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SLOW RELEASE FERTILIZER RATES FOR STRAWBERRY FRUIT PRODUCTION

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Abstract. **Strawberry (*Fragariae x ananassa* Duch.) was grown on a fine sand at GCREC-Dover using drip irrigation. A granular 16-2.1-13.3 (NPK) fertilizer was applied preplant banded in the bed center 2 inches deep at rates of 0, 50, 100, and 150 lbs/acre. A control treatment of granular 30-12.5-25 (NPK) derived from NH_4NO_3, sulfur coated urea, triple super phosphate, and KCl was applied as above at 200 lbs/acre. A liquid 17-2.1-25 (NPK) fertilizer was applied weekly to all treatments by drip irrigation so as to give a total N application of about 200 lbs/acre. Canadian grown transplants of 'Selva' and 'Oso Grande' were set on 16 Oct., 1991. The treatment receiving no granular fertilizer had smallest fruit and lowest fruit yields for Mar., Apr., and for the season. Petiole sap N & K analyses of 11 Mar., 1992 were lowest with the control treatment and highest with the 50 lbs N/acre treatment. On 15 Apr., 1992 the treatment receiving no granular fertilizer had the highest and the 150 lbs N/acre granular fertilizer treatment had the lowest petiole N & K concentrations in the plant sap.**

Most Florida strawberry growers apply some or all of their fertilizer in the granular form and irrigate with either overhead or microirrigation. It is generally used as a starter fertilizer with microirrigation, but some growers may apply an amount sufficient for the season. A previous 2-year study used preplant fertilizer treatments of 0, 1, 2, 3 and 4 times a basic N (NH_4NO_3) and K (KCl) rate of 15 and 13 lbs/acre, respectively. Additional N and K were applied twice weekly through the microirrigation system at 1.0 and 0.8 lbs/acre/day, respectively. No consistent yield differences occurred (Albregts et al., 1991). Locascio and Myers (1975) and Locascio et al., (1977) obtained increased fruit yields when 50% of the N and K was applied preplant compared with all preplant or all through the microirrigation tube. Similar results have been obtained with tomato (Locascio et al., 1989). Daily or weekly application of liquid fertilizer did not affect strawberry yield (Locascio et al., 1977). Some Florida strawberry growers report no advantage to using preplant fertilizer with microirrigation injection of N and K on fine sands. The purpose of this study was to determine the response of fruiting strawberry to various combinations of a liquid fertilizer 17-2.1-25. and a 16-2.1-13.3 slow-release fertilizer.

Materials and Methods

Strawberry was grown during the 1991-92 winter season on a Seffner fine sand (sandy, siliceous, hyperthermic Quartzipsammentic Haplumbrept) using the polyethylene annual hill cultural system. The results of the initial soil test by the University of Florida Soil Testing Laboratory were Mg 19, K 27, and P 206 ppm using the Mehlich I extractant with a pH of 6.3. Mg and K soil concentrations

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were low and P was very high. Prior to fumigation and bed preparation, 95 lbs/acre of $MgSO_4$ and 6 lbs/acre of a micronutrient mix containing 3% B and Cu, 7% Mn and Zn, and 9% Fe were incorporated into the experimental area. During the week of 6 Sep., 1991, plant beds on 4 ft centers were prepared and drip tube (T-Tape) with 8" orifice spacing was placed 2 inches deep in a trench in bed center. The drip tube applied 0.5 gpm/100 linear ft at 10 psi. One inch of soil was placed over the drip tape, and then the rates of the dry fertilizer as listed in Table 1 were applied. Granular N, P, and K fertilizer sources for treatment 5 were NH_4NO_3, sulfur coated urea, triple super phosphate, and KCl. Beds were fumigated with methyl bromide and chloropicrin (MC-98-2) at 350 lbs/bedded acre and immediately mulched with black polyethylene. Plant holes were punched on 14 Oct. 1991, and 'Oso Grande' and 'Selva' plants from the Ghesquiere Nursery of Simcoe Canada were set the same day in all plots. Plants were spaced 11 inches apart with 22 plants/plot and 5 replicates. Overhead sprinkler irrigation was applied from 4 to 8 hrs/day for 12 days to establish the plants. All treatments except Treatment 1 received liquid fertilizer starting on 20 Nov., 1991. Treatment 1 received liquid fertilizer on 20 Oct. The data for NPK rate/acre/day are in Table 1. After plant establishment, only drip irrigation was provided except for 21 and 27 Jan., 1992 when overhead sprinkler irrigation was provided for freeze protection for a total of 12 hours. The N and K concentrations of the plant petiole sap were taken on 11 Mar. and 12 Apr., 1992. In addition, the most recently mature leaves were taken for N and K analyses on 22 Jan. and 15 Apr., 1992. 'Selva' fruit were harvested from Nov. 1991 through Apr. 1992 while 'Oso Grande' were harvested from Dec. 1991 through Apr. 1992. Fruit were harvested, graded, counted, and weighed twice weekly during the season. Plants were evaluated several times visually during the season for plant size and color.

Results

Marketable fruit yields were significantly affected by fertilizer treatments in Mar., Apr. and for the season (Table 2). With either clone, the lowest yields were with Treatment 1. Treatment 1 yields with the 'Selva' clone were also lower in Jan. and Feb. (but not significantly so). Treatment 3 yields for both clones in Mar. and Apr. were reduced but not as severely as Treatment 1. Seasonal fruit yields of Treatment 4 with 'Selva' and Treatment 3 with 'Oso Grande' were not significantly different from all other treatments. 'Oso Grande' fruit weight was always greater than that of 'Selva' (Table 3). Treatment 1 provided the lowest average fruit weight for the season. The average fruit weight of 'Selva' for Treatment 5 was high all season as was the fruit of Treatment 4 of 'Oso Grande'. There were no significant treatment × clone interactions for fruit weight.

The percent of all harvested fruit which were marketable (percent marketable fruit) of 'Oso Grande' was always greater than that of 'Selva' (Table 3). For the season, Treatment 5 had the highest and Treatment 1 the lowest percent marketable fruit.

Table 1. Granular and liquid fertilizer applied to various treatments.

	Fertilizer source									
	Granular lbs/acre			Liquid lbs/acre/day			Time period liquid fertilizer	Total applied (lbs/acre)		
Treatment	N	P	K	N	P	K	applied (days)	N	P	K
1	0	0	0	1	0.13	1.46	193	193	25	282
2	50	6.5	41.5	0.9	0.12	1.29	162	196	26	250
3	100	13	83	0.6	0.08	0.88	162	197	26	226
4	150	18.5	124.5	0.3	0.04	0.44	162	199	25	196
5[z]	60	23	50	0.84	0.11	1.23	162	196	41	249

[z]Granular N, P, and K fertilizer sources for treatment 5 were NH_4NO_3, sulfur coated urea, triple super phosphate, and KCl. All other treatments received the 16-2.1-13.3 granular fertilizer.

Table 2. Main effects of fertilizer treatments and cultivars on monthly and total fruit yield for 1991-92 season.

	Combined Marketable Fruit Yield (lbs/acre)						
Treatments	Nov.[z]	Dec.	Jan.	Feb.	Mar.	April	Seasonal
Fertilizer treatment[y]							
1	118	2632	5377	7051	9006c	5732b	29914b
2	251	2235	6009	7487	10140ab	7368a	33490a
3	243	2703	6094	8103	9434bc	6262ab	32839ab
4	133	2593	5848	7401	10795a	6077ab	33645a
5	93	2405	6556	7280	10306ab	7415a	33554a
Cultivar[x]							
Oso Grande	0	3006	6575	9438	13289	10091	42349
Selva	167	2019	5178	5490	6582	3430	22866
		*	*	*	*	*	*

[z]November yield for Selva only.
[y]Mean separation of fertilizer treatment by Duncan's multiple range test, 5% level.
[x]Cultivars were significantly different by the F test, 5% level (*).

Table 3. Seasonal average fruit weight, percent marketable fruit, and total cull fruit as affected by main effects of fertilizer treatment and cultivars.

Treatment	Seasonal average fruit weight (g/fruit)	Marketable fruit (%)	Total cull fruit lbs/acre Selva	Total cull fruit lbs/acre Oso Grande
Fertilizer treatment[z]				
1	14.1 b	69.1 b	15937 a	8556 a
2	14.3 ab	72.0 b	15166 a	8103 a
3	14.5 a	71.7 b	15465 a	8527 a
4	14.6 a	72.2 ab	15414 a	8467 a
5	14.6 a	74.0 a	13470 b	8134 a
Cultivars[y]				
Selva	12.09	60.11	15090	
Oso Grande	16.70	83.49	8338	
	*	*	*	

[z]Mean separation of fertilizer treatment by Duncan's multiple range test, 5% level.
[y]Cultivars were significantly different by the F test, 5% level (*).

Table 4. Main effects of leaf N and K concentrations on two dates as affected by fertilizer treatments and two cultivars.

Treatments	Leaf N and K (%) 22 January 1992 N	22 January 1992 K	15 April 1992 N	15 April 1992 K
Fertilizer treatment[z]				
1	2.85 a	1.75 a	2.38	2.06 a
2	2.87 a	1.75 a	2.38	2.03 a
3	2.86 a	1.69 b	2.37	1.90 ab
4	2.88 a	1.65 bc	2.37	1.51 c
5	2.88 a	1.61 c	2.31	1.70 b
	*	*	*	*
Cultivars[y]				
Selva	2.88	1.70	2.39	1.82
Oso Grande	2.85	1.68	2.34	1.84
	*	*	*	*

[z]Mean separation of fertilizer treatment by Duncan's multiple range test, 5% level.
[y]Cultivars were significantly different by the F test, 5% level (*).

'Selva' produced nearly twice the weight of cull fruit as that produced by 'Oso Grande' (Table 3). This greatly reduced the marketable yield of 'Selva' compared to 'Oso Grande'. Treatment 5 of 'Selva' gave lower cull fruit yield and higher percent marketable fruit than other 'Selva' treatments. This trait occurred throughout most of the season. This did not result in higher marketable yields than Treatments 2, 3, and 4. Most of the fruit of 'Selva' were cull because of small size. 'Oso Grande' had many small fruit, but fruit rot and misshapen fruit were also a factor (data not presented).

Treatments 1 and 2 had somewhat higher N and K concentrations in the petiole sap on 11 Mar. and 15 Apr., 1992

Table 5. Main effects of petiole sap N and K concentrations on two dates as affected by fertilizer treatments and two cultivars.

Treatments	Petiole N & K (PPM) 11 March 1992 N	11 March 1992 K	15 April 1992 N	15 April 1992 K
Fertilizer treatments[z]				
1	276 a	2220 ab	275 a	1860 a
2	297 a	2290 a	269 ab	1790 a
3	232 b	2100 abc	229 bc	1700 ab
4	235 b	1940 bc	178 d	1470 b
5	174 c	1820 c	214 cd	1690 ab
	*	*	*	*
Cultivar[y]				
Selva	280	2216	266	1764
Oso Grande	205	1932	200	1640
	*		*	

[z]Mean separation of fertilizer treatment by Duncan's multiple range test, 5% level.
[y]Cultivars were significantly different by the F test, 5% level (*).

(Table 4). Treatments 4 and 5 had somewhat lower N and K levels on the same dates. The data of 22 Jan. and 15 Apr., 1992 sampling dates (Table 5) indicates no difference in leaf N concentrations because of treatments. Treatments 1 and 2 had the highest leaf K concentrations. However, all K levels were more than adequate. Plant size and color varied only slightly among treatments during the season.

The reduction in marketable fruit weight, percent marketable fruit, and perhaps marketable fruit yield may be related to the rate of K applied. In addition, the granular source of K used in treatment 5 may have been less available to the plant than the granular source of K used in other treatments. Note the differences in leaf and petiole K concentrations for treatments 2 and 5 in Tables 4 and 5. These 2 treatments had similar total amounts of K applied. However, the K source had no affect on marketable fruit yields for these 2 treatments. The K concentrations in the leaf were always above the critical levels (Ulrich et al., 1980).

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