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FLORAL BIOLOGY OF *Syagrus oleracea* cf (Mart.) Becc IN BARIRI PARK, PARA MINAS CITY, MG, BRAZIL

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ABSTRACT:

*S. oleracea*is a species belonging to the family Arecaceae, is popularly known as guariroba and originally from Brazil.It is located in the tropics, lying naturally composing the vegetation of forests in several states, such as Goiás, Minas Gerais, MatoGrosso do Sul, MatoGrosso, Bahia, São Paulo, Rio de Janeiro, Espirito Santo and Paraná.Pollination is the process by which male reproductive cells of higher plants (pollen grains) produced in the anthers of flowers, are transferred to the female recipient (stigma) of the same plant or plant of the same species.Through this process, the pollen sowing the flower stigma, beginning the formation of the pollen tube, which will culminate with the fertilization of the egg cell.Thus the study of floral biology of this species and other justified by the importance of this process in reproductive propagation of species.Excessive use of pesticides in agriculture has led to numerous endangered pollinators become the pollen grain process for unviable egg cell, which may jeopardize the survival of many species. This work aims to study the reproductive biology of the species *Syagrus oleracea* cf and its floral morphology in order to provide a basis for understanding the pollination process of this species. Its main objectives Identify potential pollinators of S. oleracea; Determine schedules and frequency of pollinator species visitation; Featuring floral, external and internal morphology of *S. oleracea*; Determine the presence of relevant substances and structures to their relationship to pollinators.

Keywords: *Floral Biology, Syagrusoleracea, pollination*

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1. INTRODUCTION:

REPRODUCTIVE BIOLOGY OF ANGIOSPERMS

Angiosperms, or Anthophyta, currently make up the dominant group of terrestrial plants.The characteristic derived from this group is a flowers production and fruits.The flowers contain the reproductive parts of plants and, by definition, is a particular growth branch that carries sporophylls (leaves producing sporangia).The structure defining the flower is the carpel (cup), eggs that contain, inside which develops the female gamete (egg cell) (RAVEN,2001).

The flowers can be grouped in several ways, in aggregates called inflorescences. The stem of inflorescence or isolated flower is called peduncle, while the stem of individual flower on an inflorescence is called a pedicel.The part of flower stem on which floral elements are attached is called a receptacle.

Many flowers include two groups of sterile appendages, the sepal and petals, which are attached to receptacle, just below the fertile flower parts, the stamens and carpels. The sepals are located beneath the petals and stamens beneath the carpels.Collectively sepals form the chalice, and petals form the corolla.Together the chalice and corolla form the perianth.

The stamens, collectively denominated androceu, are microsporophiles, that is, microspores produce structures.In almost all angiosperms, stamens consist of a thin filament or thread, attached to apex one anther bilobedmicroesporângios containing four or pollen sacs (RAVEN, 2001).

Within anther, the pollen grains that will disperse and reach the female parts will give rise to male plants gametes.

The carpels, collectively termed gynoecium, are megaporephilic folded and welded longitudinally, sheltering in their interior one or more eggs.Inside the egg will be produced the female gametophyte that will contain the Oosphere.

In most flowers, groups of fused carpels are differentiated into ovary, while their medial part merges into stylet through which pollen tubes grow. At the apex of the stylus there is the stigma that receives the pollen grain.

Pollination is a process by which male reproductive cells of higher plants (pollen grains) produced in the anthers of flowers, are transferred to female receptor (stigma) of the flower in the same plant or other of the same species(FIGUEIREDO,2000).Through this process, the pollen grain reaches

toflower stigma, initiating the formation of pollen tube, which will culminate inoosphere fertilization.

The pollination process probably arises in Gnetophytes and modern Cycadaceae. Insects feeding on pollen The adaptive advantage of animal pollination will favor the emergence of plant structures specializing in attraction of pollinating agents, the flower. This fact is such an important plants evolution, which contributed to the emergence, expansion and diversification of a largest group called higher vegetal, the angiosperms. Insects deeply influenced the course of angiosperms evolution and contributed to diversification, leading to extreme specialization through the co-evolution (RAVEN, 2001).

The flower phenotypic characteristic plays an important role in attracting its pollinator. Flowers should draw attention of pollinator by characteristics such as size, color pattern or containing specialized structures, called nectaries.Nectaries produce and secrete a sugary, nutritious and energetic substance, used as food by pollinators, the nectar (RAVEN, 2001).

The more attractive, the greater the attractiveness of insects, and any change in flower structure that provides a greater number of visits, offers a selective advantage for the species.When a plant species is pollinated by a single pollinator or by a and other floral parts can return to these pollen sources and transfer it from plant to plant.This system is more efficient than passive pollination by the wind, and allows a much more accurate pollination with smaller pollen amount. few types, natural selection favors specializations related to the characteristics of these visited. Many changes have evolved in flowers promoted of consistency of one specific type of a visitor to a particular type of flower (RAVEN, 2001).

The ARECACEAE family is formed by shrubs or arboreal plants, introducing the stem unbranched type.Its palm leafbacksides are wandering or with long petioles and invaginating thelarge sheath. These plants have small flowers unisexual or rarely hermaphrodite with any flashy perianto, trimer gathered in inflorescences particulate, axillary, protected by one or more woody bracts.The male flowers generally have 6 stamens, while the female flower has a super ovary, tricarpelar, trilocular, with one ovary at each lobe. Popularly known as coconut and palm trees produce a nut or fleshy, and indehiscent seed endosperm with abundant, generally oily (JOLY, 2002).

*S. oleracea*species belonging to the family ARECACEAE, is popularly known as guariroba and originally from Brazil.It is located in the tropical regions, being found in a natural way composing the vegetation of the forests

in several States, such as: Goiás, Minas Gerais, MatoGrosso do Sul, MatoGrosso, Bahia, São Paulo, Rio de Janeiro, Espírito Santo and Paraná.

This work look for study the reproductive biology species *Syagrus oleracea* cf plants and its floral andvisiting frequency; And correlate the morphology features with floral biology of this species.

3. MATERIALS AND METHOD:

3.1.*Studyarea:*

The ecological and sporting park of Bariri is an area composed of sports courts, athletics tracks, lagoon and a diversity of species, animals, vegetables etc. This Park is located in the Pará de Minas City, MG state.

S. oleracea individuals were studied (FIG. 1) that composes part of the ornamental vegetation of the recreational area of park, constituting a total of 25 individuals.

FIG. 1.*Syagrus oleracea* cf plant situated in Bariri Park, showing the inflorescence.

Picture: Amanda Lemos

morphology in order to provide information for understanding the pollination process of this species. Our main objectives is identify the potential pollinator of *S.oleracea*;Determine yours time

Pará de Minas is located in central part of Minas Gerais State (19º 53'latitude south; 44º31' longitude West), area of 552.6 km². The municipality borders on the north with Onça do Pitangui and São José da Varginha City, on the east with Esmeralda and Florestal City, on the south with MateusLemes, Itaúna and Igaratinga City and to the west with Conceição do Pará City. The region under study presents average annual temperature varying between 19º and 23ºC.

These values indicate the predominance of medium to high temperatures in region during most part of year, especially during the spring and summer.The hottest months, January, present average maximums ranging between 28º and 30ºC. In the fall - winter period, there is a significant decrease in temperature, with the average of the coldest months in July varying between 15º and 18ºC.In Para de Minas, live 73,007 people, of whom

35,855 are women and 37,152 are men(ZAMPESE *et al.*, 2004).

3.2 ***Collection and Identification of Pollinators:***

For the collection of insect pollinators, a collector was used that was made with a piece of wood to support and tulip fabric for formation of the collector bulb.

For insect sacrifice the method used was lethal glass with toxic liquid. This is prepared by placing a cotton pad containing formol on the bottom of the glass, then cover it with a bundle of cardboard tightly fitted to the inner wall of the glass. The perforations are made in the cardboard side edges which allow the passage of gases to poison the upper glass (ALMEIDA *et al*, 1998).

Samples were collected during the flowering *S. oleracea* of 2005 into three periods.

1st collection period:

Samples were collected on three consecutive days from 21 to 23.04.2005 in three times: 10:00, 15:00 and 19:00, in order to identify potential pollinators. The insects collected were identified in FAPAM(Pará de Minas Faculty) by the Professor StênioAlves.

2nd collection period:

The second collection was held from 05 to 08.07.2005, collected in a single plant at 06 times (09:00, 10:00, 13:00, 15:00, 17:00 and 19:00) to determine the period of greatest visitation of the flowers. The new species, collected in this period, were identified in the Laboratory of Ecology of bees of the Department of Biology of the ICB of UFMG.

3rd Collection Period:

In the third sample was collected on days 20 and 04 21.08.05 flowering plants Bariri within the park, and in two different shifts: Morning (from 10:00 to 12:00) and evening (15:00 to 17:00) where three species of different bees were also collected.

Animal species through the dry route: Direct bonding: Pinning is the best process for the conservation of insects with a highly sclerotinized body.A piece of Styrofoam is prepared and the pins in this case are inserted directly into the body of the insect vertically as a shield, so that it is at an angle of 90 ° to the longitudinal axis of the insect's body (ALMEIDA e*t al*, 1998).

3.4 ***Characterization of Floral Morphology of*** *Syagrusoleracea:*

It was performed a cut of the inflorescence and preserved in FAA. This was prepared in an exhaust hood, this mixture is composed of the following solutions: Alcohol 95% (50ml); Acetic Acid (5ml);Formaldehyde (10 ml) and distilled water (35 ml)(MACEDO*et al,*1997).

The external structures of the inflorescence in fresh material were observed and analyzed with the aid of a magnifying glass. Then he proceeded to cut the free hand, longitudinal and transverse flower of *S. oleracea.*

The sections were stained with Saflablau, and 12 cuts were separated for reaction testing substances.Starch were carried out identification tests, by staining with Lugol, lipids with Sudam III and phenolic compounds by staining with $FeCl_2$(KRAUS, 1997).

3.5 ***Data analysis:***

For the calculation of averages and determination of the time of greatest visitation the absolute data were transformed into relative frequencies of the total sampled during the day of collection following the formula:

$$Sampling\ Frequency\ (F) = \frac{Total\ individual\ collected}{Total\ species\ collected}$$

The calculation was done for the second sampling period, with a repetition being considered each day.

4. RESULTS AND DISCUSSION:

4.1 ***Identification of pollinators(1st collection period):***

In the first period they were collected and identified two types of different species of bees:*Apismellifera*(FIG. 2) and *Tetragoniscaangustula*.In this period main objective was the identification of pollinators therefore not recorded the number of bees presented in local as shown in TABLE 1.

TABLE 1. Identification ofhoneybees pollinating*Syagrusoleracea*in April 2005.

	Schedule		
	10:00am	**3:00 p.m.**	**7:00 p.m.**
04/21/05	*A. mellifera* and *T. angustula*	*A. mellifera*	*A. mellifer*
4/22/05	*A. mellifera* and *T. angustula*	*A. mellifera*	*A. mellifer*
04/23/05	*A. mellifera* and *T. angustula*	*A. mellifera*	*A. mellifer*

FIGURE 2.*Apismellifera*coleted while visiting the

Picture: Amanda Lemos

The bee *A. mellifera*is commonly found asapollinator species of flora, especially in disturbed areas(TAUR and LAROCA, 2004; MORGADO e*t.* a*l.*, 2002; MORAIS e*t. al.*,2000).Studies by THUM and COSTA (1998/99) show that this species is found visiting

*Syagrusramanzoffiana.A. mellifera*is a European species of APIDAE family, subfamily Apinae,producing honey forming society with one queen various drones and workers (GALLO *et.al.*,2002).

*T. angustula*that is native without stinger MELIPONINAE belonging to the subfamily, and this species were communities with many queens or queen bees together, only one of which is impregnated, and its nests in hollow stick, or trees Or abandoned termite mounds. As no sting can be created near houses, raising animals, posing no risk whatsoever.You have collector apparatus "pollen basket"where the pollen is collected (Gallo *et. al.*,2002).

4.2 ***Visitation frequency(2nd collectionperiod):***

The largest collection was*A. mellifera* with a total of 45 individuals. On the other hand, *T.angustula*virtually disappeared from the collection, recording only two individuals at 9:00 am (TAB.2). *A. mellifera*has the most evolved system of communication through a dance that uses the sun as a reference, and vibrate the abdomen to indicate the amount of nectar available (GALLO *et.al.,* 2002).This mechanism provides the direction of theperarias, which may explainthe large number of individuals collected in different periods and times.

TABLE2. Total number of pollinating bees *Syagrusoleracea*in three days of collection.

	A. mellifera	***T. angustula***	***T. hyalinata***
9:00 a.m.	10	2	11
10:00am	16	0	17
1:00 p.m.	11	0	6
3:00 p.m.	7	0	5
5:00 p.m.	1	0	0
7:00 p.m.	0	0	0
Total	45	2	39

During this period, a third bee species visiting the flowers were identified: *Trigonahyalinata.*During the sample period, collected a total of 39 individuals of this species distribute of the times as TAB.2. This species is a native bee that has no sting and

according to the Agency FAPESP they exchange information about food location and act to hide it

are food source tracks to the hive, *T. hyalinata*leaves shorter marks, preventing workers from other groups know where the food is.

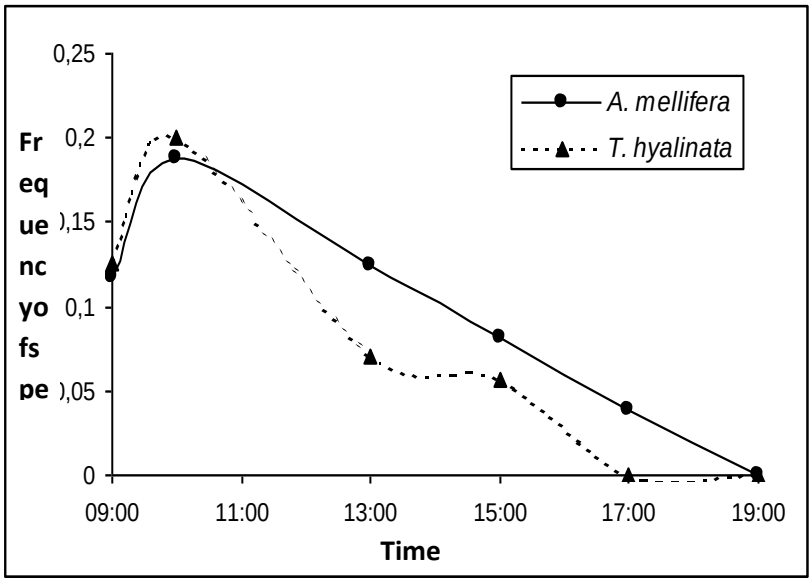
Bees leave odoriferous substances marking the trajectory of the food source. Initially, the smell points appear in greater quantity as the workers approach the chosen flowers. This odor comes from a secretion produced by the mandibular glands of the insects and lasts on average 15 minutes, which is the time necessary for

from the bees of other colonies. While some species

the food to be identified by other insects of the colony

The sampling frequency of each species times throughout the day, shows that most visits occurred between the surcharges 9:00 or 11:00 hours (FIG. 3). Sincethe two species*A. mellifera and T. hyalinata*showed the same peak frequency and decreasing during the day. The last collection*T. hyalinata*was at 17:00, while the last collection *A. mellifera* occurred at 19:00 (FIG.4).

FIGURE 3. Relative Frequency of Polinizator bee species collected in *Syagrusoleracea* inflorescence during ten hours of observation.



Picture: Eduardo Corrêa

FIGURE 4. *A mellifera*individualsvisitingthe*Syagrus. Oleracea* inflorescence, during morning

Picture: Amanda Lemos

The largest number of subjects in the morning was also recorded byTHUM (1998) in *Syagrusromanzoffiana,*in which there is a predominance of *A. mellifera.*These colors,and the bees use the sun to their orientation in the external environment of the hive, when the sun intensity decreases, returning to the hive in the evening periods (VILLENEUVE e DÉSIRÉ, 1975).This behavior may justify the highest collections in the period from nine to ten o'clock and the decrease during the afternoon periods.

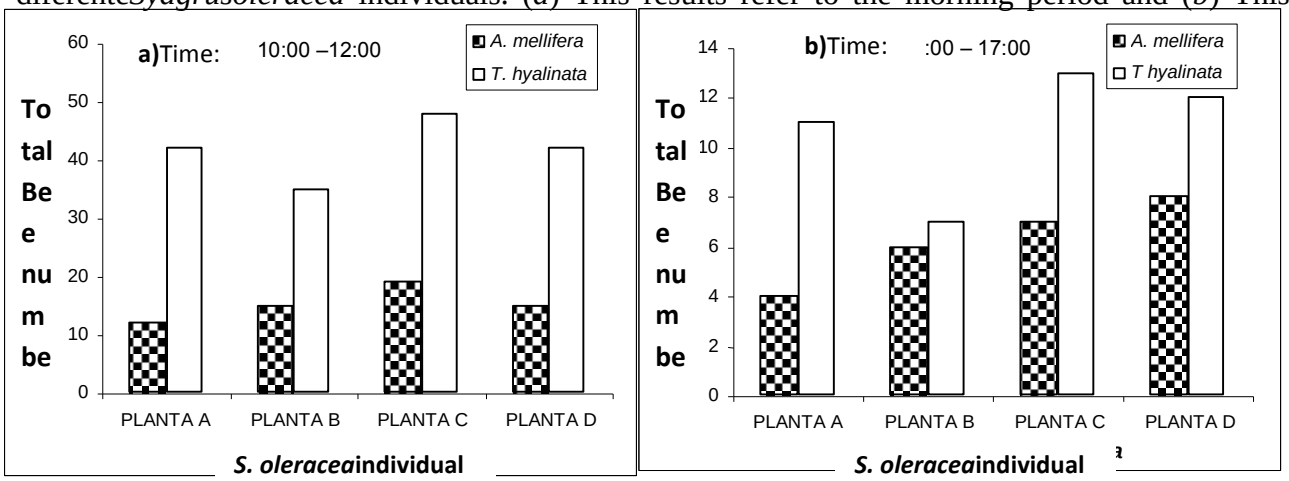
4.3***Variation* in *the number of pollinators between individuals ofS. oleracea(3rdcollectionperiod):***

During this period, four individuals were assessedwith*S. olerace*inflorescence, aiming to identify the variations in the number and pollinator between individuals of plant species.

In all plants were again found pollinating species*A. mellifera*and*T.hyalinata.*The number of*T. hyalinata*was larger than*A. mellifera*both two zones (FIG.5*a* and*b).*

There was no significant variation in results from different individuals considering*S. oleracea.*

FIGURE 5. Total number of collected bens during the two days period among four diferente*Syagrusoleracea* individuals. (*a*) This results refer to the morning period and (*b*) This

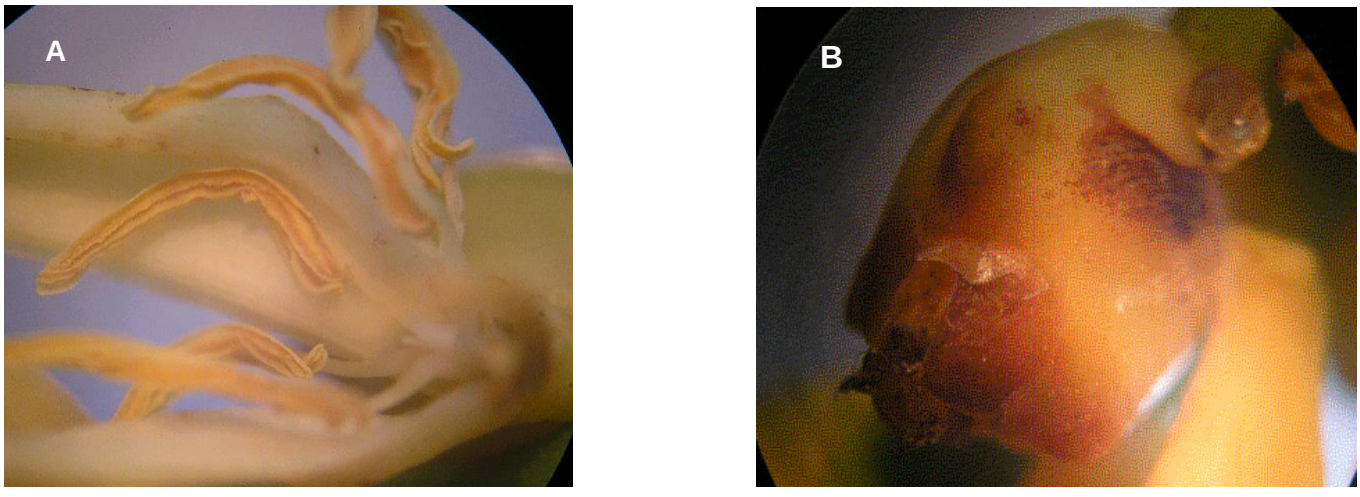


In early spring, the number of flowering plant species increases, thus increasing the availability of nectar sources. According MORGADO*et.al*(2002), this increased availability of food sources can lead to a reduction in*A. mellifera* visitation frequency will have a greater dispersion of individuals to other flowers from other plant species.

4.4.*Floral Morphology*

The flowers of *S. oleracea* are grouped into aggregates called paniculate inflorescence yellow color and protected by a large bract.This inflorescence is composed of imperfect flowers, that is, they present stamens and carpels in different flowers. However, it is a plant monoecious since the male and female flowers are found in the same individual (Fig. 6 *b*).

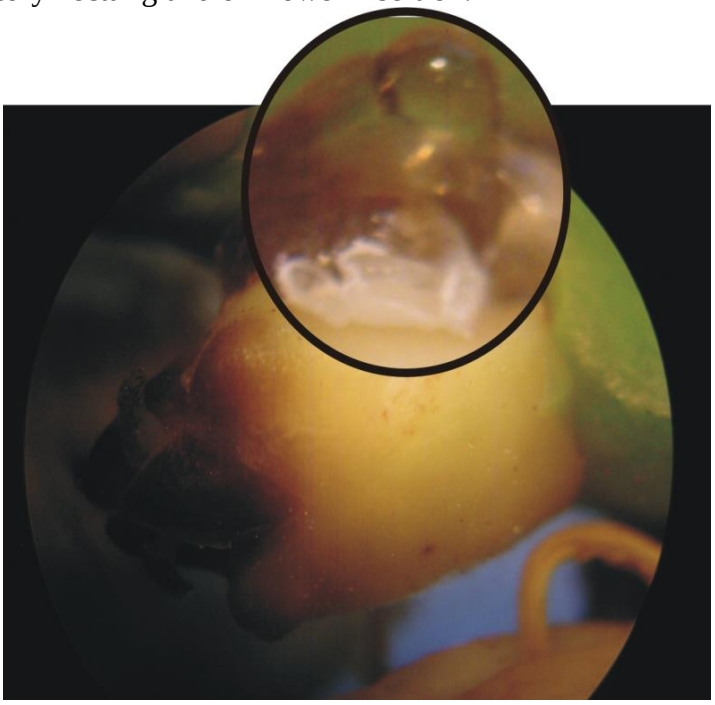
FIGURE 6. Sexual Dimorfism in *Syagrusoleracea.*(*a*)Male Flowers. (*b*) Female Flowers showing in flower base the nectaries in the basal flower.



In *S.oleracea,*the perianto undeveloped calling attention to its yellow coloring.With the aid of a magnifying glass it was possible to identify nectar-secreting glands located at the flower base, as shown in detail in FIGURE 7.

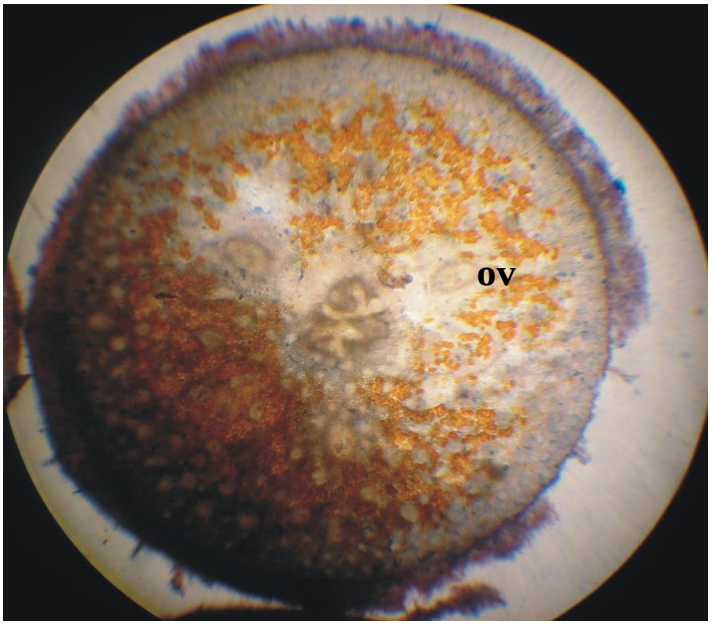
Ovarian cross sections show that this species is tricarpellate, indicating the presence of three eggs (FIG. 8).

FIGURE 7. Female Flower of *Syagrusoleracea*, showing in a 4x increase, in details are the secretory néctar gland on flower insertion.



Picture: Amanda Lemos

FIGURE 8. Tranversal cut of *Syagrusoleracea* ovary stainned with SAFRABLAU in 40x increase, showing the ovules presence (ov).



Picture: Amanda Lemos

These results show the typical morphology of the ARECACEAE family, as they have tricarperlares ovaries, inflorescences Protegacidic by bracts and sexual dimorphismmale flowers and female flowers(JOLY2002).

Flowers pollinated bybees, ie flowers that co-evolved with bees, have strong colors like blue and yellow, apre sitting distinct standards for efficient recognition, this pattern may indicate nectar guides, these marks identify the location of nectar. The necessities are typically located at the base of the corolla tube, which is accessible to specialized mouthparts (RAVEN, 2001). This would justify the characteristics observed in the species studied.

ATABLE 3 shows the results of reaction tests performed on four cuts ovarian*S. oleracea*.The data presented show the absence of significant amounts of reserve compounds such as starch and lipids, as evidenced by the negative reactions with LUGOL and SUDAM III respectively.

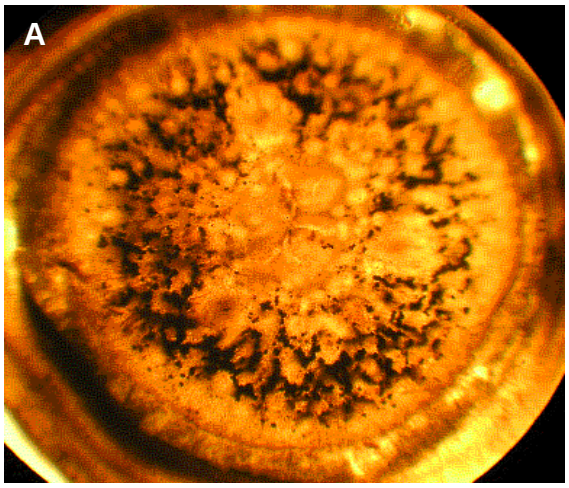
However, a positive reaction was observed for phenolic compounds. This reaction can be demonstrated by cutting the large amount of dark colored granules after reaction with ferric chloride (FIGURE 9*a* and*b*).

TABLE 3. Test Reaction in cross sections of *S. Oleracea ovary.*

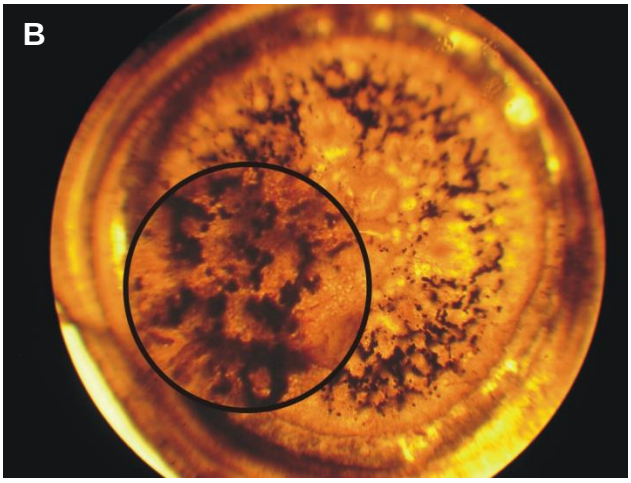
Repetitions	**Lugol**	**Sudam III**	**$FeCl_2$**
Cut 1	-	-	+
Cut 2	-	-	+
Cut 3	-	-	+
Cut 4	-	-	+

Note: (+) positive reaction (-) Negative reaction

FIGURE 9. Transversal Cut of *S. oleracea* ovary showing a positive reaction to the Ferric Chloride ($FeCl_2$). (*a*) Increasing at 40x, showing all cut with phenolic compounds stained in black by the $FeCl_2$. (*b*) Phenolic granules details stained in black inside the ovary cells.



Picture: Amanda Lemos



Picture: Amanda Lemos

A phenomenon known in nature as herbivory, has a negative effect on the host plant, because it reduces the chances of reproduction and development, therefore some plants produce selective characteristics of defenses against herbivorous insects. One feature is the presentation of phenolic compounds which provides a characteristically bitter taste (ODUM, 1989).The high concentration of phenolic compounds shown in ovarian will prevent pollination or other herbivores Ante in flowers.Onthe other hand, the nectar produced by the necessities in the flower base, will function as attraction of specialized insects in pollination.

5.CONCLUSIONS:

In this study we can identify the species as polinizadores*Syagrusoleracae,*species of bees*A. mellifera*, *T. angustula*and*T. hylinata.* The time of greatest visitation, by the pollinating species, was the period of the morning, between 09:00 and 12:00.The exotic species,*A.mellifera,*was present throughout the study period.The native species had alternating predominance dependent on the period of the year. The *S. oleracea*flowersshowed characteristicsofboth protection againstHerbivory, as pollinator attraction structures.

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