MedCrave
Step into the World of Research

Horticulture International Journal

Research Article

Open Access

CrossMark

Organic cultivation of two species of pitahaya (*Selenicereus undatus* and *Selenicereus megalanthus*) in the Southeast of Mexico

Abstract

Both species of Pithaya *Selenicereus undatus* and *Selenicereus megalanthus*, were established on the 25th of May and the 26th of June, 2019. Three hundred and forty-four cuttings were planted. The seedlings used were 30cm long, previously rooted at the ranch for three months with vegetable soil and worm-compost in a protective cultivation system using horticulture shadowed cloth with 70% sunlight penetration. The substratum that was used to plant was of organic existence enriched with worm-compost and mountain microorganisms. These plants were planted in rows of high density with a distance of 50cm interspersing between the two species. The organic products that were used to enrich the plants were created at Rancho Alegre by mountain microorganisms, cattle, sheep, and horse manure, vegetable carbon, wood ash, milk, molasses, saltwater, garlic, onion, habanero chile (Capisum Chinese Habanero Group), Neem tree leaves (Azadirachtaindica), soap, rock flour, yeast, Sulfur (S), Potassium hydroxide (KOH), vegetable oil, and Calcium oxide (CaO), the schedule is ongoing cyclically. Three hundred kilograms were produced in the first year, a total of 8 groups every 19 days, with fruit up to 960 grams, where the normal weight of pitahayas in the Southeast of Mexico is between 350-450 grams. It was concluded that the use of organic products demonstrated a significant difference between production and time of fruit bearing. A favorable result is observed between the use of products and the results obtained in this production of pitahaya, that, given the first year, greatly surpasses other reference production results.

Keywords: pitahaya. hylocereus, selenicereus, organic, epiphyte, cactaceae, hemiepiphyte

Volume 5 Issue 1 - 2021

Mendoza - Barrera Victor M,[1] Ortega - Ramirez Marynor E,[2] Galán - Jímenez, Miguel Á,[1] Burelo - Ramos Carlos M,[3] Campos - Díaz Manuel J[3]

[1]Company Abonos Orgánicos, Rancho Alegre, Comalcalco, México

[2]Facultad Maya de Estudios Agropecuarios, Universidad Autónoma de Chiapas, México

[3]Universidad Juárez Autónoma de Tabasco, México

Correspondence: Ortega Ramirez Marynor E, Facultad Maya de Estudios Agropecuarios, Universidad Autónoma de Chiapas, México, Telephone 9341102486, Email Marynor.ortega@gmail.com, ranchoalegre30@live.com.mx

Received: December 07, 2020 | **Published:** January 07, 2021

Abbreviations: Kg, kilogram

Introduction

Pitahayas have been cultivated on family farms since ancestral times[1] and more recently given the physiological characteristics of the cacti such as the adaptability and the resistance to long periods of drought, different environmental conditions and the scarcity of water that is required to grow, have made it possible that its cultivation is easy and economically profitable in many parts of the world, in addition to the delicious flavor and the consistency of the fruit that it brings of high economic value. This has stimulated a commercial market of exotic fruit in Europe, Asia, and the Americas[2,3] these being highly valued in national and international markets.[3] It is consumed primarily as a dry fruit and can be used in fruit salads, sodas, marmalades, jams, beer, and wine, among others.[4,5]

The pitahaya fruit, given its physical and chemical features offer a wide market of exportation as a dry fruit, or frozen pulp and its ample and diverse forms of consumption, constitute productive and viable alternatives as long as the internal market is strengthened, promoting the habit of consumption (Meráz, 2003). On the other hand, pitahaya is a native plant that is highly adaptable to the tropical regions and conditions of seasonal variability of precipitation and light, with a lifespan of 25 to 30 years. (De Alba, 2003) (Martínez, 2006.)

Pithaya [*Hylocreus undatus* (Haworth) Britton & Rose], is a native plant that is grown throughout a vast part of Mexico, Central and South America. In Mesoamerica, this fruit was one of the main food sources of ancestorial Mexicans to survive in hard times (Meráz, 2003). Currently, there are approximately 10,000 hectares of specialized pitahaya plantations around the world, in traditional production systems, semi-specialized and specialized, found throughout Florida, Mexico, Guatemala, El Salvador, Nicaragua, Costa Rica, Venezuela, Panama, Uruguay, Peru, Brazil, Ecuador, Colombia, Thailand, Indonesia and Vietnam. Ecuador and Nicaragua are the main producers of *H. undatus* in Latin America as well as Colombia with variations of yellow pitahaya (*Selenicereus megalanthus*). In the same fashion, Vietnam and Thailand are the main global producers of *H. undatus*, consequentially developing modern cultivation technologies. (Ana Lid del Angel Pérez, 2012).

In Mexico, the cultivation of pitahaya is mainly located to two regions: the first is comprised of the states of Puebla and Oaxaca, where the cultivation has an average life of 20 years. Crop production is from May to September and the average yield is roughly 3 tons per hectare. The second region includes the Yucatan peninsula (Yucatán, Campeche, Quintana Roo) and the state of Tabasco where crop production is from July to October (Martínez, 2006.). At the beginning of the current century, Mexico with 100 cultivated hectares, approximately 300 tons of fruit were extracted each year, equivalating to 3 tons per hectare; half of the surface area and production volume corresponded to the Yucatan peninsula, where farms and various communities that belonged to the Henequen zone of the state of Yucatan, began to specialize in its cultivation.[6] The remaining was located in Tabasco, primarily in the Chontalpa region, the state of Puebla in the Cañada zones, the Valley of Tehuacan and the Mixteca as well as the Cañada zone in Oaxaca and in Autlan and Sayula in the state of Jalisco where production came from small farms. It is

estimated that in 2002, there existed 145 cultivated hectares of *H. undatus* in the country, from which approximately 450 tons of fruit were obtained annually.[6]

In this current project, the reach and the results obtained in organic cultivation of two species of pitahaya (*Selenicereus undatus* and *Selenicereus megalanthus*) are shown in the Southeast of Mexico, for their high demand in traditional use of Mexican cuisine, in addition to the importance of producing fruit from organic management, in an ergonomic system for harvesting focused on sustainability.

Cultivation characteristics

Selenicereus (A. Berger) Britton & Rose family subgenre of Cactaceae forming part of the Hylocereeae tribe, the most recent subdivision includes the species *Hylocereus* and *Selenicereus* and the species *Weberocereustonduzii* (F.A.C. Weber) G.D. Rowley and *W. glaber* (Eichlam) G.D. Rowley[7] comprised mostly of hemiepiphytes, climbers with angled stems, arial roots, large nocturnal flowers, generally white with globe like fruit.[8] Originally from tropical America with a distribution in Southern Mexico, the Caribbean, Central America, North and South America and the Southern part of the United States.[9] Th species *Selenicereus undatus* (Haworth) D.R. Hunt and *Selenicereus megalanthus* (K. Schumann ex Vaupel) Moran are hemiepiphyte cacti with large white nocturnal flowers, the *S. undatus* are from pink to red in color and yellow in *S. megalanthus*, they are known as red pitahaya, yellow pitahaya or simply pitahayas.

In the last 20 years red pitahaya and yellow pitahaya have been cultivated extensively for their commercialization on a global level. In Central America and Israel *S. undatus* is mainly cultivated,[10] in the case of *S. megalanthus*, Colombia is the main producer of yellow pitahaya in the world, followed by Israel and Mexico.[5] The price of red pitahaya on the international markets is very elevated as it is considered an exotic fruit; in Europe a kilo costs between 7 and 10 dollars (Castillo-Martínez 2006), in Israel the price per kilo has reached 26 dollars in the Hebrew and European markets.[11] In Mexico, the states that have shown interest for the cultivation of these plants are: Puebla, Veracruz, Jalisco, Chiapas, San Luis Potosí, Michoacán, Oaxaca, Campeche, Yucatán and Quintana Roo, of which the Yucatan Peninsula is the greatest surface cultivated with more than 300 hectares of production.[4] In Mexican regional markets, a kilo of red pitahaya can cost between 10 and 20 pesos reaching up to 30 pesos wholesale and retail reaching up to 60 Mexican pesos.[4]

The *Selenicereus* fruit have great significance in the industry, natural dyes can be obtained from the peel and the pulp, the seeds given their unsaturated fatty acid content have potential for food, cosmetic or pharmaceutical use.[12] The importance of the cultivation of *S.undatus* and *S. megalanthus* for their commercialization has allowed for the development of a wide variety of studies about the quality of the fruit, commercialization, nutritional composition, cultivation, phenology, organic fertilization, physical chemistry, genetics, post-harvest management, morphology and production systems.[13–22]

Materials and methods

On May 29th, 2019 organic pitahaya planting began in the determined estate of Rancho Alegre located in the community of Cuxcuchapa belonging to the city of Comalcalco, Tabasco and property of Víctor Manuel Mendoza Barrera, agronomic engineer (Figure 1).

The two species that were planted were *Selenicereus undatus* and *Selenicereus megalanthus* beginning on the 25th of May of 2019 and on June 26th there were 344 cuttings established, as shown in Table 1.

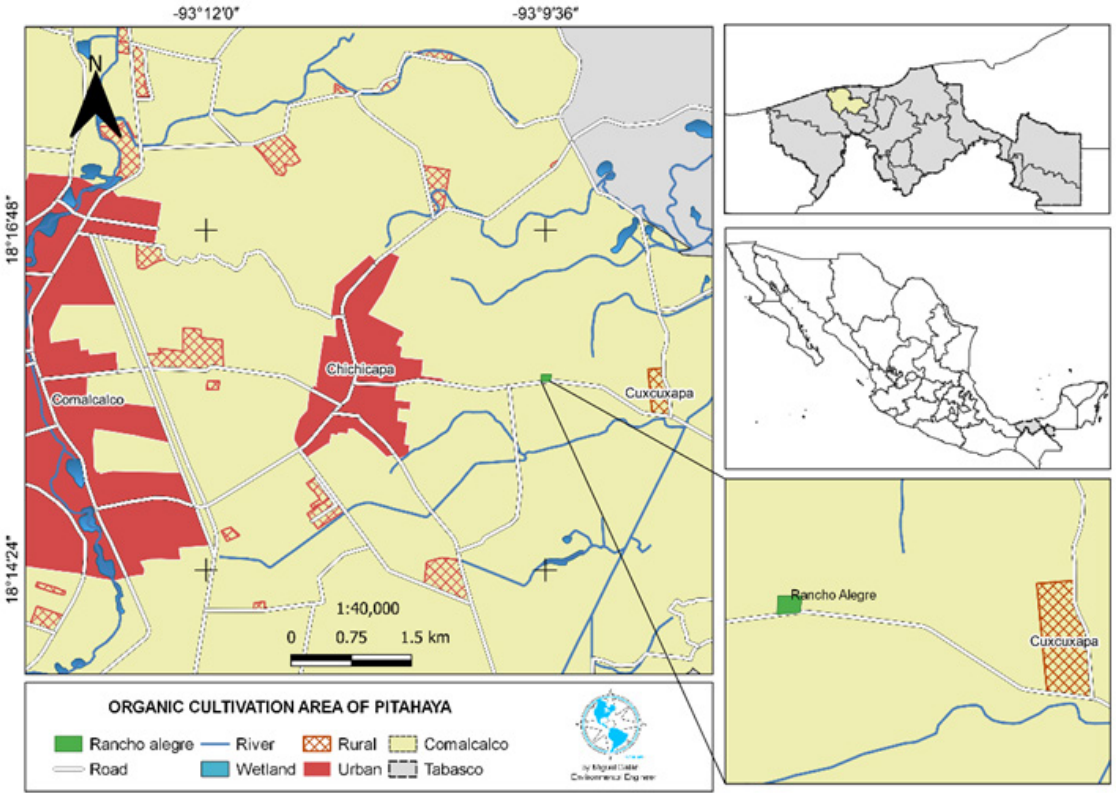

Figure 1 Location of estate.

Table 1 Established cuttings

Number	Seed time	Cuttings		Total
		Selenicereus undatus	Selenicereus megalanthus	
1	05/29/2019	24	12	36
2	05/31/2019	24	12	36
3	05/31/2019	24	12	36
4	06-10-2019	30	0	30
5	06-11-2019	30	0	30
6	06-12-2019	24	12	36
7	06/13/2019	24	12	36
8	06/13/2019	24	12	36
9	06/25/2019	24	12	36
10	06/27/2019	20	12	36
Total		248	96	344

The seedlings used were 30 cm long (Figure 2) previously germinated at the ranch for three months with vegetable soil and worm-compost in a protected cultivation system using horticulture shadowed cloth with 70% sunlight penetration. The purpose of this system is to avoid the entrance of predators such as birds, squirrels, foxes, etc. However, also preventing the entrance of pollinators consequentially using hand pollination technique. This is a species of the cacti family that only blooms at night; therefore, pollination is nocturnal.

Figure 2 Cuttings used and distance between plantings.

The substratum that was used to plant was the existing organic floor enriched with worm-compost and mountain microorganisms. They were planted in high density in a line with a distance of 50 cm interspacing one species from another (Figure 3).

The organic products are produced at Rancho Alegre by mountain microorganisms, cattle, sheep, and horse manure, vegetable carbon, wood ash, milk, molasses, saltwater, garlic, onion, habanero chile (*Capisum Chinese Habanero Group*), Neem tree leaves (*Azadirachtaindica*), soap, rock flour, yeast, Sulfur (S), Potassium hydroxide (KOH), vegetable oil, and Calcium oxide (CaO), the schedule is ongoing cyclically. (Table 2).

Figure 3 Cultivation and density of 50 cm between plants.

Table 2 Program of application of organic products in pitahaya production area

Date	Products
August 5th, 2019	Mountain microorganisms
August 12th, 2019	Biol (fermented liquid organic fertilizer) + ormus
August 19th, 2019	CaldoSulfocálsico (organic fungicide)
August 26th, 2019	Biol (fermented liquid organic fertilizer) + ormus
September 2nd, 2019	Biochar
September 9th, 2019	Organic Insecticide (potassium soap)
September 16th, 2019	Biol (fermented liquid organic fertilizer) +ormus
September 23rd, 2019	Caldo de cenizas (organic insecticide)
September 30th, 2019	Biol (fermented liquid organic fertilizer) +ormus
October 7th, 2019	Organic Insecticide (potassium soap)
October 14th, 2019	Biol (fermented liquid organic fertilizer) +ormus
October 21st, 2019	CaldoSulfocálsico (organic fungicide)

Results

From the hand pollination technique, a 95% fruit bearing was obtained (Figure 4).

From use of organic fertilizers, the following results were obtained:

The fruit ripening of the first crop was achieved in only 19 days (June 18th, 2020 first blossom, - July 7th, 2020 the first ripening) with pitahaya weighing up to 960 grams as observed in Figure 5.

Figure 4 (left) General view of the initial fruit production (right) Quality of fruit.

Figure 5 Weight in grams of harvested fruit.

Eight crops were obtained up to the last harvest on Tuesday, November 3rd, 2020 for a total of 300 kg. In Figure 5, the kilograms of the harvested fruit are shown, the quantity and weight of each species obtained is observed.

With regards to the average values obtained, the following was recorded as shown in Table 3, with an estimated equivalent total of more than 4 thousand kilograms of fruit, which greatly surpasses the estimated amount for the first year of production.

Table 3 Average values of fruits for the first year of production

Species	Average production / of plant (kg)	Average weight/fruit (kg)	Estimated performance /Ha
Selenicereus undatus	1.9	0.723	2908
Selenicereus megalanthus	1.25	1.25	1938

Discussion

In general, the bibliography indicates that in the first year we can obtain one or no pitahaya, from 4-5 crops per season that normally take from one month to 45 days; however, this project came to obtain a total of 300 kg obtained in an area of 617 m^2 the first year, with a total of 8 crops obtained every 19 days, which surpasses the reports by Rodríguez.[6] This production consisted of 179.4 kilograms of *Selenicereus undatus* and 119.6 kilograms of *Selenicereus megalanthus*, respectively. The highest recorded weight of *Selenicereus undatus* was 960 grams while the highest recorded weight of *Selenicereus megalanthus* was 775 grams, compared to the

normal weight of pitahay as in Southeast Mexico which are typically between 350-450 grams.

Estimated production for this project for both species was 4.845 tons per hectare exceeding the approximate production of 3 tons of fruit per hectare in Mexico at the beginning of the century.[6] Estimated production of red pitahaya was 2.908 tons per hectare while production of yellow pitahaya was 1.938 tons per hectare.

The flavor obtained, from the fruit produced with organic products was more bittersweet, agreeable, and palatable than commercial convection, tests of fruit quality remain to be completed.

Conclusion

The use of organic products showed a substantial difference between production and time of fruit bearing. A favorable use of the products and obtained performance of pitahaya production is observed that given the first year, greatly surpasses the performance expressed in other reference projects.

Acknowledgments

Thanks to the company Abonos Organicos Rancho Alegre for their participation in this project, and in the provision of all of the organic products and knowledge in the application.

Conflicts of interest

No conflicts of interests exist.

References

1. Castillo-Martínez R. Aprovechamiento de la pitahaya: bondades y problemáticas. *Caos Conciencia*. 2006;1:13–18.
2. Le Bellec F, Vaillant F, Imbert E. Pitahaya (*Hylocereus*spp.): a new fruit crop, a market with a future. *Fruits.* 2006;61:237–225.
3. Ortiz-Hernández YD, y Carrillo-Salazar JA. Pitahaya (*Hylocereus*spp.): a short review. C*omunicata Scientiae.* 2012;3(4):220–237.
4. Castillo-Martínez R. Caracterización morfologica, reproductora y fisiología de genotipos de hylocereus undatus (Cactaceae) de la península de yucatán. Tesis de Doctorado. Universidad Nacional Autónoma de México (UNAM). *Posgrado en Biológicas, Facultad de Ciencias*. México. 2002;111.
5. Perea-Dallos M, Tirado A, Micán-Gutieerez Y, et al. Cactaceae, pitahaya, selenicereus megalanthus (K. Schum. ex Vaupel) moran (cactaceae). *Biotecnología aplicada al mejoramiento de los cultivos de frutas tropicales*. 10:37:53.
6. Rodríguez-Canto. Pitahaya (Hylocereus undatus). Producción y comercialización en méxico. series de reportes de investigación. universidad autónoma de chapingo. centro de investigaciones económicas, sociales y tecnológicas de la agroindustria y la Agricultura Mundial (CIESTAAM). 2002;36.
7. Korotkova N., Borsch T. y Arias S. A phylogenetic framework for the Hylocereeae (Cactaceae) and implications for the circumscription of the genera. *Phytotaxa*. 2017;327(1):001–046.
8. Hunt DR. The new cactus lexicon: descriptions and illustrations of the cactus family. David Hunt Books. Milborne Port, UK. Pp. 2006;1–373.
9. Anderson DF. The cactus family. Timber Press, inc. Portland, Oregon. USA. 2001;777.
10. Montecinos-Cruz JA, Rodríguez-Larramendi L, Ortiz-Pérez R, et al. Revisión bibliográfica Pitahaya (Hylocereus SPP.) un recurso fitogenético con historia y futuro para el trópico seco mexicano. *Cultivos Tropicales*. 2015;36:67–76.
11. Ortiz YH. Hacia el conocimiento y conservación de la Pitahaya (Hylocereusspp.), IPN-SIBEJ-CONACYT-FMCN, Oaxaca, México. 2000;124.
12. Esquivel P. Araya-Quesada Y. Características del fruto de la pitahaya (*Hylocereus*sp.) y su potencial de uso en la industria alimentaria. *Revista Venezolana de Ciencia y Tecnología de Alimentos*. 2007;3(1):113–129.
13. Legaria-Solano JP, Alvarado-Cano ME, Gaspar-Hernández *R.* Diversidad genética en pitahaya *Hylocereus undatus* (Hawort) Britton y Rose. *Revista Fitotecnia Mexicana*. 2005;28:179–185.
14. Rodríguez-Rodríguez DA, Patiño-Gutiérrez Ma P, Miranda-Lasprilla D, et al. Efecto de dos Índices de Madurez y dos temperaturas de almacenamiento sobre el comportamiento en poscosecha de la pitahaya amarilla *(Selenicereus megalanthus* Haw.). *Rev Fac Nal Agr Medellín*. 2005;58(2):2827-2837-2857.
15. Osuna-Enciso T, Ibarra-Zazueta Ma E, Muy-Range Ma D, et al. Calidad postcosecha de frutos de pitahaya (*Hylocereus undatus* Haw.) cosechados en tres estados de madurez. *Rev Fitotec Mex*. 2011;34(1):63–72.
16. Figueroa-Chávez WA. Estudio de factibilidad para la producción y comercialización de pitahaya amarilla (*Selenicereus megalanthus* K. Schum.) En la Comuna El Azúcar, Provincia de Santa Elena. Tesis de Licenciatura. Universidad Estatal Península de Santa Elena Facultad de Ciencias Agrarias Carrera Administración de Empresas Agropecuarias y Agronegocios. La libertad. 2016;88.
17. Osuna-Enciso. Fenología reproductiva, rendimiento y calidad del fruto de pitahaya (Hylocereus undatus (How.) Britton And Rose) en el valle de culiacán, Sinaloa, México. *Agrociencia*. 2016;50:61–78.
18. Téllez-Gaitán JF. Análisis del sistema de producción de pitahaya (Hylocereus undatus Britt and Rose) e identificación de riesgos potenciales a la calidad e inocuidad de fruto para exportación, La Concepción, Masaya. Tesis de Maestría. Universidad Nacional Agraria, Facultad De Agronomía. Managua, Nicaragua. 2016;116.
19. De la Cruz-Sánchez E, Morán-Morán J, Cabrera-Verdezoto R, et al. Respuesta de la pitahaya roja (*Hylocereus undatus*) a la aplicación de dos abonos orgánicos sólidos en la zona de San Carlos, Los Ríos, Ecuador. *IDESIA (Chile).* 2019;37(3):99–105.
20. Sotomayor A, Pitizaca S, Sánchez M, et al. Evaluación físico química de fruta de pitahaya (*Selenicereus megalanthus*) en diferentes estados de desarrollo. *Enfoque UTE*. 2019;10(1):89–96.
21. Ortiz AT, Assari-takahashi. Quality of fruits of pitaya (Hylocereus undatus [Haworth] Britton & Rose) according to physiological maturity. *A review Revista Colombiana de Ciencias Hortícolas*. 2020;14(1).
22. Verónica-Ruíz A, Urcia-Cerna J, Paucar-Menacho LM. Pitahaya (Hylocereusspp.): Cultivo, características fisicoquímicas, composición nutricionaly compuestos bioactivos. *Scientia Agropecuaria*. 2020;11(3):439–453.