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Walter I. Knausenberger
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PERFORMANCE OF THE SOLO PAPAYA CV SUNRISE IN PUERTO RICO

W. Colón-Guasp and F. Vázquez

United States Department of Agriculture
Agricultural Research Service
Tropical Agriculture Research Station
Box 70, Mayaguez, Puerto Rico 00709

ABSTRACT

Two evaluation trials of the Solo papaya cv. Sunrise were conducted in an oxisol in Puerto Rico. The first planting consisted of 46 trees obtained from seeds introduced from Hawaii. The second, of 183 trees obtained from seeds from a local grower. Plants were spaced 1.8m x 3m. A low agricultural input approach was followed.

In the first planting, the ratio of hermaphrodites to females was 2:1; in the second, 2.5:1. Thirteen percent of the trees in the first planting were eliminated before 4 months due to viruses and micoplasms. In 7 months, 32.6% were discarded. In the second planting, 14.7% were eliminated befor 4 months. Female trees in both plantings produced larger fruits but less fruits per trees. Hermaphrodites produced an average of 65 fruits/tree with an average weight of 0.38 kg/fruit from the first planting; females, 35 fruits/tree weighing 0.5 kg/fruit. During 7 months of weekly harvesting, production from the first planting amounted the equivalent of 38,380 kg/ha of marketable fruit.

Data on average yield/tree, average yield/week, tree height and stem diameter are presented.

INTRODUCTION

In Puerto Rico there are more than 120 ha of papaya under cultivation, with an estimated value of US$ 3.7 million. At present Puerto Rico is self-sufficient in this commodity. In recent years the production of the Solo papaya cultivar Sunrise is becoming increasingly important as an export crop to the U.S. mainland market. Locally this cultivar is being marketed in the tourism sector, specifically the hotel industry and cruise ships. Producers have obtained prices ranging from $1.43-$2.97/kg in the U.S. mainland and $0.66/kg in the local market. (Toro, E., personal communication).

The Caribbean Basin has a year round growing season characterized by a warm tropical climate. At some locations within the Basin, there are relatively fertile soils and well-distributed rainfall which is ideal for the cultivation of this crop. Currently there are 60 ha of the Sunrise papaya under cultivation in Puerto Rico (Pérez, A., personal communication), 40 ha in the Dominican Republic (Estardo-Arias, 1987) and an undeterminate area in the Bahamas (Anonymous, 1980). These are all for the fresh fruit export market.

The purpose of the research herein reported was to evaluate yield and growth characteristics performance that could be useful to existing and potential producers.

Previous Work

The Solo papaya cultivar Sunrise was developed in Hawaii by Hamilton and Ito (1968). After the release of this cultivar yields have been documented to vary depending on the geographical locations. In Hawaii, Ito (1976) evaluated hermaphrodite trees of Sunrise spaced at 3.05m x 2.4m. The trees produced an average of 48 marketable fruits/tree, 0.75 kg/fruit and a total production of 36.7 kg/tree. Soares de Vasconcelos et al. (1982) evaluated trees spaced 3.5m x1.5m in Brazil. They obtained 54,990 fruits per/ha with an average of 0.354 kg/fruit after harvesting for 53 weeks. Ruggiero and Ariovaldo Banzatto (1982) compared the performance of local Sunrise from Brazil and Sunrise brought from Hawaii. Trees were spaced 3m x 2m and harvested for one year. Results for local Sunrise and Hawaiian Sunrise were as follows:

Strain	Yield
Local Sunrise	17,177 kg/ha 93.91 fruits/tree 0.56 kg/fruit
Hawaiian Sunrise	16,552 kg/ha 75.83 fruits/tree 0.385 kg/fruit

In Trinidad, Brathwaite and Heeralal (1982) spaced trees 2m x 3m and obtained 26,997 kg/ha of fresh marketable fruit. Trees were harvested for 16 months.

METHODS AND MATERIALS

Two fields were planted at the Isabela Farm of the Tropical Agriculture Research Station located in Northwestern Puerto Rico at 130m above sea level. Mean annual rainfall is 1,600mm. Mean minimum temperature is 19 C while mean maximum temperature is 28 C. May is usually the rainiest month whereas February is the driest. The typical soil of the region is Coto Clay, an Oxisol (Tropeptic Haplorthox, clayey, kaolinitic, isohyperthermic) (Lugo-López and Rivera, 1976).

The first planting, made on January 1987, consisted of 46 trees obtained from seeds introduced from the National Clonal Germplasm Repository, Waiakea, Hawaii; the second (July 1987), of 183 trees obtained from seeds from a local grower. Seedlings were transplanted one per hill spaced 1.8m x 3m. Each tree received 113g/month of a 15-8-10 fertilizer before flowering and 226g/month after flowering. Whenever trees showed symptoms of virus or mycoplasms infection they were eliminated immediately to avoid further contamination. No preventive crop protection scheme was implemented in an attempt to reduce purchased inputs and approach a low-input agricultural system.

Pesticides were applied only after identification of pests in the plantation. Supplemental overhead irrigation was applied at the rate of

94mm/ha. A mechanical mower was used to control weeds between rows and paraquat was applied to control weeds between hills. Harvesting was carried out weekly beginning at 8-9 months after transplanting. Only physiologically mature fruits were picked. Fruits showing discoloration, insect or mite damage, and fungi damage were discarded. Also if the weight of individual fruits were less than 0.32 kg, they were discarded. The purpose was to obtain only data on marketable fruits/tree. Fruits from the first planting were harvested continuously for 7 months; those from the second, for 5.5 months. Plant growth characteristics such as plant height and stem diameter were taken at the end of harvesting. Stem diameter was taken 30cm above the ground level. Data on yield were collected on each individual tree in both plantings. A standard t-Test was performed to evaluate differences in yields between hermaphroditic and female trees.

RESULTS AND DISCUSSION

First Planting

In this planting of 46 trees the ratio of hermaphrodites to females was 2:1. Harvesting commenced 9 months after transplanting. The hermaphrodite trees yielded modestly in the first three weeks averaging 0.5 kg/tree with a maximum of 3 bearing trees. From the 4th to the 7th week yields increased 10-fold with a maximum of 26 trees bearing fruit that week. The heaviest production of 2.36 kg/tree/week for the 26 trees was obtained from the 8th to the 14th week. Production dwindled considerably for the next 5 weeks. From the 20th week to the end of harvesting production increased slightly at the 28th week, but never matching the peak experienced during the 8th to the 14th week. Fruit production of the female trees followed the same pattern with two peaks of production: a heavy one from the 7th to the 14th week and a smaller from the 20th to the 28th week. The combined yields of the hermaphroditic and female trees was heaviest from the 1st to the 16th week. Afterwards, the ripening process and fruit production decreased. This was due to unknown causes. In Hawaii (Anonymous, 1970) a decrease in marketable fruits of some commercial Solo strains was observed after a decrease in temperature.

Data on the number of fruits/tree, kg/tree, kg/fruit are presented in Table 1. Yields of hermaphroditic trees were significantly superior than those of female trees in spite of the fact that individual fruits were smaller. Judging from these results it appears as though it is less economical to grow female trees. Tree height varied between sexes while stem diameter did not (Table 2). The mean height of the location of the first flowers on the stem, in both sexes combined was 1.29±0.2m. Mean weight of fruits from hermaphroditic trees was lower in the first weeks.

Thirteen percent of the trees were eliminated after 4 months of harvesting. In 7 months of harvesting 32.6% were discarded. After 7 months of harvesting more than 50% of the trees showed symptoms of viruses and mycoplasm infection. At this point harvesting would be uneconomical. In addition to the viruses and mycoplasms the major pests observed was the powdery mildew of papaya caused by a fungus, *Oidium caricae* (Hepperly, P., Personal Communication). This fungus grows superficially on the underside of leaves. Major outbreaks of this fungus occurred during the season of low

Table 1. Yield of hermaphroditic and female trees of (Carica papaya L.) cv. Sunrise in an Oxisol in Puerto Rico.

Sex	Fruits/tree	Kg/tree	Kg/fruit
	First planting		
Hermaphroditic	65±24.61	25±10.66 *	0.37±0.02 *
Female	35±12.08	18±07.45	0.50±0.06
	Second planting		
Hermaphroditic	61±23.57	28±12.6 *	0.45±0.03 *
Female	37±16.29	23±10.24	0.61±0.05

* Significant at the 5% level.

Table 2. Growth characteristics of hermaphroditic and female trees of (Carica papaya L.) cv. Sunrise in an Oxisol in Puerto Rico.

Sex	Mean ht. (m)	Mean stem dia. (cm)
	First planting	
Hermaphroditic	3.4±0.3	44.6±4.1
Female	3.0±0.2	44.0±4.2
	Second planting	
Hermaphroditic	3.4±0.13	46.6±7.0
Female	3.4±0.32	49.4±7.1

The combined production of hermaphroditic and female trees was equivalent to 38,380 kg/ha of marketable fruits in a period of 7 months of harvest. This production was considerably higher than yields obtained in Brazil (Ruggiero and Ariovaldo Bazatto,1982), and in Trinidad (Brathwaite and Heeralal, 1982), in a shorter period of time.

Second Planting

The ratio of hermaphrodite to female plants in this planting was 2.5:1. Eight months after transplanting, trees were bearing ripe fruits. Average production for the first 5 weeks was 0.72 kg/tree with a mean of 47 trees bearing fruits. From the 6th to the 12th week, average production was 1.1 kg/tree with a mean of 81 bearing trees. The production in the plantation peaked from the 13th to the 21st week at 2.36 kg/tree with 100 bearing trees. Female trees started producing fruits 3 weeks after hermaphrodites. Production was low for the first 6 weeks, then increased for the next 5 weeks to 1.63 kg/tree with a mean of 30 bearing trees. During the last 9 weeks trees averaged 2.58 kg/tree with a mean of 30 bearing trees. Mean fruits/tree, kg/tree and kg/fruit varied between both sexes (Table 1). Again, yields of hermaphroditic trees were significantly superior than yields of female trees (Table 2). The mean height of the location of the first flowers on the stem of both sexes combined was 0.92±0.05m. After 16 weeks of harvesting, 56.4% of the fruits were out of reach from the ground. After 19 weeks 92% of the trees were bearing fruits out of reach.

There was only one continuous cycle of production. This phenomenon is probably due to the fact that the second planting, which was made in the Summer, was not subjected to low temperatures during the production cycle. Trees continued to bear fruits during the 5.5 months of harveeting. After 4 months of harvesting, 20% of the trees were eliminated due to viruses and mycoplasms. At the end of the harvesting period there was no increase in the number of trees infected. The early detection and elimination of infected trees prolonged the production period of the plantation without the excessive use of costly pesticides. This plot produced an equivalent of 40,257 kg/ha of marketable fruit in a 5.5 month harvesting period.

These preliminary results indicate that planting hermaphrodite trees only, while reducing purchased inputs such as insecticides with the use of high levels of fertilizers (Pérez and Vargas, 1977), can be conducive to relatively high yields.

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