

Post-harvest evaluation of nitrogen fertigated sweet peppers under drip irrigation and plastic mulch^{1,2}

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ABSTRACT

Sweet peppers (var. Cubanelle) graded for width, length and weight were evaluated after three fertigation treatments (T1 = 150, T2 = 300 and T3 = 500 Kg of N/ha), 500 Kg of N/ha side-dressed (T4), no fertilizer (T5), plastic mulching (P) and no mulching (NP). Nitrogen source was urea. The relationships of average width and average weight versus days after transplanting were sigmoidal. A linear relationship was found between average length versus days after transplanting. More than 50% of peppers were within size classes 1 to 4; fewer than 40% were in the size classes 5 to 9. During the growing cycle, mean numbers of peppers and weight per pepper in each size class were not statistically different ($P = 0.05$) among main treatments (T1, T2, T3, T4, T5). In size classes 1 to 9, there were significantly more peppers ($P = 0.05$) in P plots than in NP plots. Fruit parameter values decreased with successive picking and were significantly lower ($P = 0.05$) in the 5th picking and were higher in the P plots than in the NP plots ($P = 0.05$). Fertilization and fertigation resulted in higher values than non-fertilization.

RESUMEN

Evaluación poscosecha de pimientos abonados con nitrógeno en el agua de riego

Se evaluaron las características de desarrollo (anchura, longitud y peso) de pimientos (var. Cubanelle) y el efecto de tres cantidades de fertilizante (T1 = 150, T2 = 300, T3 = 500 kg. N/ha.) aplicadas por el sistema de riego por goteo, 500 kg. N/ha. aplicado al banco (T4), sin fertilizar (T5), con cubierta plástica (P) y sin cubierta plástica (NP). Se utilizó urea como fuente de nitrógeno. La relación entre los promedios de anchura y peso contra los días después del trasplante fue sigmoideal, mientras que la relación que se pudo establecer para la longitud media contra días fue lineal. Se encontró que más del 50% de las frutas estaban entre los tamaños 1 al 4, mientras que menos del 40% se clasificaron en tamaños de 5 al 9.

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La medida por cosecha del número y peso de las frutas en cada clasificación por tamaño, no fueron diferentes estadísticamente ($P = 0.05$) entre los tratamientos principales (T1, T2, T3, T4, T5). En los tamaños 1-4, 5-9, en las parcelas con cubierta plástica (P) la producción fue significativamente ($P = 0.05$) mayor en número de frutas al compararse con la de las parcelas sin cubierta. Los valores de los parámetros de las frutas cosechadas fueron disminuyendo sucesivamente en cada recolección y fueron significativamente más bajas ($P = 0.05$) en la última recolección. Los valores fueron mayores ($P = 0.05$) en las parcelas con cubierta plástica (P) que en las parcelas sin cubierta (NP). Los valores en las que se aplicó fertilizante, fueron más altos que los de las parcelas que no se abonaron.

INTRODUCTION

The objectives of this study were to evaluate post-harvest parameters of nitrogen-fertigated sweet peppers (var. Cubanelle) under drip irrigation and plastic mulching at Fortuna Agricultural Experiment Substation on the semiarid south coast of Puerto Rico.

There must be standardized grades for local vegetable crops for successful competition with imported vegetables. This grading will insure the production of high quality uniform produce to supply the local market. Separation of products into various grades and trading on the basis of quality will improve methods of production and marketing. Since quality standards are of major importance to farmers and consumers, variations in appearance, texture, flavor, smell, and other characteristics can affect the selling price of produce. Although considerable research has been carried out on the subject, most if it has dealt with vegetables grown and marketed under temperate zone conditions⁷. To what extent USDA grading standards are applicable to vegetables grown in Puerto Rico remains to be determined. Goyal⁸ and Guadalupe⁷ have evaluated the effects of water application rates on size of drip-irrigated onions and tomatoes. Goyal⁹ evaluated length, weight and percentage of defective fruits in mulched and nonmulched peppers under drip irrigation. They found that values were lowest in nonmulched plots.

MATERIALS AND METHODS

The experiment described by Crespo-Ruiz¹⁰ was used in this study. Peppers (var. Cubanelle) were transplanted 29 December 1984, and were

⁷Guadalupe-Luna, R., M. R. Goyal, M. Cintrón, L. E. Rivera and M. del C. Prieto de López, 1983. Effects of water application rates, plastic mulch and staking on size arrangements of mature green tomatoes under drip irrigation. *J. Agric. Univ. P. R.* 67 (3): 293-302.

⁸Goyal, M. R., R. Guadalupe-Luna, E. R. Hernández, L. E. Rivera and E. Caraballo, 1985. Effects of water application rates and planting density on size arrangements of drip irrigated onions. *J. Agric. Univ. P. R.* 69 (3): 383-89.

⁹Goyal, M. R., R. Guadalupe-Luna, L. E. Rivera and E. R. de Hernández, 1984. Effects of plastic mulch types on crop performance of drip irrigated winter and summer peppers. *J. Agric. Univ. P. R.* 68 (3): 209-306.

¹⁰Crespo-Ruiz, M., M. R. Goyal, C. Chao de Báez and L. E. Rivera, 1988. Nutrient uptake and growth characteristics of nitrogen fertigated sweet peppers under drip irrigation. *J. Agric. Univ. P. R.* 72 (4): 575-84.

subjected to three fertigation levels (T1 = 150, T2 = 300 and T3 = 500 kg of N/ha) in 11 equal applications, fertilization (T4 = 500 kg of N/ha) banded in 2 equal dosages and control T5 = 0.0 kg of N/ha. These treatments were replicated four times in a complete randomized split plot block design. Urea was the N source. Split plots were used to evaluate plastic mulching (P) and no mulching (NP). The mulch was silver-coated black plastic.

Fruits were manually harvested on the 65th, 79th, 93rd, 107th and 121st days after planting. The last picking was 20 April 1985. Fifty peppers from each treatment were sampled and taken to the Food Technology Laboratory at Río Piedras, for physical measurements: width, length, weight. They were grouped into nine classes. Anova was used to evaluate statistical differences. Regression analysis was used to fit regression equations among physical measurements versus days after transplanting.

RESULTS AND DISCUSSION

Relationships between pepper width (Y) and days after transplanting (X = 67 to 123) were sigmoidal in the P, NP, T1, T3, T4, T5 plots respec-

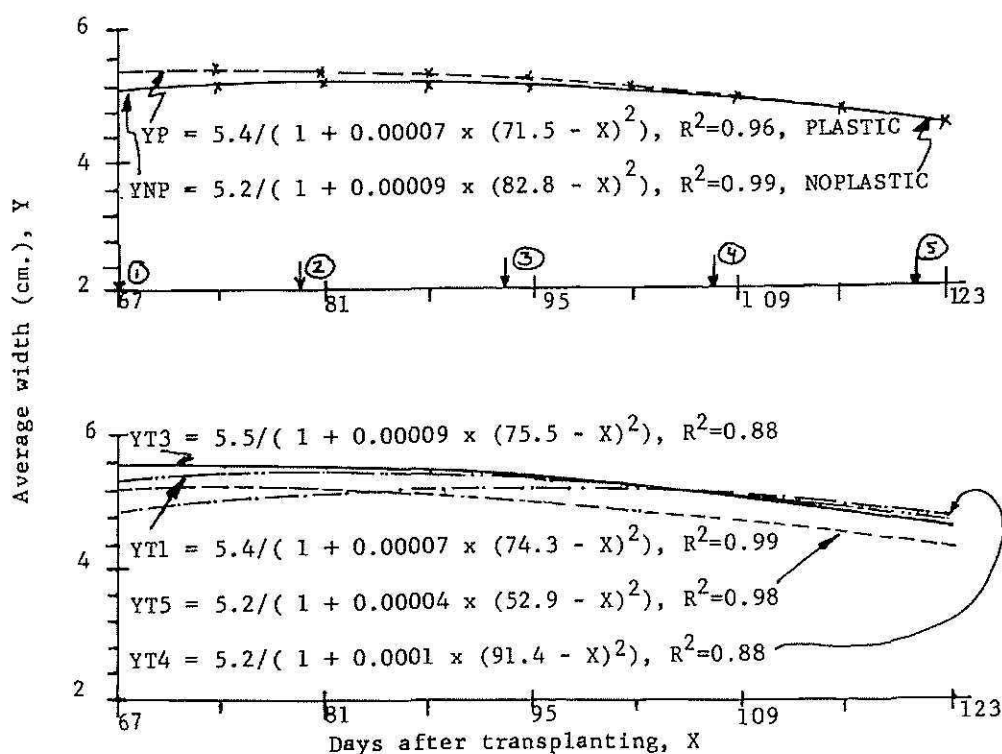


FIG. 1.—Relationships between pepper width (Y) and days after transplanting X = 67 to 123) in drip irrigated peppers (var. Cubanella). Each observation is a mean of 200 peppers. T1 = 9g of urea/plant, T2 = 18g of urea/plant, T3 = 30g of urea/plant fertigated in 11 equal dosages; T4 = 30g of urea/plant banded; T5 = control; P = plastic and NP = no plastic. 1-5 indicate picking #. All regression coefficients were significant at P = 0.05.

TABLE 1.—*Effects of nitrogen fertigation rates and plastic mulching on fruit parameters of drip irrigated peppers (var. Cubanelle). Date of transplanting: December 29, 1984. Last picking: April 29, 1985*

Fruit parameter ¹	Seasonal average of fruit parameters ²						
	Treatment ³						
	T1	T2	T3	T4	T5	P	NP
Average width, cm	5.1	5.1	5.2	4.9	4.8	5.1	5.0
Average length, cm	11.2	10.6	10.8	10.5	10.7	10.9	10.6
Weight per fruit, g	54.5	54.5	55.8	48.5	46.3	54.3	49.5
No. of fruits (%) in each size class							
1	5	3	6	6	6	4	6
2	7	7	9	10	15	9	10
3	33	34	30	39	37	32	36
4	12	14	10	12	10	11	12
5	7	7	9	6	7	7	7
6	18	19	19	15	13	19	16
7	10	10	10	7	7	10	7
8	7	4	5	4	5	6	5
9	1	2	2	1	—	2	1
Weight per fruit (g) in each size class							
1	18.7	19.7	17.9	19.7	17.5	20.2	17.2
2	29.8	26.5	28.3	27.4	27.6	28.3	27.5
3	41.7	41.3	42.1	41.1	41.0	41.6	40.3
4	53.4	52.4	52.6	53.0	54.6	53.1	52.3
5	59.2	58.2	55.8	57.3	57.3	58.3	57.0
6	66.0	66.0	66.2	65.2	68.6	66.8	65.9
7	79.5	81.8	80.1	82.9	87.1	83.8	80.7
8	100.5	97.6	94.9	92.9	98.8	97.5	90.3
9	123.6	123.1	130.3	130.0	—	126.2	120.1

¹USDA class size based on pepper width of 3.18, 3.81, 4.76, 5.08, 5.40, 5.70, 6.35, 6.74, 7.35 cm in size class 1, 2, 3, 4, 5, 6, 7, 8, 9, respectively. Each observation is mean of 200 fruits.

²Average of 50 fruits and 4 replications.

³Fertigation: T1 = 9 g urea/plant, T2 = 18.0 g urea/plant, T3 = 30.0 g urea/plant in 11 equal dosages applied weekly via drip irrigation; fertilization, T4 = 30.0 g urea/plant (1/2 at planting and 1/2 at first harvest); T5 = 0.0 g urea/plant (control); P = silver coated black plastic mulch and NP = no plastic mulching.

tively (fig. 1). All regression coefficients were significant at $P = 0.05$ and coefficient of determination (R^2) varied from 0.88 to 0.99. Mean seasonal pepper width (cm) was 5.1, 5.2, 5.2, 4.9, 4.8 in the T1, T2, T3, T4, T5 treatments, respectively; and 5.1 in P and 5.0 in NP subtreatments, respectively (table 1). Pepper width decreased with each successive week's harvest; peppers were narrowest in the 5th picking. Plastic mulching resulted in wider peppers than nonmulching ($P = 0.05$). Pepper width was significantly lowest ($P = 0.05$) in the control plots. Fertigation resulted in significantly wider peppers than fertilization ($P = 0.05$). Differences among weekly values were significant at $P = 0.05$ in all plots.

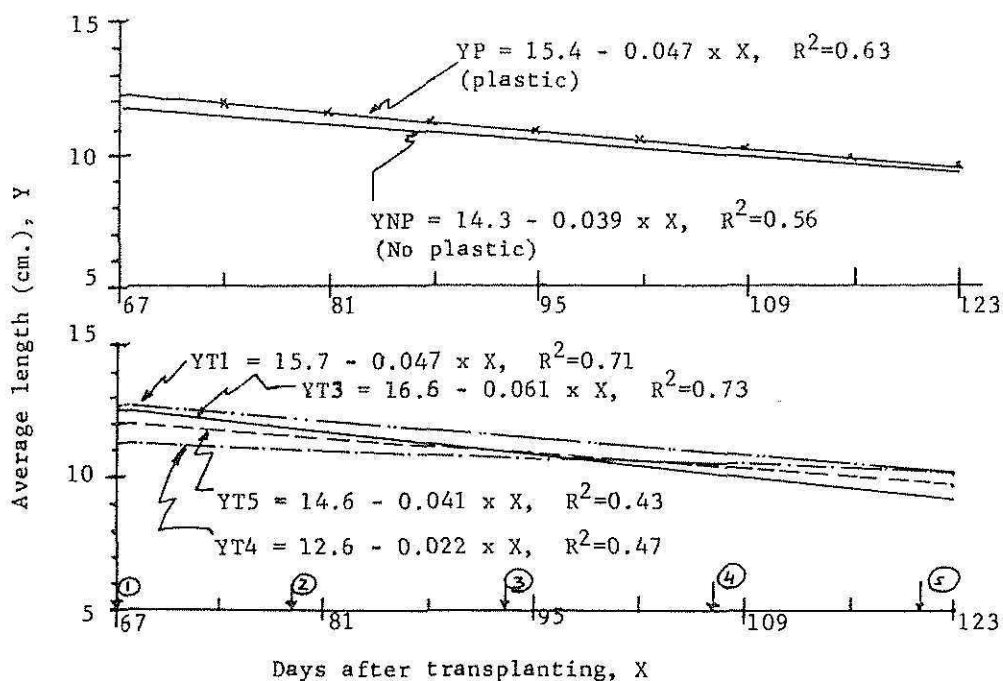


FIG. 2.—Relationships between pepper length (Y) and days after transplanting (X = 67 to 123) in drip irrigated peppers (var. Cubanelle). Each observation is a mean of 200 peppers. T1 = 9g of urea/plant, T2 = 18g of urea/plant, T3 = 30g of urea/plant fertigated in 11 equal dosages; T4 = 30g of urea/plant banded; T5 = control; P = plastic and NP = no plastic. 1-5 indicate picking #. All regression coefficients were significant at P = 0.05.

Figure 2 shows linear relationships ($Y = A + BX$) between average length and days after transplanting in all plots. All regression coefficients were significant at $P = 0.05$. The coefficient of determination varied from 0.43 to 0.73. Mean seasonal pepper length (cm) was 11.2 in T1, 10.6 in T2, 10.8 in T3, 10.5 in T4, 10.7 in T5, 10.9 in P, and 10.6 in NP plots (table 1). Pepper length decreased with each successive picking and was lowest in the 5th picking. Plastic mulching resulted in higher values than nonmulching at $P = 0.05$. Peppers were shorter ($P = 0.05$) in T4 plots up until the 97th day and continued shorter 75 days thereafter. Fertigation resulted in significantly longer fruit ($P = 0.05$) than fertilization (T4). Differences among weekly values were significant ($P = 0.05$) in all plots.

The relationships of average pepper weight versus days after transplanting were sigmoidal, $Y = A/[1 + B \times (C-X)^2]$, in all treatments except T5 where a linear relationship was observed (fig. 3). All regression coefficients were significant at $P = 0.05$ and the coefficient of determination varied from 0.60 to 0.99. Relationships were negatively correlated. Differences among weekly values were significant ($P = 0.05$) in all plots. Mean weight per fruit (g) was 54.5 in T1 and T2, 55.8 in T3, 48.5 in T4, 46.3 in T5, 54.3 in P and 49.5 in NP plots, respectively (table 1). Pepper weight decreased with successive harvests and was lowest in the

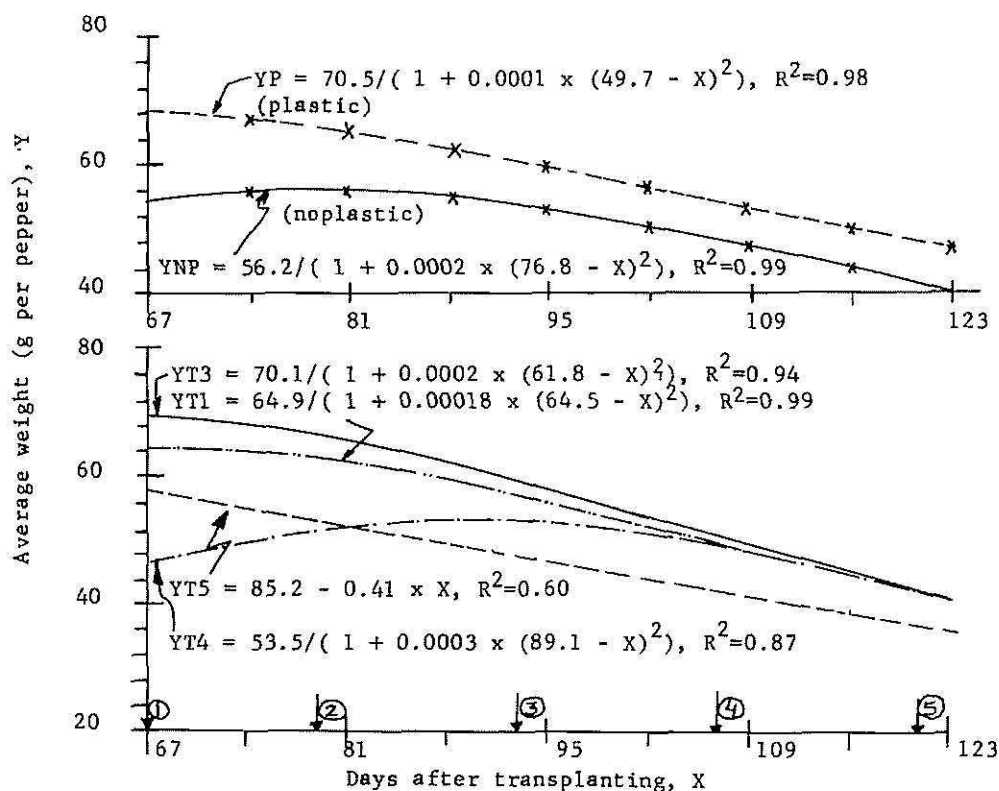


FIG. 3.—Relationships between average weight per pepper (Y) and days after transplanting (X = 67 to 123) in drip irrigated peppers (var. Cubanelle). Each observation is a mean of 200 peppers. T1 = 9g of urea/plant, T2 = 18g of urea/plant, T3 = 30g of urea/plant fertigated in 11 equal dosages; T4 = 30g of urea/plant banded; T5 = control; P = plastic and NP = no plastic. 1-5 indicate picking #. All regression coefficients were significant at $P = 0.05$.

5th picking ($P = 0.05$). Plastic mulching resulted in heavier peppers ($P = 0.05$) than nonmulching. Pepper weight was significantly lowest ($P = 0.05$) in control plots for $X = 81$ to 123. Fertigation resulted in heavier peppers ($P = 0.05$) than fertilization.

Table 1 also summarizes percentage of fruits and average weight of fresh harvested peppers during the season in the fertigated, fertilized and nonfertilized plots with plastic mulching and no mulching.

More than 50% peppers were within size classes 1 to 4. Fewer than 40% were in the size classes 5 to 9. Values were not statistically different among main treatments ($P = 0.05$). Plastic mulching resulted in significantly higher ($P = 0.05$) values than in the nonmulched plots for size classes 1 to 9.

This study recommends the use of plastic mulch for better quality, lower percentage defects and heavier peppers. Fertigation is more beneficial for physical parameters than side dressing of nitrogen fertilizer (urea source). Both fertigation and side dressing of N fertilizer resulted in a better quality product than that with no N fertilizer.