-15 BC ^w	175	339	236	234	234	209	167	213	1632
LSD.05 ^w			NS	NS	NS	NS	NS	NS	NS	NS
Main effects:										
	15-5-15		273	313	248	164	220	105	181	1505
	19-5-14		292	285	244	152	234	105	153	1465
	Signif. ^v		NS	NS	NS	NS	NS	NS	NS	NS
		75	358	264	241	127	184	61	72	1310
		125	343	292	204	156	226	133	120	1470
		175	261	300	243	162	292	88	202	1550
		225	232	293	289	187	190	111	224	1530
		275	219	346	253	159	244	133	216	1570
	Regression ^v		L**	NS	NS	NS	NS	NS	L**	L**Q*
^z Fruit graded by USDA grade standards for slicing cucumber. ^y Acre was considered to consist of beds on 6-ft. centers for fertilizer calculations. ^x Soluble fertilizer was mixture of ammonium nitrate and potassium nitrate. ^w Treatment13 was 15-5-15 Meister fertilizer broadcast and incorporated in bed. Remaining treatments were a wide-band application on surface of bed as prescribed by Meister manufacturer. ^v Treatment effects were significant at 1%(*) or 5% (**) probability level or were not significant (NS). Regression equations contained linear (L) or quadratic (Q) terms.										

Table 5. Response of cucumber whole-leaf N, P, and K concentrations to Meister controlled-release fertilizer, Gainesville, FL. Fall 1996.

Trtmt	Fertilizer	N Rate lb/acrev	Leaf concentrations (%) ^z					
			16 September			3 October		
			N	P	K	N	P	K
1	15-5-15	75	6.3	1.1	4.5	4.0	0.7	2.8
2		125	6.6	1.1	4.2	4.8	0.8	2.7
3		175	6.4	1.1	4.3	5.4	0.9	3.1
4		225	6.8	1.1	4.3	5.0	0.8	2.6
5		275	6.5	1.1	4.4	5.6	0.9	3.2
6	19-5-14	75	5.2	1.0	3.7	3.5	0.7	2.9
7		125	5.6	1.0	3.9	4.3	0.7	2.9
8		175	6.1	1.0	4.1	4.7	0.8	2.8
9		225	5.7	1.0	4.6	5.4	0.8	3.4
10		275	6.9	0.9	3.9	5.2	0.7	3.0
11	Check	0	3.7	0.7	2.2	3.2	0.8	3.1
12	Soluble ^x	175	6.7	1.0	4.7	5.0	0.7	2.9
13	15-5-15 BC ^w	175	6.5	1.0	4.6	5.3	0.7	2.9
LSD.05 ^w			1.1	0.1	0.8	0.7	NS	NS
Main effects								
	15-5-15		6.5	1.1	4.3	4.9	0.8	2.9
	19-5-14		5.9	1.0	4.0	4.6	0.8	3.0
	Signif. ^v		*	*	NS	*	NS	NS
		75	5.8	1.0	4.1	3.8	0.7	2.9
		125	6.1	1.1	4.0	4.5	0.8	2.8
		175	6.2	1.0	4.2	5.0	0.8	3.0
		225	6.2	1.0	4.4	5.2	0.8	3.0
		275	6.7	1.0	4.1	5.4	0.8	3.1
	Regression ^v		NS	NS	NS	L**Q*	NS	NS
	Adequate ranges		3.5 to 6.0	0.3 to 0.6	1.6 to 3.0	2.5 to 5.0	0.3 to 0.6	1.6 to 3.0
^z Sampling dates were 16 Sept. (early flowering) and 3 Oct. (two days after first harvest). ^y Acre was considered to consist of beds on 6-ft. centers for fertilizer calculations. ^x Soluble fertilizer was mixture of ammonium nitrate and potassium nitrate. ^w Treatment13 was 15-5-15 Meister fertilizer broadcast and incorporated in bed. Remaining treatments were a wide-band application on surface of bed as prescribed by Meister manufacturer. ^v Treatment effects were significant at 1%(*) or 5% (**) probability level or were not significant (NS). Regression equations contained linear (L) or quadratic (Q) terms.								