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Full Length Research Paper

Cultivation of Pitahaya (*Hylocereus undatus*) in three soil types of Guyana

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The study is aimed to investigate the adaptability of Pitahaya (*Hylocerous undatus*) cactus and to investigate the best soil type for its cultivation in Guyana. Three soil types were chosen namely: White sand, Sandy loam and Clay. A total of twelve replicate were established within four treatments. Treatment one (T1) contain white sand, treatment two (T2) Clay, Treatment three (T3) Sandy loam and Treatment four White sand with cow manure. One plantulate was planted in each replicate. Stem (main vine) height, diameter and shoot appearance were measured, recorded and analyzed. The study was conducted for thirty weeks period. Measurements were collected over a twenty six weeks period. The data collected was analyzed using Duncan's Multiple Range test. ANOVA table was used to test whether there was any significant difference among treatment. Results obtained have shown that Pitahaya (Hylocerous *undatus*) significant differences exist between White sand with cow manure and White sand; and White sand with manure and Clay however there was no significant difference between white sand with manure and sandy loam in relation to height. Results also showed that white sand has a value of zero or no growth, however White sand with manure (T1) showed the greatest shoot appearance for the four treatments follows by treatment two (Clay) and treatment three (Sandy loam) respectively. It was observed that for the twenty six (26) week of data collection treatment three (Sandy loam, Replicate one and 3 showed shoot appearance of approximately fourteen (14) days after the main vine was planting. Based on the result of this study I can said that Pitahaya (Hylocerous *undatus*) grow well in White sand with manure, Clay soils and Sandy loam however will not grow well in White sand.

Keywords: *Pitahaya, Hylocerous undatus, Dragon fruit, Cactus succulent*.

INTRODUCTION

Guyana's agricultural sector is a vital contributor to the nation's economy. The agriculture sector's contribution to the Gross Domestic Products (GDP) growth in 2003 was 31.5% (Ministry of Agriculture).

The total arable land is approximately 400000 ha, most of which lies below sea level. About 50,000 hectares have soils with fair to good potential for agricultural development in the Savannahs. Also, has a vast white sand area and shrubs lands where Pitahaya can be introduced as an agricultural crop. It can be cultivated in areas where soils are not suitable for the production of traditional agricultural crops because Pitahaya has an epiphytic nature that allows her to grow in live or dry host, rocks and concrete walls. It has been grown successfully in sandy soils.

Pitahaya is a popular tropical fruit with high nutritive values and has been utilized for medicinal and industrial uses in Latin American countries. It has potential for local and international market. Pitahaya is a cactus with numerous potential uses and application (coloring food component and/or as a raw material for food color production, ices, sherbets and fruit bars, yogurt and dairy product flavoring, international marketing and alternative tropical fruit consume.

Literature reviews shows that Pitahaya is cultivated around the world in tropical regions. Recently the Israelist were experimenting with the fruit in the Negev Desert. (Obregon 1996). The Introduction of an exotic fruit of the cactus family to Guyana will enhance the diversification of agricultural production particularly in areas consisting of poor soils and also provide a source of income for marginal economic living communities

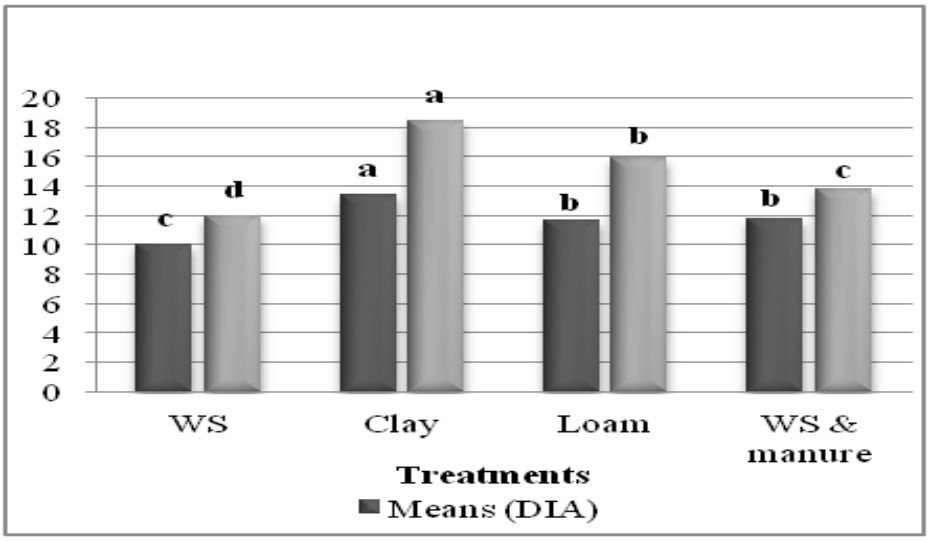

Figure 2: Mean height and thickness of plants (main vine) among treatments

around these areas. The cultivation of Pitahaya will be a new learning venture for Guyana in the production of non-traditional crop that can attract export marketing possibilities.

Fresh Pitahaya fruit from Nicaragua is currently being exported to Canada, Holland and Belgium. France has been experimenting with frozen pitahaya pulp as an ingredient of various food and beverage items. This study seeks to investigate if Pitahaya cactus will grow successfully in uyana's soils.

METHODOLOGY

Stage 1: Cultivation:

Experimental design

The experimental design was a randomized complete block with four treatments: T1–White Sand, T2–Clay, T3–Loam, T4 – White Sand with manure and three replicates.

Soil medium was mixed with White sand, Loam, Clay or White and with cow manure. Black polyethylene bags were filled with soil medium.

Data collection

Data was collected systematically for twenty six weeks. Height and diameter (thickness) of main vine were measured and recorded in a field book. The first measurement was conducted at 2 weeks after planting of the plants. Data was entered in spreadsheet format using Excel and most ANOVA using SAS and Statistix 9 software. Comparison of mean and differences were conducted as pairwise comparison among treatments.

This research had three objectives: (i) to determine the response of Pitahaya to three soil types of Guyana (ii) to investigate ac best adaptability for thee cacti to grow in Guyana (iii) to evaluate fruit production. Four research questions were developed: (i) What is the response of Pitahaya when planting in three different soil types in Guyana? (ii) What is the difference of the number of flowers produced by treatment? (iii) What is the season (rainy and dry) that influence the number of flower produced per treatment?

Statistical analysis

The vines were planted in different soil types (white sand, clay, sandy loam and white sand with manure only 1 to 2 inch deep. The plants were watering once every two week during dry weather.

The statistical analysis was done using ANOVA to test whether there was no significant difference among the treatments.

Figure 2 shows significant differences among the mean height between white sand and manure and white sand; and the white sand and manure and clay however there was no significant difference between white sand with manure and loam in relation. The bar chart also shows significant diameter differences among the four treatments.

Previous research has being shows that Pitahayas aren't usually too picky as to soil type, but because of their semi-epiphytic nature, it is recommended to grow them in soil that is supplemented with high amounts of organic material. The plant has been grown successfully in sandy soils. (www.tradewindsfruit.com/dragon_fruit.htm)

The graphic below shows significant differences among the four treatments. Treatment four (White sand

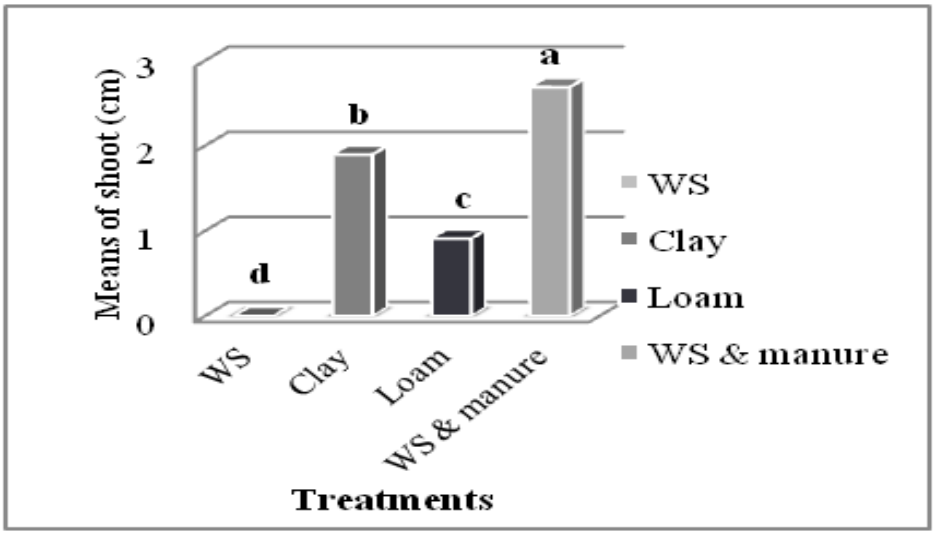

Figure 3: Mean of shoots

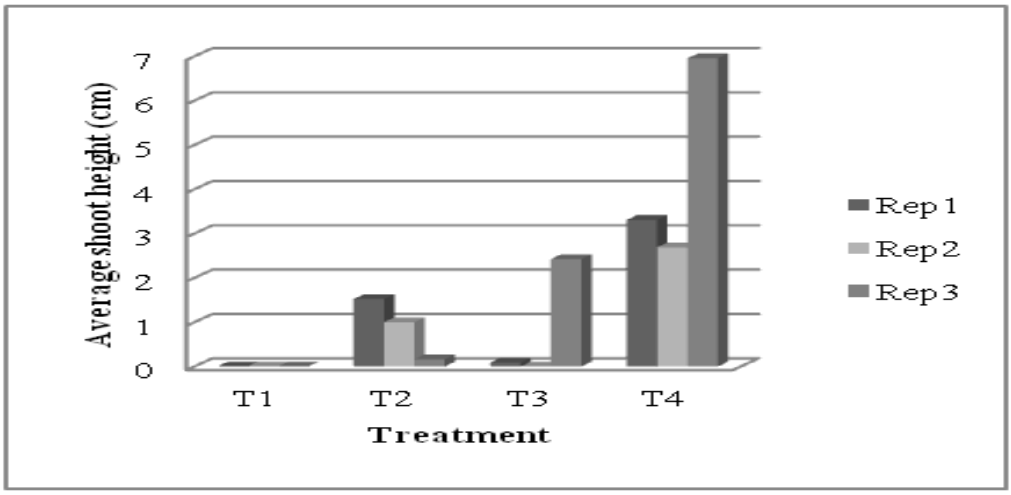

Figure 4: Average shoots height per treatments

with manure) showed the highest number of shoot appearance, follows by treatment two (Clay soil) and treatment three (Sandy loam). However, treatment one (White sand) indicated no growth. During the period of measurement, it was observed that the largest shoot measurement was approximately 20.5 cm with a diameter of 10 cm in treatment four (White sand with manure). Also it was noticed that all the four treatments including treatment one (White sand) had a well developed ground root system.

Figure 4 show that Treatment 4 has the greatest growth for the four treatments follows by Treatment 2 and Treatment 3 respectively however Treatment 1 has no growth.

Figure 5 show the time of shoot appearance by treatments. It can be seen that the greatest shoot appearance occurred in treatment one (Sandy loam), replicate three and treatment two (White sand with manure), replicate two. The lowest shoot appearance was observed in treatment three (Clay) and no shoot development in treatment one (White sand).

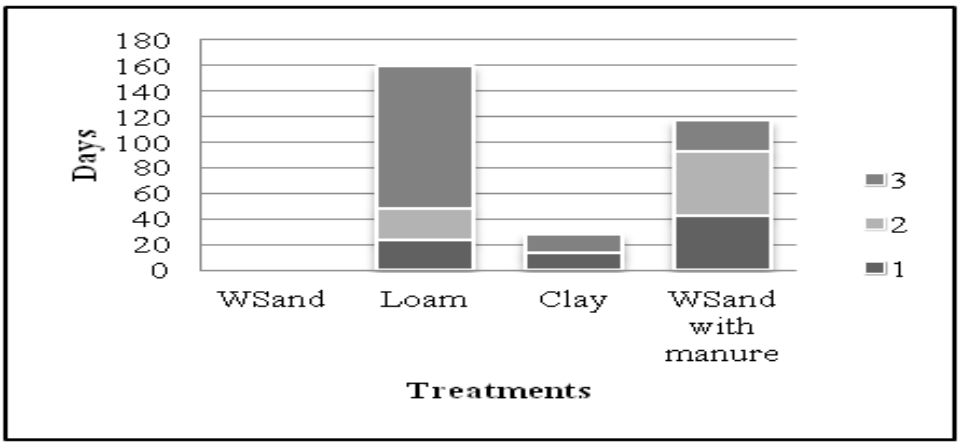

Figure 5: Time of shoot appearance per replicates and between *treatments*

Picture 1: shows *Hylocereus* plant climbing on a concrete wall at 486 Diamond H/S E.B.D, Guyana

***Stage 2*: Planting and adaptation**

Pitahaya are semi-epiphytic plants which crawl, climb and attach naturally to any natural and artificial support they meet (trees, wood or cement posts, stone or concrete walls, etc) (Fabrice et al., 2005). (Picture 1). My intention is to bring together observations on the capability of the *Hylocereus* cactus to adapt to Guyana's environmental conditions as a non-traditional growing fruit.

My goals in this stage are to investigate the soil type that shows greatest adaptability of *Hylocereus* in terms of flower production, shoot development and vines thickness and the association of season (rainy and dry) with flower production in Diamond-Guyana.

Throughout this review, I use the word 'adaptability' to mean the process by which a plant becomes adjusted to a new condition. Traditional methods of Pitahaya cultivation have changed in production areas as they have been adapted and improved to overcome the problems encountered there (Fabrice et al., 2005).

Pitahaya grows a lot like a tomato vine (Chow, 2004), the planting distance depends on the type of support used and the available planting space. There are different forms to train the plant however field practices shown that Pitahaya are best grown on living and dead support (Barbeau and La Pitahaya rouge, 1990; Merten, 2003). A vertical support of 1.40 m and 1.60 m (*Picture 1 and 2*), 2-3 m distance between planting lines is required. One vine was attached to the Wallaba post which was located at the center of the drum. Commercial growers in Nicaragua train the Pitahaya into fountain (hangs down); the vertical support is 5 feet above ground. Also, it train in rows in containers and the vines are supported by a trellis. Whatever, support are used to train the plant has to be strong because the plants becomes heavy at maturity.

Picture 2: shows *Hylocereus spp* plants with vertical support (Soft wallaba post) in 486 Diamond, H/S, E.B.D, Guyana

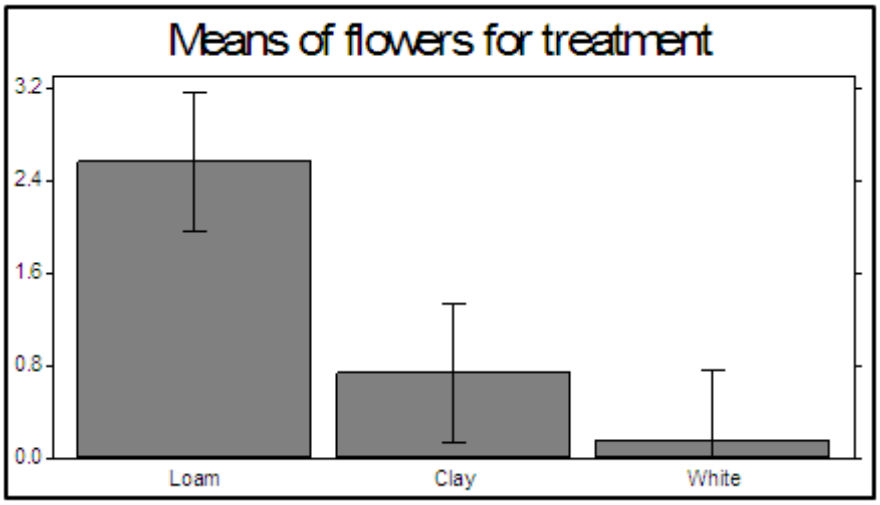

Figure 6: Mean flowers produced for fifteen months per three treatments for the period January 2009 to June 2010.

Statistical analyses

The analyses focused on comparing the effect of the treatments on the number of flowers produced by soil type.

Differences in the number of flowers produced between the three treatments were tested for the year 2009/2010 from January to June. Data on the number of flowers was tested with one-way ANOVA. Comparison between treatments were analysed by the Turkey-Kramer pairwise mean comparison test. Turkey's multiple comparisons test showed no significant difference between clay soil and white sand with manure which also is not significantly different from loam (Figure 6; $F = 17.57$, $P < 0.05$). Total of flowers was significantly lower in the white sand treatment compare with all other treatments (Figure 6).

The Chi-square test was used to analyse the frequency of flowers occurrence between treatments and season. The results of the analyses showed that the proportion of flowers was higher for loam soil than in clay and white sand with manure during the rainy season ($X^2 = 2.51$, $P = 0.28$) (Table 2).

Proportional differences in the number of flowers between treatments were analysed by multiple comparisons for proportions table. The result suggests no significant distribution of flowers amount treatments (Table 2) ($q = 3.314$).

Table 1: Number of flowers observed in three soils type during rainy and dry season

Treatment	Rainy	Dry
Loam	104	91
Clay	28	28
White sand	9	3

Table 2: Proportional differences in number of flowers between treatments (q=3.314)

Multiple comparison for proportions			
TREATMENTS	**P**	Loam	Clay
Loam	46.9		
Clay	45	1.9	
White sand with manure	58.8	11.9	13.8

Stage 3: **Fruit** p**roduction**

During the four years of this study fruit production data was unable to collect due to flowers drops. In this research, the initiation of fruit bearing started in 2010 approximately two years after the cactus were transplanting. From 2010 to 2013, five fruits were bearing in loam, two in clay and one in White sand with manure. This yield data cannot be useful to estimate a production cost. This study can only stated that fruit bearing may start two years after transplanting of the vein and it is very much depend on the soil nutrients, pollinator and planting space and shape.

DISCUSSION

Stage 1 This study indicates no significant differences in growth of pitahaya among the four treatments. No growth was observed in terms of shoots development in white sand. Literature review suggests the use of well decomposed manure or compost mixed with soil for the effective growth of Pitahaya in sandy soils. Contrary to literature growth of Pitahaya in soil that retaining water should be avoided however this study shows greatest growth was observed in clay soils.

Stage 2 Pitahaya is native of the tropical forest regions of Mexico, Central and South America (Merten, 2002). Several problems have to be dealt with when adapting Pitahaya to growing conditions outside of their native environment (Mizrahi and Nerd, 1999). Guyana is a tropical country which posses suitable condition for the grow of Pitahaya for sustainable and commercial agriculture however more work has to be done in terms of suitable planting space and forms, the effect of high humidity on the development of the cactus when planting in Guyana coast land region and to investigate the reasons for the falling of flowers. Based on the results of this study, it is recommend furthering investigating the growing of Pitahaya on white sand areas using regular additions of organic matters and fertilizer. Also, it should be planted using fast growing live host of the leguminosae family (*Dimorphandra conjugate or Acacia mangium*). In Guyana Pitahaya flowering appearance showed to be higher on sandy loam compare to the other treatments.

Stage 3 Based on literature review, there are several reasons for low fruit production as follows:

a) The fact that flowers only bloom at night is a main problem as the general pollinators like the bees and birds are missing and during the day the flowers area open till around 9 in the morning in Guyana but also, it will depend on the weather nevertheless moths and bats are good pollinators during night time when there is no bee pollination as in the case of Diamond

b) Temperature above 45^{o}C will have an impact on annual flower production. Mizrahi's observations in showed that in the hottest part of Negev desert annual flower production was very low, about 15-20%. He also considered that Pitahaya may be better suited to growing along coastal areas where temperatures are moderated by the ocean influence. Based on the results of this study I can safely say that Guyana climatic conditions are suitable for the growing of Pitahaya.

c) Lack of nutrients in soils. Marten 2002 indicates that these cacti respond well to most fertilizers, although care must be taken not to burn the shallow roots system. In Israel, Nicaragua, USA and Colombia applications of organic matter and compost is used to enhance plant growth. In this research 15:15:15 was applied three times during the year. Manure was added every three months. During time of flowering Potassium was applied to induce flowering and retention of fruits.

Pest and diseases

A king of bacteria of the main veins was observed during this study. Previous study suggests that excess humidity causes proliferation of soft rot caused by the *Erwina carotoyora* bacteria. Also, a dry rot is caused by extreme soil moisture.

RECOMMENDATIONS

Based on the finding of this study, it is recommended to establish plantation of Pitahaya in areas having the soil type that were tested.

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