

Bunch and ratoon management for profitable production of high quality bananas (*Musa acuminata*, AAA)^{1,2}

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ABSTRACT

Two long-term banana experiments were conducted to determine the effect of bunch bagging, removal of lower hands, and sucker management on fruit and bunch characteristics and total yield. Bunches covered with either Dursban-treated or untreated perforated polyethylene bags yielded 10,539 kg/ha more than the uncovered ones during a 40-month production period. Considering the price that quality bananas demand at the farm gate and the cost of bagging (materials and labor), this practice represents a net profit of \$3,329.25/ha. The removal of the three lower hands from the immature racemes significantly reduced bunch mean weight and total yield. However, both removal of lower hands and bunch bagging increased size of individual fruits in the distal hand, thus up-grading fruit quality. In addition, these practices also reduced the number of days required from bunch-shooting to harvest. The selection of a vigorous "sword" sucker soon after planting, combined with repeated pruning of other competing suckers produced the maximum yield of 183,744 kg/ha during a 40-month period.

RESUMEN

Manejo del racimo y los retoños para rendimientos rentables y frutos de alta calidad en guineos (*Musa acuminata*, AAA).

Se llevaron a cabo dos experimentos para estudiar los efectos de enfundar los racimos, remover las manos inferiores del racimo y seleccionar los hijuelos sobre las características del fruto, el racimo y en el rendimiento total. En ambos experimentos se obtuvieron datos por 40 meses. La producción media de los racimos cubiertos con bolsas de polietileno perforadas tratadas con el insecticida Dursban al 1% y sin tratar fue de 10,539 kg/ha más que en los racimos sin enfundar. Considerando el precio que se paga por el guineo de alta calidad empacado en la finca y el costo de cubrir el racimo (materiales y mano de obra), el uso de esta práctica resulta en una ganancia neta de \$3,329.25/ha. La remoción de las tres manos inferiores del racimo inmaduro redujo significativamente el peso medio final de los

¹Manuscript submitted to Editorial Board 18 October 1991.

²This paper covers work carried out cooperatively between the Agricultural Research Service-USDA and the Agricultural Experiment Station, University of Puerto Rico (UPR-AES), Río Piedras, Puerto Rico.

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⁶Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of materials by the USDA/ARS or the UPR-AES, nor is this mention a statement of preference over other materials.

racimos y el rendimiento total. Sin embargo, el eliminar manos y el enfundar los racimos aumentaron substancialmente el tamaño y el peso de las frutas individuales en la mano distal, con lo que mejoró la calidad de los frutos. Ambas prácticas, además, acortaron el tiempo entre la floración y la cosecha. La selección de un hijuelo de "lanza" vigoroso inmediatamente después de la siembra seguido de la poda continua de otros hijuelos competidores produjo el mayor rendimiento equivalente a 183,744 kg/ha de frutos.

INTRODUCTION

Local banana production is estimated at 85,000 metric tons per year with a farm gate value of \$9 million (9). About 22% of the crop is sold as ripe fresh fruits (4).

Most of the production originates from the tall Montecristo cultivar growing in the mountain region intercropped with coffee and without proper management. Under these conditions, yields are low, quality is poor, and profits are negligible. The availability of high yielding dwarf banana cultivars (7) offers growers the opportunity to implement appropriate bunch and sucker management practices for the production of quality fruits that conform to modern market requirements and generate acceptable profits.

Banana bagging has been found to increase bunch weight by 10 to 15% (3, 12), to reduce the time from bunch-shooting to harvest, and to improve grading of fruits by protecting against fungi and insect damage and blemishes (8, 10). The increase in bunch weight is attributed to a rise in temperature and humidity inside the plastic bag.

The removal of the male flower bud and lower hands from the immature bunch has been shown to increase individual fruit size and weight at the expense of reducing total bunch weight (1, 5). This practice, however, is considered justifiable by Calvo and Soto (2), because it up-grades fruit quality and shortens the interval from bunch-shooting to harvest.

The timed desuckering of the banana plant is another field practice that can affect long-term production (11). Proper sucker management permits control of the number of production units in successive ratoons.

This paper reports the effects of bunch bagging, removal of lower hands, and ratoon-sucker selection on yield and fruit quality of the 'Grand Nain' banana.

MATERIALS AND METHODS

Two experiments were established at the Corozal substation and on a private farm in the municipality of Lares from October and December 1983 through April 1987.

The Lares experiment was planted on Mr. Luis M. Elizalde's farm, at an elevation of 450 m. No weather data were recorded at this location; however, in a normal year, rainfall is more abundant than at the Corozal

substation. The soil is a Humatas clay (Typic Tropohumults, clayey, kaolinitic, isohyperthermic). The upper 30 cm of soil contained 6.3 mg/kg of available phosphorus (Bray Method II), and had an exchangeable base capacity of 7.1 cmol (+)/kg of soil. The initial soil pH was 4.2 and limestone was surface-applied at the rate of 6.7 t/ha.

The Corozal substation is at an elevation of 200 m. Mean monthly rainfall was 174.8 mm, and pan evaporation 122.7 mm. However, evaporation exceeded rainfall by 25% during January, February, March, June and July. The average monthly minimum and maximum temperatures were 19.5 and 29.5°C, respectively, with a \pm variation of 1.5°C. The soil is a Corozal clay (Aquic Tropudults, clayey, mixed, isohyperthermic).

The upper 30 cm of soil contained 3.3 mg/kg of available phosphorus, and had an exchangeable base capacity of 10.4 cmol (+)/kg of soil. During land preparation, limestone was incorporated at the rate of 4.5 t/ha to increase the pH to about 5.2.

In both experiments suckers of 'Grand Nain' weighing about 2 kg each were planted at 1.8 by 1.8 m. The plant crop received 3,300 kg/ha of a 10-5-20-3 (N, P₂O₅, K₂O and MgO) fertilizer supplemented with 25.4 kg/t of a fritted minor element mixture. The fertilizer was divided into equal applications 2, 5, 8 and 11 months after planting. Thereafter, the ratoon crops were fertilized with 750 kg/ha every 3 months.

The experiments were maintained free of weeds with postemergence applications of glyphosate (Round-up)⁶ at the rate of 1.5% v/v.

Yellow Sigatoka (*Mycosphaerella musicola*), nematodes, and the corm weevil (*Cosmopolites sordidus*) were controlled according to UPR-AES recommendations (6).

At the Lares experiment three bunch bagging and three dehanding treatments were arranged in a split-plot design with six replications of 12 plants per sub-plot. The main treatments consisted of covering the immature bunches with either insecticide-treated or untreated polyethylene bags or leaving the bunches uncovered. The bags were made of blue-perforated polyethylene film 0.05 mm in thickness. The insecticide-treated bags were factory impregnated with Dursban at 1%. In the subtreatments the immature bunches (fig. 1) were subjected to the removal of the male flower bud with either one, two or three lower hands. All treatments were applied 3 weeks after bunch-shooting.

A desuckering program was implemented throughout the experiment. It consisted of maintaining in each stump the "mother" plant plus two suckers, the latter representing the "daughter" and "granddaughter" plants.

At the Corozal experiment four ratoon-sucker management treatments were evaluated in a randomized complete block design with six replications of 15 plants per plot. In the plant crop, the treatments were as follows: 1 a vigorous "sword" sucker selected soon after planting and



FIG.2—Banana stump showing three production units, the “mother”, “daughter” and “granddaughter” plants.



FIG. 3—Mature-green banana bunch covered with a perforated polyethylene bag.

TABLE 1.—*Effect of bagging on bunch weight, total yield and size of fruits in the distal hand of the banana raceme intensively managed during a 40-month period at Lares, Puerto Rico*

Bagging treatment	Plant crop	Ratoon crops	Combined plant and ratoon crops		Fruit measurements		
	Bunch weight	Bunch weight	Bunch weight	Total yield	Length	Diameter	Weight
	kg	kg	kg	kg/ha	cm	cm	g
Bunch covered with treated polyethylene bags	20.1a ¹	24.5a	22.3a	150,545.5a	17.1a	3.4a	120.1a
Bunch covered with untreated polyethylene bags	19.8a	24.3a	22.1a	149,405.6a	17.0a	3.4a	118.7a
Bunch uncovered	18.3b	22.8a	20.6b	139,436.8b	16.3b	3.2b	110.7b

¹Means followed by the same letters in each column do not differ significantly at P = 0.05 probability level.

TABLE 2.—*Effect of removal of lower hands on bunch characteristics, total yield and size of fruits in the distal hand of the banana raceme intensively managed during a 40-month period at Lares, Puerto Rico*

Number of hands removed	Plant crop		Ratoon crops		Combined plant and ratoon crops			Fruit measurements		
	Hands remaining in the bunch	Bunch weight	Hands remaining in the bunch	Bunch weight	Hands remaining in the bunch	Bunch weight	Total yield	Length	Diameter	Weight
	No.	kg	No.	kg	No.	kg	kg/ha	cm	cm	g
One	8.2a ¹	20.5a	8.9a	24.9a	8.5a	22.7a	153,529.6a	15.9c	3.2b	104.0c
Two	7.5b	19.4ab	7.8b	23.6a	7.7b	21.5ab	145,223.3ab	16.7b	3.4a	118.2b
Three	6.6c	18.3b	7.5b	23.1a	7.1c	20.7b	140,635.1b	17.8a	3.5a	127.3a

¹Means followed by the same letters in each column do not differ significantly at P = 0.05 probability level.

TABLE 3.—*Effect of ratoon-sucker selection on bunch weight and total yield of bananas intensively managed during a 40-month period at Corozal, Puerto Rico*

Treatment number	Sucker selection and pruning	Plant crop	Ratoon crops	Combined plant and ratoon crops		
		Bunch weight	Bunch weight	Hands per bunch	Bunch weight	Total yield
1	Selecting a vigorous "sword" sucker soon after planting, and thereafter pruning other competing suckers.	kg	kg	No.	kg	kg/ha
		20.6ab ¹	21.1a	90.4a	20.8a	183,774.3a
2	Selecting a vigorous "sword" sucker 6 months after planting, and thereafter pruning other competing suckers.	21.4a	20.8a	9.6a	21.1a	170,602.8b
3	Allowing free-growth of all suckers from planting, then selecting a vigorous "sword" sucker when 50% of the plants have flowered, and thereafter pruning other competing suckers.	20.2ab	20.7a	9.6a	20.4ab	166,607.5bc
4	Pruning all suckers from planting, then selecting a vigorous "sword" sucker when 50% of the plants have flowered, and thereafter pruning other competing suckers.	20.0b	19.1b	9.6a	19.5b	157,609.6c

Means followed by the same letters in each column do not differ significantly at $P = 0.05$ probability level.

days from bunch-shooting to harvest, while the uncovered ones required 112 days to reach the fruit harvest criterion of 3/4 full.

The removal of one to three lower hands from the immature racemes progressively reduced bunch size and weight, and total yield in all crops (table 2). Except for bunch weight in the ratoon crops, the effect was always significant with the removal of three hands. However, individual fruit size and weight in the distal hand were appreciably increased at the expense of reducing total yield by 5.4 to 8.4% (table 2). Racemes trimmed by two and three hands averaged 109 days from bunch-shooting to harvest, whereas fruits in racemes with only one hand removed took 114 days to reach a marketable grade.

Both bunch bagging and removal of lower hands improved banana grading, but fruits in the distal hand were smaller than those reported for the Grand Nain cultivar in Costa Rica. According to Soto (11), individual fruit length can be affected by an excess or deficit of soil moisture during the first 30 to 40 days after bunch-shooting.

Corozal experiment

The peak plant-crop harvest at Corozal occurred 13 months after planting. Except for treatment 1, other ratoon treatments averaged 2.7 marketable bunches per stump during a 40-month production period. The selection of a vigorous "sword" sucker soon after planting (treatment 1), combined thereafter with the pruning of other competing suckers produced about 2.9 marketable bunches per stump with a maximum yield of 183,744 kg/ha (table 3). Since bunch weight was similar for treatments 1 through 3 in all crops, we conclude that the increase in total yield detected in treatment 1 (early "sword" sucker selection) was mainly the result of 20% more bunches being harvested during a 40-month production period. Pruning of all suckers from planting and then delaying the selection of a ratoon sucker until flowering (treatment 4) significantly reduced bunch weight and total yield (table 3).

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