



**Center for Applied Horticultural Research  
Research Report**

**By Lucia Villavicencio  
CfAHR Executive Director**

**Prepared for: Encina Water Authority**

**Project title:** Use of PureGreen pellets as fertilizer for ornamental plant production.

**Objectives:**

- Compare a granular human waste-derived fertilizer to a commercial slow release fertilizer, liquid fertilizer, and combinations of the various products for commercial nursery production of ornamental plant species.

**Materials and Methods**

**Experiment 1:**

*Rosa* 'Iceberg' liners were obtained from a commercial source and planted on July 3, 2013 into 1-gallon (2.37 L) containers filled with a custom made substrate composed of 78% peat and 22% perlite. The mix was amended with 3 lbs per cubic yard of a product containing calcium carbonate and dolomite. It also contained a starter nutrient charge of 0.5 lb per cubic yard each potassium nitrate, ferrous sulfate, calcium nitrate, micronutrient complex, triple super phosphate, and 1 lb. of a surfactant. All plants were placed in benches in an outdoor location under natural light and temperature conditions

**Treatments:**

1. Control: 7 g per container of Nutricote 13-13-13.
2. PureGreen pellets: 32 g per plant (twice the amount required to supply 0.9 g N supplied by the slow release fertilizer).
3. PureGreen pellets plus slow release fertilizer: 3.5 g 13-13-13 plus 16 g PureGreen pellets per plant.
4. Liquid feed: 200 mL of a solution containing 150 ppm N Peters® Excel Cal-Mag Special 15-5-15 water soluble fertilizer once a week.
5. PureGreen pellets plus liquid feed: 200 mL of a solution containing 75 ppm N Peters® Excel Cal-Mag Special 15-5-15 water soluble fertilizer once a week plus 16 g PureGreen pellets per plant.

Solid fertilizers were incorporated in the substrate by placing the substrate required to fill each container in a Ziploc bag along with the fertilizer and mixing well.

**Variables evaluated:**

1. Growth index measured at the beginning and at the end of the trial based on measurements of height and diameter in two directions according to the formula  $GI = (H + (D1 + D2) / 2) / 2$ .
2. Leaf color (chlorophyll content) measured every two weeks using a SPAD 502 Minolta chlorophyll meter.
3. Electric conductivity (EC), pH, and nitrate in leachate measured every two weeks. Nitrate was measured with a Horiba NO<sub>3</sub> twin meter and expressed as parts per million (ppm). Nitrate concentration in milligrams contained in the total volume of leachate collected from each plant was calculated using the concentration in ppm and the recorded leachate volume collected in a graduated cylinder.
4. Nutrient content. Leaf samples consisting of 30 fully extended leaves per treatment were collected 2 weeks before and 2 weeks after the plants reached market quality and sent to an external laboratory for nutrient content determination.
5. Plant quality measured once plants reached market size 8 weeks after transplant (WAT) on a scale of 1 (not salable) to 5 (excellent quality).
6. Number of flowers and flower buds 8 WAT.

7. Root distribution on a scale of 1 (25% or less volume occupied by roots) to 4 (75-100% of the volume occupied by roots) 8 WAT.
8. Shoot and root fresh and dry weight at the end of the trial (10 WAT).

### Experiment 2:

Hibiscus (*Hibiscus rosa-sinensis*) 'San Diego', New Guinea impatiens (*Impatiens hawkeri*) 'Appleblossom', red fountain grass (*Penisetum rubrum*), and red leaf banana (*Ensete ventricosum*) 'Maurelii' liners were obtained from a commercial source and transplanted on July 24<sup>th</sup>, 2013 to 1-gallon containers filled with a custom made substrate as described for experiment 1. Hibiscus and fountain grass were grown in an outdoor location under natural temperature and full sun conditions. Banana and New Guinea impatiens were grown in a Quonset hut under 50% shade and natural temperature conditions. All plants reached market size 8 WAT.

### Treatments:

1. Control: 7 g Nutricote 13-13-13 per plant
2. PureGreen pellets: 32 g per plant
3. PureGreen pellets plus slow release fertilizer: 3.5 g 13-13-13 plus 16 g PureGreen pellets per plant.

Fertilizers were incorporated as described for experiment 1.

### Variables evaluated:

1. Growth index at the beginning and at the end of the trial based on measurements of height and diameter in two directions according to the formula  $GI = (H + (D1 + D2) / 2) / 2$ .
2. Leaf color (chlorophyll content): measured every two weeks using a SPAD 502 Minolta chlorophyll meter.
3. EC and pH in leachate measured one week after transplant and at the end of the trial (8 WAT).
4. Quality at market size on a scale of 1(not salable) to 5 (excellent quality) 8 WAT.

**Experimental Design, Sampling and Data Analysis:** Plants were arranged in a completely randomized design with 10 replicates per treatment for experiment 1 and 12 replicates per treatment for experiment 2. To satisfy the assumptions of the analysis of variance, a logarithmic transformation was applied to the variables root distribution, plant quality, number of flowers, and number of flower buds. Data was analyzed using JMP version 9.0 (SAS Institute, Inc. Cary, NC). Following a significant treatment effect, means were separated by Student's t-test ( $\alpha=0.05$ ).

## Results

### Experiment 1:

A comparison of nutrient content of all fertilizers used in this trial can be found in Appendix 1. Data are summarized in Tables 1-3. Roses receiving PureGreen pellets, and pellets with either Nutricote or liquid fertilizer (15-5-15) had higher growth index and more flowers buds than roses receiving Nutricote or liquid fertilizer only. Similarly, plants receiving PureGreen pellets also had a higher root distribution rating than the rest of the treatment. All plants had a similar number of flowers and quality rating, as well as similar root fresh and dry weight; however, shoot fresh and dry weight was lower in plants receiving liquid fertilizer compared to the rest treatments (Table 2).

Nutrient analyses of the plants were conducted 2 weeks before the plants reached market quality (6 WAT) and 2 weeks after the plants reached market quality, immediately before taking fresh and dry shoot and root weight (10 WAT). The first analysis showed that all plants had high levels of phosphorus. Nitrogen, calcium, magnesium, copper, and zinc content was normal in all treatments. Potassium was low in plants receiving a combination of PureGreen pellets and Nutricote. Iron concentration was high in plants receiving 15-5-15, PureGreen pellets plus 15-5-15, and Nutricote, and it was normal for plants receiving PureGreen pellets plus Nutricote, and PureGreen pellets only. Boron was high in all treatments with the exception of plants receiving Nutricote. Tissue analysis of samples taken 2 weeks after plants reached market quality revealed low nitrogen, phosphorus, and potassium content in all treatments with the exception of plants fertilized with PureGreen pellets, which had normal phosphorus content in leaf tissue. Calcium, magnesium, iron, and boron were high for all treatments. The exception was magnesium, which was normal for plants that received liquid fertilizer; however, zinc concentration for this treatment was low. Copper, zinc, and manganese were found at normal concentration for all treatments, with the exception of zinc for liquid fertilizer as previously noted (see appendix section).

Chlorophyll content measured with a SPAD meter varied throughout the study. In general, plants receiving liquid fertilizer had lower chlorophyll content than the rest of the plants. Regarding pH, it also varied throughout the study; these variations were significant at times, however, the fluctuations were minimal. For example, 8 WAT

substrate pH of the group fertilized with PureGreen pellets was significantly lower than the pH of the group receiving Nutricote, but the pH values of each group were 6.7 and 6.8 respectively. Such small variations are not likely to have an effect on plant growth. The EC, which is a measure of nutrient availability, was consistently higher in leachate collected from the PureGreen treatment than it was for the rest of the treatments up to 4 WAT. The PureGreen treatment and PureGreen with either liquid or slow release fertilizer continued to result in higher EC than Nutricote and 15-5-15 at 6 and 8 WAT. The nitrate content measured in leachate progressively decreased with WAT due to utilization by the plants; however, there were variations among treatments. Nitrate concentration was lower in the PureGreen pellets group up to 2 WAT, this indicates a slower rate of release from the material; however, nitrate concentration was highest in the PureGreen treatment 6 WAT. A combination of PureGreen and 15-5-15 resulted in the lowest nitrate concentration in leachate 8 WAT, the rest of the treatments had similar levels of nitrate (Table 3).

Rose plant appearance between and among treatments can be seen in Figure 1 A-D.

### **Experiment 2:**

The data shows some variation of the effect of PureGreen pellets depending on species. In general terms, the material resulted in plants that were similar in size and quality to those receiving Nutricote 13-13-13 and a combination of both types of fertilizer.

Hibiscus (Tables 4 and 5), Impatiens (Tables 6 and 7), and Penisetum (Tables 8 and 9) plants grew well regardless of treatments. All plants had similar height, growth index, market quality, number of flowers and flower buds, and chlorophyll content.

Regarding banana plants, since the plants were significantly different in size at the beginning of the trial, the differential growth index was calculated at the end of the trial by subtracting the initial growth index taken immediately after transplant from the final growth index taken 8 WAT. Statistical analysis of the differential growth index shows that bananas fertilized with PureGreen pellets grew at a slower rate than plants fertilized with Nutricote or a combination of PureGreen pellets and Nutricote. Plants fertilized with PureGreen pellets also had slightly lower market quality than the rest of the treatments. *Ensete ventricosum* belongs to the banana family (Musaceae). Bananas require high levels of potassium in the soil to grow adequately; the low potassium content of PureGreen pellets could be the reason for the lower size and plant quality observed. The chlorophyll content of banana plants fertilized with PureGreen pellets was lower than for the rest of the treatments but only at 4 WAT. Chlorophyll content measured at 2, 6, and 8 WAT was similar in all plants (Tables 10 and 11).

Regarding pH and EC, There were slight variations in pH and EC values for fountain grass, impatiens, and bananas. Plants fertilized with PureGreen pellets had lower substrate pH and higher EC (fertility) than the rest of the treatments 8 WAT (Tables 5, 7, 9, and 11).

Plant appearance between and among treatments can be seen in Figures 2-5.

### **Conclusion**

Based on the results of these trials PureGreen pellets or a combination of PureGreen pellets and either slow release or liquid fertilizer can be successfully used in ornamental plant production. Plants will require higher amounts of PureGreen pellets than they would of slow release or liquid fertilizer due to the slower nutrient release rate of PureGreen pellets and supplementation with potassium should be considered in plants that are highly susceptible to potassium deficiency. In this study, fertilization with PureGreen pellets resulted in plant growth that was comparable to that obtained when plants were fertilized with slow release or liquid fertilizer, quality, with the exception of slight variations on banana plants, was similar across all plants<sup>1</sup>.

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<sup>1</sup> The information on this report is not presented as recommendations, but rather as research-based knowledge intended to help clientele make informed decisions. Neither the author nor the Center for Applied Horticultural Research assume liability for pesticide-related information or pesticide use. Pesticide applicators are responsible for reading and following all directions on the pesticide label; the label is the law. Because state and local regulations vary and change over time, it is the responsibility of the applicator to verify the registration status of any pesticide and to insure that the material is cleared for the intended use prior to application. It is unlawful to use any pesticide in any manner other than the registered use. The use of company or commercial product trade names is for the benefit of the reader and does not indicate or imply endorsement, nor does it indicate discrimination against comparable materials that are not mentioned.

Table 1. Mean  $\pm$  SE height (cm), diameter in two directions (cm), growth index (GI), market quality, number of flowers, number of flower buds, and root distribution of *Rosa* 'Iceberg' plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	Height	Diameter 1	Diameter 2	GI	Quality	# Flowers	# Flower Buds	Root Distribution
0	Nutricote 13-13-13 (7g)	17.5 $\pm$ 0.7	17.6 $\pm$ 0.8	13.5 $\pm$ 0.7	16.5 $\pm$ 0.6	4.4 $\pm$ 0.1	N/A	N/A	N/A
	Peters 15-5-15 (150ppm N)	17.3 $\pm$ 0.7	17.0 $\pm$ 0.8	12.1 $\pm$ 0.7	15.9 $\pm$ 0.5	4.5 $\pm$ 0.1	N/A	N/A	N/A
	PureGreen (32g)	16.8 $\pm$ 0.8	15.6 $\pm$ 1.0	13.0 $\pm$ 0.8	15.6 $\pm$ 0.7	4.5 $\pm$ 0.1	N/A	N/A	N/A
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	18.8 $\pm$ 0.5	16.6 $\pm$ 0.8	13.4 $\pm$ 0.9	16.9 $\pm$ 0.4	4.5 $\pm$ 0.1	N/A	N/A	N/A
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	17.1 $\pm$ 0.7	15.6 $\pm$ 0.7	12.0 $\pm$ 0.8	15.4 $\pm$ 0.4	4.5 $\pm$ 0.2	N/A	N/A	N/A
	P-value	0.3	0.3	0.6	0.2	1.0			
8	Nutricote 13-13-13 (7g)	31.2 $\pm$ 2.1 c	50.3 $\pm$ 2.6 a	37.9 $\pm$ 1.8	37.6 $\pm$ 1.4 bc	4.1 $\pm$ 0.1	6.4 $\pm$ 0.6	6.8 $\pm$ 0.8 b	3.2 $\pm$ 0.1 b
	Peters 15-5-15 (150ppm N)	33.3 $\pm$ 1.4 bc	43.2 $\pm$ 2.5 b	33.9 $\pm$ 1.9	35.9 $\pm$ 1.3 c	4.2 $\pm$ 0.2	5.6 $\pm$ 0.5	4.0 $\pm$ 0.9 c	3.1 $\pm$ 0.1 bc
	PureGreen (32g)	38.0 $\pm$ 1.5 a	50.4 $\pm$ 2.6 a	38.5 $\pm$ 1.9	41.2 $\pm$ 1.1 a	4.2 $\pm$ 0.1	4.9 $\pm$ 0.4	10.2 $\pm$ 0.8 a	3.5 $\pm$ 0.1 a
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	33.2 $\pm$ 1.6 bc	52.0 $\pm$ 1.7 a	41.1 $\pm$ 1.9	39.8 $\pm$ 1.3 ab	4.1 $\pm$ 0.1	6.2 $\pm$ 0.7	9.5 $\pm$ 1.0 ab	3.0 $\pm$ 0.0 bc
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	37.7 $\pm$ 1.4 ab	54.2 $\pm$ 2.0 a	36.2 $\pm$ 1.5	41.4 $\pm$ 1.1 a	4.2 $\pm$ 0.1	6.2 $\pm$ 0.6	8.0 $\pm$ 0.6 ab	2.9 $\pm$ 0.1 c
	P-value	0.01	0.02	0.09	0.009	0.92	0.4	<0.0001	0.002

Table 2. Mean  $\pm$  SE shoot and root fresh (SFW, RFW) and dry weight (SDW, RDW) of *Rosa* 'Iceberg' plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SFW	SDW	RFW	RDW
10	Nutricote 13-13-13 (7g)	70.7 $\pm$ 2.9 a	27.6 $\pm$ 1.6 a	22.6 $\pm$ 2.1	4.4 $\pm$ 0.5
	Peters 15-5-15 (150ppm N)	56.6 $\pm$ 3.0 c	21.3 $\pm$ 1.2 c	19.9 $\pm$ 1.4	4.9 $\pm$ 0.4
	PureGreen (32g)	67.4 $\pm$ 2.2 ab	25.1 $\pm$ 1.0 ab	18.9 $\pm$ 1.5	3.5 $\pm$ 0.3
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	70.0 $\pm$ 1.9 ab	26.4 $\pm$ 0.8 ab	23.4 $\pm$ 1.3	4.1 $\pm$ 0.3
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	63.2 $\pm$ 2.5 bc	23.9 $\pm$ 1.0 bc	18.8 $\pm$ 0.9	4.0 $\pm$ 0.3
	P-value	0.001	0.002	0.09	0.09

Table 3. Mean  $\pm$  SE leaf chlorophyll content (SPAD units), substrate pH, electric conductivity (EC , millisiems), Nitrate in leachate, and nitrate concentration in total leachate volume of *Rosa* 'Iceberg' plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SPAD units	pH	EC (mS)	Nitrate (ppm)	Nitrate (mg)
0	Nutricote 13-13-13 (7g)	39.8 $\pm$ 1.3 ab	6.8 $\pm$ 0.1 a	2.3 $\pm$ 0.1 b	69.5 $\pm$ 6.7 b	8.5 $\pm$ 1.1 a
	Peters 15-5-15 (150ppm N)	33.6 $\pm$ 1.6 c	6.9 $\pm$ 0.0 a	2.4 $\pm$ 0.2 b	85.5 $\pm$ 4.8 a	8.2 $\pm$ 0.9 a
	PureGreen (32g)	41.0 $\pm$ 1.1 a	6.7 $\pm$ 0.1 b	3.1 $\pm$ 0.2 a	74.8 $\pm$ 3.2 ab	8.3 $\pm$ 1.0 a
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	38.4 $\pm$ 1.0 ab	6.6 $\pm$ 0.0 b	3.3 $\pm$ 0.2 a	85.5 $\pm$ 5.3 a	8.5 $\pm$ 0.6 a
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	36.5 $\pm$ 1.4 bc	6.8 $\pm$ 0.0 a	2.5 $\pm$ 0.2 b	70.6 $\pm$ 3.5 ab	4.4 $\pm$ 0.5 b
	P-value	0.001	0.004	0.0004	0.04	0.005
2	Nutricote 13-13-13 (7g)	34.7 $\pm$ 1.7	6.0 $\pm$ 0.0 cd	2.8 $\pm$ 0.3 b	518.5 $\pm$ 57.8 a	103.3 $\pm$ 18.9 a
	Peters 15-5-15 (150ppm N)	37.7 $\pm$ 1.4	5.9 $\pm$ 0.0 d	2.0 $\pm$ 0.1 c	351.5 $\pm$ 25.1 b	50.6 $\pm$ 7.0 b
	PureGreen (32g)	36.1 $\pm$ 1.5	6.7 $\pm$ 0.0 a	3.7 $\pm$ 0.3 a	155.4 $\pm$ 11.3 d	21.6 $\pm$ 6.1 d
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	36.1 $\pm$ 1.7	6.5 $\pm$ 0.0 ab	3.0 $\pm$ 0.3 b	254.1 $\pm$ 30.2 c	33.2 $\pm$ 5.3 c
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	38.3 $\pm$ 1.6	6.2 $\pm$ 0.2 bc	2.6 $\pm$ 0.1 bc	205.4 $\pm$ 17.3 cd	34.6 $\pm$ 3.4 bc
	P-value	0.5	<0.0001	<0.0001	<0.0001	<0.0001
4	Nutricote 13-13-13 (7g)	45.9 $\pm$ 1.1 a	6.2 $\pm$ 0.1 c	2.1 $\pm$ 0.3 c	342.9 $\pm$ 62.7 a	31.7 $\pm$ 11.4 c
	Peters 15-5-15 (150ppm N)	40.9 $\pm$ 1.2 b	6.4 $\pm$ 0.0 a	1.9 $\pm$ 0.1 c	250.8 $\pm$ 24.6 ab	24.6 $\pm$ 4.3 bc
	PureGreen (32g)	47.0 $\pm$ 1.1 a	6.4 $\pm$ 0.0 a	3.9 $\pm$ 0.3 a	334.6 $\pm$ 24.9 a	40.4 $\pm$ 5.1 ab
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	45.6 $\pm$ 0.8 a	6.3 $\pm$ 0.0 bc	3.1 $\pm$ 0.3 b	340.8 $\pm$ 26.0 a	41.8 $\pm$ 5.8 a
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	45.8 $\pm$ 0.8 a	6.4 $\pm$ 0.0 a	2.1 $\pm$ 0.1 c	186.2 $\pm$ 14.0 b	17.7 $\pm$ 3.0 c
	P-value	0.0008	0.001	<0.0001	0.005	0.01
6	Nutricote 13-13-13 (7g)	43.2 $\pm$ 2.0	6.4 $\pm$ 0.1 b	2.5 $\pm$ 0.2 bc	57.3 $\pm$ 5.6 b	4.4 $\pm$ 0.6 b
	Peters 15-5-15 (150ppm N)	40.0 $\pm$ 1.6	6.6 $\pm$ 0.0 a	2.0 $\pm$ 0.2 c	38.5 $\pm$ 2.4 cd	4.1 $\pm$ 0.3 b
	PureGreen (32g)	40.5 $\pm$ 1.9	6.4 $\pm$ 0.0 b	3.3 $\pm$ 0.3 a	119.9 $\pm$ 19.6 a	13.8 $\pm$ 2.6 a
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	43.6 $\pm$ 1.7	6.4 $\pm$ 0.0 b	3.2 $\pm$ 0.4 ab	56.9 $\pm$ 8.6 bc	4.5 $\pm$ 1.1 b
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	43.5 $\pm$ 1.7	6.4 $\pm$ 0.0 b	2.6 $\pm$ 0.2 abc	38.2 $\pm$ 4.9 d	3.0 $\pm$ 0.6 b
	P-value	0.4	<0.0001	0.004	<0.0001	<0.0001
8	Nutricote 13-13-13 (7g)	39.8 $\pm$ 1.3 ab	6.8 $\pm$ 0.1 a	2.3 $\pm$ 0.1 c	42.2 $\pm$ 1.8	5.9 $\pm$ 0.9 a
	Peters 15-5-15 (150ppm N)	33.6 $\pm$ 1.6 c	6.9 $\pm$ 0.0 a	2.4 $\pm$ 0.2 c	43.8 $\pm$ 3.0	4.0 $\pm$ 0.4 a
	PureGreen (32g)	41.0 $\pm$ 1.1 a	6.7 $\pm$ 0.1 b	3.0 $\pm$ 0.2 ab	40.2 $\pm$ 3.4	4.6 $\pm$ 0.7 a
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	38.4 $\pm$ 1.0 ab	6.6 $\pm$ 0.0 b	3.3 $\pm$ 0.2 a	43.1 $\pm$ 3.0	4.2 $\pm$ 0.3 a
	PureGreen (16g)+Peters 15-5-15 (75ppm N)	36.5 $\pm$ 1.4 bc	6.8 $\pm$ 0.0 a	2.5 $\pm$ 0.2 bc	39.8 $\pm$ 3.6	2.7 $\pm$ 0.4 b
	P-value	0.001	0.004	0.0003	0.8	0.05

Table 4. Mean  $\pm$  SE height (cm), diameter in two directions (cm), growth index (GI), market quality, number of flowers, and number of flower buds of Hibiscus ‘San Diego’ plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	Height	Diameter 1	Diameter 2	GI	Quality	# Flowers	# Flower buds
0	Nutricote13-13-13 (7g)	15.0 $\pm$ 0.8 a	16.1 $\pm$ 1.4	12.9 $\pm$ 1.2	14.7 $\pm$ 0.7 a	4.6 $\pm$ 0.1	N/A	N/A
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	12.5 $\pm$ 0.7 b	13.4 $\pm$ 0.9	11.8 $\pm$ 1.1	12.5 $\pm$ 0.5 b	4.5 $\pm$ 0.0	N/A	N/A
	PureGreen (32g)	15.0 $\pm$ 0.8 a	15.0 $\pm$ 0.9	14.3 $\pm$ 1.0	14.8 $\pm$ 0.7 a	4.5 $\pm$ 0.1	N/A	N/A
	P-value	0.04	0.2	0.3	0.02	0.3	N/A	N/A
8	Nutricote13-13-13 (7g)	39.3 $\pm$ 1.0	39.2 $\pm$ 1.0	31.0 $\pm$ 1.2 ab	37.2 $\pm$ 0.7	4.4 $\pm$ 0.1	0.3 $\pm$ 0.2	10.1 $\pm$ 1.1
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	35.1 $\pm$ 1.5	38.5 $\pm$ 1.5	29.1 $\pm$ 1.9 b	34.5 $\pm$ 1.1	4.7 $\pm$ 0.1	0.1 $\pm$ 0.1	7.9 $\pm$ 1.2
	PureGreen (32g)	35.9 $\pm$ 1.3	39.8 $\pm$ 1.8	34.6 $\pm$ 1.3 a	36.6 $\pm$ 0.9	4.7 $\pm$ 0.1	0.0 $\pm$ 0.0	9.3 $\pm$ 0.9
	P-value	0.1	0.8	0.04	0.1	0.2	0.3	0.3

Table 5. Mean  $\pm$  SE chlorophyll content (SPAD units, left), and pH and EC (right) of Hibiscus ‘San Diego’ plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SPAD units
2	Nutricote13-13-13 (7g)	54.8 $\pm$ 1.8
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	49.3 $\pm$ 1.8
	PureGreen (32g)	52.5 $\pm$ 1.8
	P-value	0.1
4	Nutricote13-13-13 (7g)	72.8 $\pm$ 1.3
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	70.4 $\pm$ 1.8
	PureGreen (32g)	67.9 $\pm$ 1.9
	P-value	0.1
6	Nutricote13-13-13 (7g)	61.1 $\pm$ 2.1
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	61.4 $\pm$ 2.2
	PureGreen (32g)	68.1 $\pm$ 2.9
	P-value	0.1
8	Nutricote13-13-13 (7g)	72.1 $\pm$ 1.8
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	69.9 $\pm$ 2.0
	PureGreen (32g)	71.2 $\pm$ 2.2
	P-value	0.7

WAP	Treatment	pH	EC (mS)
1	Nutricote13-13-13 (7g)	5.6 $\pm$ 0.0 b	2.8 $\pm$ 0.2 ab
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.6 $\pm$ 0.1 a	2.5 $\pm$ 0.1 b
	PureGreen (32g)	6.5 $\pm$ 0.1 a	3.0 $\pm$ 0.1 a
	P-value	<0.0001	0.02
8	Nutricote13-13-13 (7g)	6.0 $\pm$ 0.1	1.8 $\pm$ 0.1
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.1 $\pm$ 0.1	2.0 $\pm$ 0.1
	PureGreen (32g)	5.9 $\pm$ 0.1	2.2 $\pm$ 0.3
	P-value	0.1	0.3

Table 6. Mean  $\pm$  SE height (cm), diameter in two directions (cm), growth index (GI), growth index differential, market quality, number of flowers, and number of flower buds of New Guinea impatiens 'Appleblossom' plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	Height	Diameter 1	Diameter 2	GI	GI Differential	Quality	# Flowers	# Flower buds
0	Nutricote13-13-13 (7g)	4.8 $\pm$ 0.3	13.7 $\pm$ 0.3 a	13.3 $\pm$ 0.4 a	9.1 $\pm$ 0.1 a	N/A	4.6 $\pm$ 0.1	N/A	N/A
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	4.1 $\pm$ 0.3	12.4 $\pm$ 0.5 b	11.1 $\pm$ 0.7 b	7.9 $\pm$ 0.3 b	N/A	4.5 $\pm$ 0.1	N/A	N/A
	PureGreen (32g)	4.6 $\pm$ 0.3	13.6 $\pm$ 0.3 a	13.2 $\pm$ 0.4 a	9.0 $\pm$ 0.2 a	N/A	4.5 $\pm$ 0.1	N/A	N/A
	P-value	0.2	0.03	0.01	0.0004	N/A	0.5	N/A	N/A
8	Nutricote13-13-13 (7g)	13.0 $\pm$ 0.3	24.7 $\pm$ 0.8	21.4 $\pm$ 0.8	18.0 $\pm$ 0.4	8.9 $\pm$ 0.4	4.6 $\pm$ 0.1	4.8 $\pm$ 0.9	21.8 $\pm$ 2.8
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	13.7 $\pm$ 0.3	24.7 $\pm$ 0.7	21.9 $\pm$ 0.6	18.5 $\pm$ 0.4	10.5 $\pm$ 0.5	4.5 $\pm$ 0.1	4.2 $\pm$ 0.7	23.3 $\pm$ 2.6
	PureGreen (32g)	13.1 $\pm$ 0.6	27.6 $\pm$ 2.0	22.8 $\pm$ 1.0	19.2 $\pm$ 0.8	10.2 $\pm$ 0.8	4.1 $\pm$ 0.2	4.8 $\pm$ 0.7	23.0 $\pm$ 3.2
	P-value	0.5	0.2	0.5	0.4	0.2	0.1	0.8	0.9

Table 7. Mean  $\pm$  SE chlorophyll content (SPAD units, left), and pH and EC (right) of New Guinea impatiens 'Appleblossom' plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SPAD units	WAP	Treatment	pH	EC (mS)
2	Nutricote13-13-13 (7g)	50.9 $\pm$ 2.2	1	Nutricote13-13-13 (7g)	5.6 $\pm$ 0.0 c	2.7 $\pm$ 0.1 b
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	53.4 $\pm$ 1.0		PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.1 $\pm$ 0.0 b	2.2 $\pm$ 0.1 c
	PureGreen (32g)	54.2 $\pm$ 0.8		PureGreen (32g)	6.4 $\pm$ 0.0 a	3.3 $\pm$ 0.2 a
	P-value	0.3		P-value	<0.0001	<0.0001
4	Nutricote13-13-13 (7g)	71.6 $\pm$ 1.3	8	Nutricote13-13-13 (7g)	5.9 $\pm$ 0.1 a	2.1 $\pm$ 0.2 b
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	69.1 $\pm$ 1.2		PureGreen (16g)+Nutricote13-13-13 (3.5g)	5.3 $\pm$ 0.1 b	2.4 $\pm$ 0.1 b
	PureGreen (32g)	68.4 $\pm$ 1.4		PureGreen (32g)	5.2 $\pm$ 0.1 b	3.1 $\pm$ 0.3 a
	P-value	0.2		P-value	<0.0001	0.003
6	Nutricote13-13-13 (7g)	67.1 $\pm$ 1.8				
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	62.6 $\pm$ 1.3				
	PureGreen (32g)	64.0 $\pm$ 1.9				
	P-value	0.2				
8	Nutricote13-13-13 (7g)	70.1 $\pm$ 0.9				
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	69.0 $\pm$ 1.7				
	PureGreen (32g)	70.9 $\pm$ 1.9				
	P-value	0.7				

Table 8. Mean  $\pm$  SE height (cm), diameter in two directions (cm), growth index (GI), market quality, and number of inflorescences of red fountain grass plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	Height	Diameter 1	Diameter 2	GI	Quality	# Inflorescences
0	Nutricote13-13-13 (7g)	20.8 $\pm$ 1.2	17.8 $\pm$ 1.2	12.6 $\pm$ 1.1 ab	18.0 $\pm$ 0.5	4.5 $\pm$ 0.1	
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	18.9 $\pm$ 1.3	15.7 $\pm$ 1.2	10.4 $\pm$ 0.6 b	15.9 $\pm$ 0.7	4.6 $\pm$ 0.1	
	PureGreen (32g)	17.8 $\pm$ 1.1	16.7 $\pm$ 1.3	14.8 $\pm$ 0.7 a	16.8 $\pm$ 0.7	4.5 $\pm$ 0.1	
	P-value	0.2	0.5	0.004	0.1	0.4	
8	Nutricote13-13-13 (7g)	47.3 $\pm$ 2.3 a	58.1 $\pm$ 1.6	57.3 $\pm$ 2.0 b	52.5 $\pm$ 1.6	4.8 $\pm$ 0.1	2.8 $\pm$ 0.4
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	42.2 $\pm$ 1.7 ab	59.0 $\pm$ 2.2	55.7 $\pm$ 2.3 b	49.8 $\pm$ 1.8	4.5 $\pm$ 0.1	2.1 $\pm$ 0.3
	PureGreen (32g)	38.8 $\pm$ 2.5 b	63.7 $\pm$ 1.6	63.3 $\pm$ 1.6 a	51.1 $\pm$ 1.6	4.7 $\pm$ 0.2	1.9 $\pm$ 0.5
	P-value	0.03	0.1	0.03	0.5	0.3	0.1

Table 9. Mean  $\pm$  SE chlorophyll content (SPAD units, left) and pH and EC (right) of red fountain grass plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SPAD units	WAP	Treatment	pH	EC (mS)
2	Nutricote13-13-13 (7g)	27.6 $\pm$ 0.8	1	Nutricote13-13-13 (7g)	5.8 $\pm$ 0.0 b	2.9 $\pm$ 0.1
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	24.9 $\pm$ 1.3		PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.2 $\pm$ 0.0 a	2.7 $\pm$ 0.2
	PureGreen (32g)	24.9 $\pm$ 1.3		PureGreen (32g)	6.3 $\pm$ 0.1 a	3.1 $\pm$ 0.2
	P-value	0.2		P-value	<0.0001	0.2
4	Nutricote13-13-13 (7g)	41.4 $\pm$ 2.5	8	Nutricote13-13-13 (7g)	6.7 $\pm$ 0.0 a	1.7 $\pm$ 0.1 b
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	42.8 $\pm$ 2.0		PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.4 $\pm$ 0.1 b	2.4 $\pm$ 0.2 a
	PureGreen (32g)	45.2 $\pm$ 2.1		PureGreen (32g)	5.8 $\pm$ 0.1 c	2.7 $\pm$ 0.2 a
	P-value	0.5		P-value	<0.0001	0.002
6	Nutricote13-13-13 (7g)	32.4 $\pm$ 1.6				
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	32.4 $\pm$ 1.6				
	PureGreen (32g)	33.7 $\pm$ 1.6				
	P-value	0.8				
8	Nutricote13-13-13 (7g)	31.7 $\pm$ 0.7				
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	31.5 $\pm$ 0.9				
	PureGreen (32g)	30.0 $\pm$ 0.7				
	P-value	0.3				



Table 10. Mean  $\pm$  SE height (cm), diameter in two directions (cm), growth index (GI), and market quality of red leaf banana plants under several various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	Height	Diameter 1	Diameter 2	GI	Mean Quality	# Inflorescences
0	Nutricote13-13-13 (7g)	20.8 $\pm$ 1.2	17.8 $\pm$ 1.2	12.6 $\pm$ 1.1 ab	18.0 $\pm$ 0.5	4.5 $\pm$ 0.1	
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	18.9 $\pm$ 1.3	15.7 $\pm$ 1.2	10.4 $\pm$ 0.6 b	15.9 $\pm$ 0.7	4.6 $\pm$ 0.1	
	PureGreen (32g)	17.8 $\pm$ 1.1	16.7 $\pm$ 1.3	14.8 $\pm$ 0.7 a	16.8 $\pm$ 0.7	4.5 $\pm$ 0.1	
	P-value	0.2	0.5	0.004	0.1	0.4	
8	Nutricote13-13-13 (7g)	47.3 $\pm$ 2.3 a	58.1 $\pm$ 1.6	57.3 $\pm$ 2.0 b	52.5 $\pm$ 1.6	4.8 $\pm$ 0.1	2.8 $\pm$ 0.4
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	42.2 $\pm$ 1.7 ab	59.0 $\pm$ 2.2	55.7 $\pm$ 2.3 b	49.8 $\pm$ 1.8	4.5 $\pm$ 0.1	2.1 $\pm$ 0.3
	PureGreen (32g)	38.8 $\pm$ 2.5 b	63.7 $\pm$ 1.6	63.3 $\pm$ 1.6 a	51.1 $\pm$ 1.6	4.7 $\pm$ 0.2	1.9 $\pm$ 0.5
	P-value	0.03	0.1	0.03	0.5	0.3	0.1

Table 11. Mean  $\pm$  SE chlorophyll content (SPAD units, left) and pH and EC (right) of red leaf banana plants under various fertilizer regimes. Rows in columns followed by different letters are significantly different ( $\alpha=0.05$ ).

WAP	Treatment	SPAD units
2	Nutricote13-13-13 (7g)	41.0 $\pm$ 1.9
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	40.5 $\pm$ 1.7
	PureGreen (32g)	42.3 $\pm$ 2.2
	P-value	0.8
4	Nutricote13-13-13 (7g)	51.4 $\pm$ 0.9 a
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	51.8 $\pm$ 1.2 a
	PureGreen (32g)	45.8 $\pm$ 1.9 b
	P-value	0.007
6	Nutricote13-13-13 (7g)	50.5 $\pm$ 1.4
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	49.3 $\pm$ 1.8
	PureGreen (32g)	50.5 $\pm$ 1.7
	P-value	0.8
8	Nutricote13-13-13 (7g)	50.8 $\pm$ 1.2
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	47.9 $\pm$ 0.8
	PureGreen (32g)	48.2 $\pm$ 1.1
	P-value	0.1

WAP	Treatment	pH	EC (mS)
1	Nutricote13-13-13 (7g)	5.9 $\pm$ 0.0 c	2.3 $\pm$ 0.2 b
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.7 $\pm$ 0.0 a	2.7 $\pm$ 0.1 a
	PureGreen (32g)	6.3 $\pm$ 0.1 b	2.9 $\pm$ 0.1 a
	P-value	<0.0001	0.01
8	Nutricote13-13-13 (7g)	6.1 $\pm$ 0.1 b	2.0 $\pm$ 0.1 b
	PureGreen (16g)+Nutricote13-13-13 (3.5g)	6.3 $\pm$ 0.0 a	2.1 $\pm$ 0.1 b
	PureGreen (32g)	5.3 $\pm$ 0.1 c	3.3 $\pm$ 0.2 a
	P-value	<0.0001	<0.0001

Figure 1. Appearance of representative *Rosa* 'Iceberg' plants under different fertilization treatments.

A. Nutricote 13-13-13



B. Peter's 15-5-15



C. PureGreen pellets



Figure 1 (continued). Appearance of representative *Rosa* 'Iceberg' plants under different fertilization treatments.

D. PureGreen pellets plus Nutricote 13-13-13



E. PureGreen pellets plus 15-5-15



Figure 2. Appearance of representative Hibiscus 'San Diego' plants under different fertilization treatments.

A. Nutricote 13-13-13



B. PureGreen pellets



C. PureGreen pellets plus Nutricote 13-13-13



Figure 2 (continued). Appearance of representative Hibiscus 'San Diego' plants under different fertilization treatments.

D. Comparison of plants in each treatment group. Treatments were: Nutricote 13-13-13 (white label), PureGreen pellets (yellow label), and Nutricote 13-13-13 plus PureGreen pellets (orange label).



Figure 3. Appearance of representative New Guinea impatiens 'Appleblossom' plants under different fertilization treatments.

A. Nutricote 13-13-13



B. PureGreen pellets



C. PureGreen pellets plus Nutricote 13-13-13



Figure 3 (continued). Appearance of representative New Guinea impatiens 'Appleblossom' plants under different fertilization treatments.

D. Comparison of plants in each treatment group. Treatments were: Nutricote 13-13-13 (white label), PureGreen pellets (yellow label), and Nutricote 13-13-13 plus PureGreen pellets (orange label).



Figure 4. Appearance of representative red fountain grass plants under different fertilization treatments.

A. Nutricote 13-13-13



B. PureGreen pellets



C. PureGreen pellets plus Nutricote 13-13-13





Figure 4 (continued). Appearance of representative red fountain grass plants under different fertilization treatments.

D. Comparison of plants in each treatment group. Treatments were: Nutricote 13-13-13 (white label), PureGreen pellets (yellow label), and Nutricote 13-13-13 plus PureGreen pellets (orange label).



Figure 5. Appearance of representative red leaf banana plants under different fertilization treatments.  
A. Nutricote 13-13-13



B. PureGreen pellets



C. PureGreen pellets plus Nutricote 13-13-13



Figure 5 (continued). Appearance of representative red leaf banana plants under different fertilization treatments.

D. Comparison of plants in each treatment group. Treatments were: Nutricote 13-13-13 (white label), PureGreen pellets (yellow label), and Nutricote 13-13-13 plus PureGreen pellets (orange label).



## Appendices

Appendix 1. Nutrient content of Nutricote 13-13-13, PureGreen pellets, and Peter's 15-5-15 as percent, and amounts of nutrients in grams per treatment.

Element	Fertilizers (%)			Mineral content of each element per treatment (g)				
	13-13-13	PureGreen	15-5-15	Treatment 1 13-13-13 only	Treatment 2 Puregreen only	Treatment 3 Puregreen and 13-13-13	Treatment 4 150ppm 15- 15-15	Treatment 5 Puregreen and 75 ppm 15-5- 15
13-13-13				7	0	3.5	0	0
PureGreen				0	32	16	0	16
15-5-15				0	0	0	1.6	0.8
Nitrogen	13.00	5.75	15.00	0.91	1.84	1.38	0.24	1.04
Nitrate	6.50	5.50	11.60	0.46	1.76	1.11	0.19	0.97
NH4	6.50	0.25	1.40	0.46	0.08	0.27	0.02	0.05
Phosphate	13.00	6.89	5.00	0.91	2.20	1.56	0.08	1.14
Potash	13.00	0.18	15.00	0.91	0.06	0.48	0.24	0.15
Magnesium	1.20	0.48	1.80	0.08	0.15	0.12	0.03	0.09
Calcium	0.00	3.60	5.00	0.00	1.15	0.58	0.08	0.62
Boron	0.02	0.0025	0.02	0.0014	0.0008	0.0011	0.0003	0.0006
Copper total	0.05	0.04	0.015	0.0035	0.01	0.0069	0.0002	0.0071
Iron Total	0.20	3.03	0.12	0.014	0.97	0.48	0.00192	0.49
Manganese total	0.05	0.17	0.06	0.0035	0.0541	0.0270	0.0010	0.0275
Molybdenum	0.00	0.0009	0.01	0.00	0.0003	0.0001	0.0002	0.0002
Zinc Total	0.00	0.09	0.015	0.00	0.0283	0.0142	0.0002	0.0143



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Center for Applied Hort Research  
3742 Blue Bird Canyon  
Vista , CA 92084

Grower :

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P.O.

## PLANT MINERAL ANALYSIS

Sample Id - Plant Name Sample Description	N %	P %	K %	Ca %	Mg %	Na %	S %	Cu ppm	Zn ppm	Mn ppm	Fe ppm	B ppm	NO <sub>3</sub> -N	Lab No
ROSES BLUE	2.90	0.34	2.13	1.22	0.26	0.05	0.27	10	21	178	188	72		93164
ROSES GREEN	3.31	0.43	1.97	1.18	0.28	0.06	0.25	10	29	215	191	66		93165
ROSES ORANGE	2.84	0.37	1.68	1.19	0.26	0.05	0.23	8	27	218	148	67		93166
ROSES WHITE	2.83	0.37	1.84	0.98	0.25	0.07	0.21	9	27	177	168	56		93167
ROSES YELLOW	3.08	0.46	1.83	1.23	0.33	0.05	0.27	10	30	270	142	73		93168

White: 13-13-13

Blue: 15-5-15

Yellow: PureGreen pellets

Orange: PureGreen pellets plus 13-13-13

Green: PureGreen pellets plus 15-5-15

Values expressed as element in oven dried sample ground to pass 40 mesh. N nitrogen, P phosphorus, K potassium, Ca calcium, Mg magnesium, Na sodium, S sulfur, Cu copper, Zn zinc, Mn manganese, Fe iron and B boron. NO<sub>3</sub>-N by 2% acetic acid extraction, if requested .

LOW -NORMAL - HIGH

Analysis prepared by: Soil & Plant Laboratories, Inc.



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www.soilandplantlaboratory.com

Center for Applied Horticulture Research  
3742 Blue Bird Canyon  
Vista , CA 92084

Grower : Director  
Vista, CA

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P.O. Lucia Villavicencio

## PLANT MINERAL ANALYSIS

Sample Id - Plant Name Sample Description	N %	P %	K %	Ca %	Mg %	Na %	S %	Cu ppm	Zn ppm	Mn ppm	Fe ppm	B ppm	NO <sub>3</sub> -N	Lab No
ROSES Yellow	1.86	0.20	1.09	2.43	0.45	0.06	0.18	12	17	172	227	172		93543
ROSES Blue	1.69	0.18	1.78	1.85	0.31	0.06	0.18	11	14	150	231	147		93544
ROSES Green	1.94	0.19	1.25	1.82	0.35	0.05	0.17	11	19	154	223	131		93545
ROSES Orange	2.15	0.18	1.39	2.15	0.41	0.05	0.15	14	15	139	202	180		93546
ROSES White (Control)	1.75	0.19	1.36	1.83	0.36	0.04	0.18	13	15	94	225	128		93547

Values expressed as element in oven dried sample ground to pass 40 mesh. N nitrogen, P phosphorus, K potassium, Ca calcium, Mg magnesium, Na sodium, S sulfur, Cu copper, Zn zinc, Mn manganese, Fe iron and B boron. NO<sub>3</sub>-N by 2% acetic acid extraction, if requested .

LOW - NORMAL - HIGH

Analysis prepared by: Soil & Plant Laboratories, Inc.