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Article

Landscape and Ornamental Potential and Phenology of *Palicourea rigida* Kunth (Rubiaceae)

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ABSTRACT

This study sought to evaluate growth variables and the phenological development of *Palicourea rigida* Kunth plants in a natural population and determine their ornamental potential. Ten plants were studied, their locations recorded using GPS, and evaluated monthly (December 2013 to December 2014). Plant growth was evaluated through characteristics such as plant height; height of the first fork; number of branches at the first fork; stem diameter 20 cm above the ground; and crown diameters in the north-south and east-west directions. Phenological monitoring was carried out qualitatively (observing monthly the presence and absence of the phenophases of leafing, flowering, and fruiting) and quantitatively (using a scale of one to ten). Each month, the part of the plant with the highest ornamental value at the time of evaluation was also determined, considering the stem, foliage, flowers, or fruits. The species *Palicourea rigida* showed slow growth, being a small plant with a low, small, rounded crown, few branches, evergreen foliage, and inflorescences with warm, orange-yellow flowers. The species flowers for nine months and fruits for eight months. *P. rigida* has characteristics that indicate high ornamental potential for use in landscaping projects.
Keywords: Cerrado; native plant; douradão; growth; ornamentation.

RESUMO

O presente estudo buscou avaliar variáveis de crescimento e o desenvolvimento fenológico de plantas de *Palicourea rigida* Kunth em população natural, e determinar seu potencial ornamental. Foram estudadas dez plantas, que tiveram suas localizações registradas por meio de GPS, avaliadas mensalmente (dezembro de 2013 a dezembro de 2014). O crescimento da planta foi avaliado através de características como: altura da planta; altura da primeira bifurcação; número de ramificações na primeira bifurcação; diâmetro do caule a 20 cm do solo e diâmetros da copa nos sentidos Norte-Sul e Leste-Oeste. O acompanhamento fenológico foi realizado de forma qualitativa (observando-se mensalmente a presença e ausência das fenofases folhação, floração e frutificação) e quantitativa (por meio de uma escala de notas de um a dez). Mensalmente, determinou-se ainda, a parte da planta de maior valor ornamental no momento da avaliação, considerando-se o caule, a folhagem, as flores ou os frutos. A espécie *Palicourea rigida* apresentou crescimento

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lento, sendo uma planta de pequeno porte, copa baixa, pequena e arredondada, pouco ramificada, com folhagem perene e inflorescências com flores de coloração quente, amarelo-alaranjada. A espécie apresenta floração durante nove meses, e frutificação por oito meses. *P. rígida* possui características que indicam alto potencial ornamental para uso inclusive em projetos paisagísticos.
Palavras-chave: Cerrado; planta nativa; douradão; crescimento; ornamentação.

Introduction

In Brazil, the exploration and insertion of native species to replace exotic ones in landscaping projects or in the recovery of areas degraded by anthropic action has gained visibility (Stumpf et al. 2012). The planned use of native plants, especially those endemic to specific regions, can offer an opportunity for population growth and reduce the risk of possible extinction in a given location, thereby leading to greater environmental balance (Gengo & Henkes 2012). In addition, the introduction of these plants into landscaping represents a way to value and conserve local flora.

Among these native plants is *Palicourea rigida* Kunth (Rubiaceae family), commonly known as bate caixa, chapéu de couro, douradinha, douradão, gritadeira-do-campo, tangaraca, or erva-de-rato-grande. It refers to a plant up to 2.0 m tall, shrubby or subshrubby in habit, with thick, suberous bark with longitudinal cracks. It has cylindrical, rarely tetragonal branches, sparsely pubescent and strongly suberized basal branches. The leaves are 10.5 cm to 21 cm long and 3.5 cm to 14.5 cm wide, simple, opposite to falsely whorled, short-petiolate to subsessile, elliptical to obovate blade, acute base, thickened margins, rounded to retuse apex, rarely acute, leathery, sparsely pubescent to glabrescent, with 9-18 pairs of secondary veins, prominent on both sides, yellowish in living leaves; stipules bipartite, persistent. The inflorescence is pyramidal or cylindrical, large, terminal, with a yellow or reddish axis, with yellow-orange flowers. The fruits are ovoid drupes, about 4.5 mm long, dark purple to black (Gavilanes et al. 2016; Durigan et al. 2018).

Palicourea rigida occurs in almost all biomes in Brazil, according to data from the Specieslink network herbariums (2018). However, it requires studies of various kinds, especially of a phenological nature, including to define its potential for use as an ornamental species. Phenological analyses can serve as references in botanical and ecological studies, as well as guiding the development of appropriate management plans and projects aimed at maintaining and conserving biodiversity and recovering degraded areas, reconciling sustainability with economic efficiency (Biondi et al. 2007; Silva & Santos 2007; Bedê & Martins 2008).

The behavior of species is marked by the occurrence of phenological phases, resulting from climatic stimuli, mainly temperature and precipitation (Prause & Angeloni 2000; Martini et al. 2010). Studies in this area seek to examine the relationships between plant cycles and fluctuations recorded in certain environmental parameters (Costa 2002).

For landscaping, it is essential to know about the morphology and phenology of the species, as well as its relationship with local climatic factors. Research of this nature on a particular plant of interest is essential from a commercial point of view, given its cultivation in production systems, thus reducing the exploitation of the plant in its natural environment, which is often already degraded by anthropic action, as is the case of the Cerrado (Durigan 2010). Thus, the present study aimed to evaluate growth variables and the phenological development of *Palicourea rigida* Kunth plants in a natural population and to determine their landscape-ornamental potential.

Materials and Methods

Study area

This study was conducted in the Serra dos Pireneus State Park, 124 km from Goiânia, GO, located on the banks of the BR-070 highway, whose boundaries cover the municipalities of Pirenópolis, Cocalzinho de Goiás,

and Corumbá de Goiás. The park's geographical coordinates are 15º50'S latitude, 48º47'W longitude, and altitude ranging from 1,100 m to 1,395 m. The region's climate is classified as Aw according to the Köppen climate classification, characterized by two well-defined seasons: a dry season from April to October (fall/winter) and a wet season with heavy rains from November to March (spring/summer). Average precipitation is 1,500 mm per year and the average annual temperature is 22°C (Álvares et al. 2013).

The predominant soil type is Cambissolo, poor in organic matter, shallow and gravelly, considered litholic, with the occurrence of slabs, rock blocks of varying sizes, and rocky outcrops throughout its extent. The predominant vegetation types in the region are Cerrado *sensu stricto,* clean field, dirty field, semi-deciduous humid forest, gallery forest, and rocky fields (Pirineus State Park 2008).

Meteorological characterization

For the meteorological characterization of the area during the period from December 2013 to December 2014, data from the National Institute of Meteorology (INMET) were used, from its Pirenópolis weather station, opened on February 17, 1977, WMO code 83376, located at latitude 15.85°, longitude 48.966667°, and altitude 740 m. The data collected, downloaded on a daily basis, were: maximum, average, and minimum temperatures, precipitation, relative humidity, sunshine, cloud cover, and wind speed.

Identification of the species Palicourea rigida Kunth

The species *Palicourea rigida* Kunth was identified, herbariumed, and deposited in the Herbarium Conservation Unit of the Federal University of Goiás (UFG) (deposit no.: 66,711). In a natural population located in a rocky field area in the State Park, ten plants were selected using the random walk technique, which were located approximately 3-5 m apart (Filgueiras et al. 1994). These were marked and evaluated monthly from December 2013 to December 2014. The individual location was recorded using the Global Positioning System (GPS) (Table 01).

Table 01. Geographic coordinates of the ten *Palicourea rigida* Kunth plants in a natural population in the Serra dos Pirineus State Park, GO, evaluated from December 2013 to December 2014.

Palicourea rigida	Latitude S	Longitude W	Altitude (m)
Plant 1	15°48'10.5"	48° 52'00.5"	1,312
Floor 2	15°48'10.0"	48° 51'58.0"	1,311
Floor 3	15°48'10.0"	48° 51'58.0"	1,311
Floor 4	15°48'10.3"	48° 51'57.8"	1,313
Floor 5	15°48'10.6"	48° 51'57.6"	1,316
Floor 6	15°48'10.6"	48° 51'57.6"	1,316
Floor 7	15°48'10.3"	48° 51'57.3"	1,314
Floor 8	15°48'09.5"	48° 51'57.9"	1,311
Floor 9	15°48'09.1"	48° 51'58.0"	1,311
Floor 10	15°48'08.9"	48° 51'57.9	1,311

Source: Daniel Cardoso Brandão (2025)

Biometric evaluation

Plant growth was evaluated using previously established characteristics, according to the methodology of Stumpf et al. (2007) with adaptations, as follows: plant height measured from the ground to the height of the last leaf; height of the first fork measured from the ground to the beginning of the first fork in the stem;

number of branches at the first fork; stem diameter 20 cm above the ground, determined by perimeter; crown diameters in the North-South (DN/S) and East-West (DL/O) directions measured at the ends of the crown in both directions. For plants with more than one stem from the ground, the average diameter of all stems was calculated at 20 cm from the ground.

Phenological and ornamental evaluation

Phenological monitoring was performed qualitatively, observing monthly the presence and absence of the phenophases of leafing, flowering, and fruiting; and quantitatively, according to the methodology of Ribeiro & Castro (1986) with modifications, determining the percentage of intensity of their occurrence using a ten-category scale (from 1 to 10), with the following scores: 1) 1-10%; 2) 11-20%; 3) 21-30%; 4) 31-40%; 5) 41-50%; 6) 51-60%; 7) 61-70%; 8) 71-80%; 9) 81-90%; 10) 91-100%. When the phenophase was not observed in a given plant, it was disregarded for the calculation of the monthly average of the scores. Similarly, the intensity of diseases and insect attacks on plant structures was also determined using the scoring scale. The part of the plant with the highest ornamental value at the time of each evaluation was also determined, considering the stem, foliage, flowers, or fruits.

Statistical evaluation

For the purpose of quantifying phenotypic characteristics, the data were subjected to descriptive and multivariate analysis. Multivariate exploratory analysis, of the Principal Component Analysis (PCA) type, was performed to verify the existence or not of anomalous samples, relationships between the measured variables (leaf, flower, and fruit), and relationships or groupings between samples of atmospheric variables (average, maximum, and minimum temperatures; precipitation; relative humidity; insolation; cloudiness and wind speed) with the phenological characteristics of *Palicourea rigida*. Past software version 4.03 was used for the analysis, and PCA was performed using a data correlation matrix with a 95% statistical significance criterion.

Results and Discussion

In general climatic terms, the highest maximum temperatures occurred from August to October 2014, while the lowest minimum temperatures were from May to August. Precipitation, relative humidity, and cloud cover showed similar behavior, with higher values between December 2013 and April 2014, and between November and December 2014; and lower values in August. This month even showed an absence of precipitation, which was reduced from May to July. However, wind speed and sunshine tended to increase from December 2014, peaking in August, after which they showed decreasing values (Figure 01).

In general, *Palicourea rigida* plants (Figure 2) were short, averaging 1.23 m (0.55-2.00 m) in height, with a stem diameter of 5 cm (3.1-8.2 cm) in stem diameter, with the first fork at 0.43 m above the ground (0.0-1.10 m), exhibiting practically two branches at the fork, with some plants having up to three branches. A single plant showed the first fork at ground level. The crown was rounded with diameters of 0.80 m (0.20-1.80 m) and 0.78 m (0.15-1.60 m) in the north/south and east/west directions, respectively (Table 2).

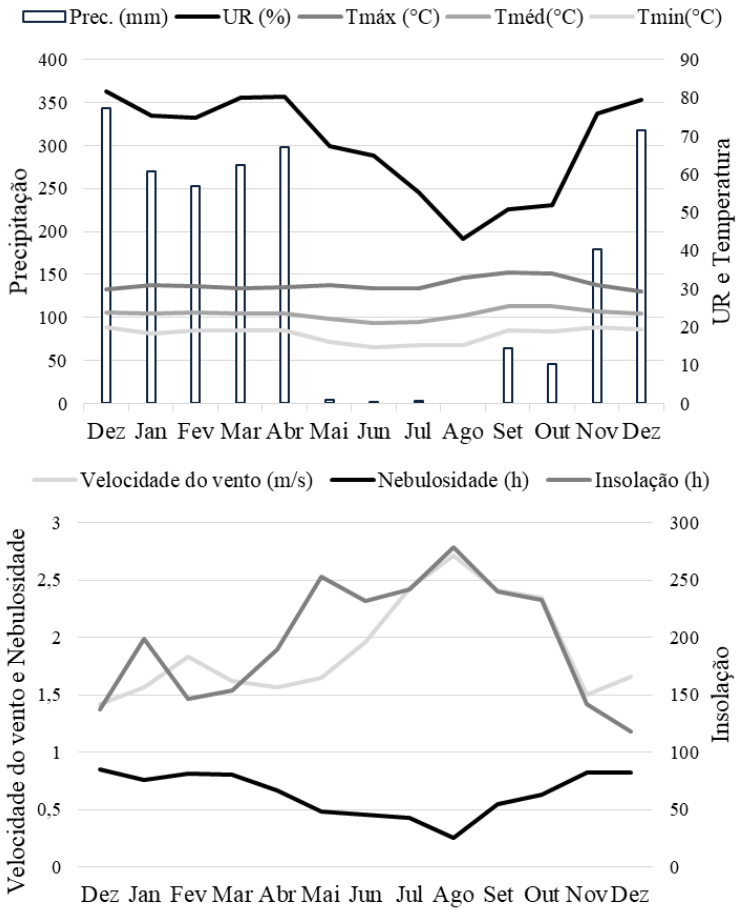

Figure 01. Climatogram with data from the National Institute of Meteorology (INMET) weather station in Pirenópolis, GO, from December 2013 to December 2014. Source: Daniel Cardoso Brandão (2025)

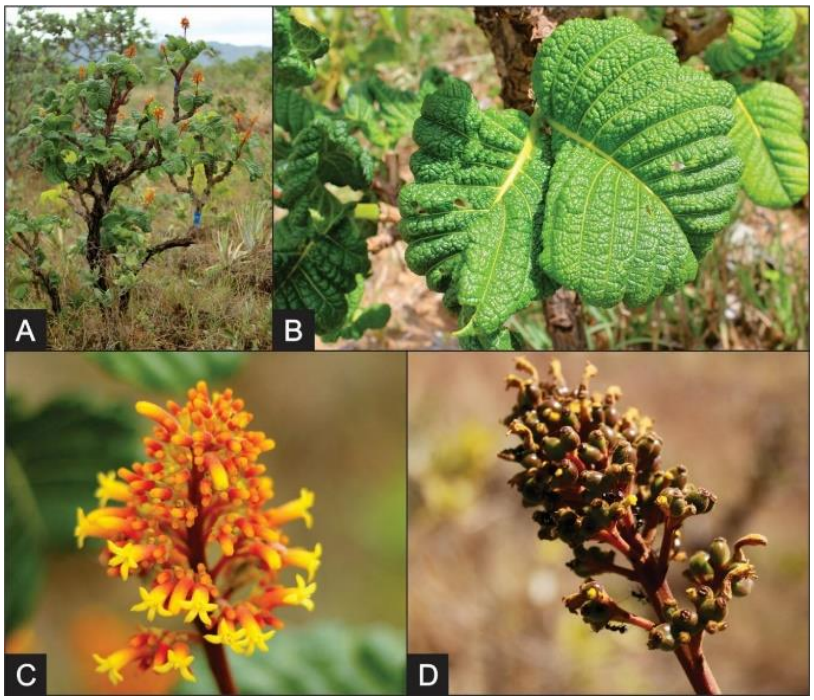

Figure 2. *Palicourea rigida* Kunt: (A) Habit, (B) leathery leaves (C) inflorescence, and (D) infructescence. Serra dos Pireneus State Park, GO, 2014. Source: Daniel Cardoso Brandão (2025)

Table 2. Average, minimum, and maximum data for biometric variables of ten *Palicourea rigida* Kunth plants , in a natural population in Serra dos Pireneus State Park, GO. December 2013 to December 2014

Period	Plant height (m)	Stem diameter 20 cm above ground (cm)	Height of first fork (m)	North-South crown diameter (m)	East-West crown diameter (m)
December	1.32 (0.85-2.00)	4.7 (3.1-7.0)	0.48 (0.00-1.10)	0.81 (0.40-1.50)	0.78 (0.35-1.30)
January	1.25 (0.75-1.90)	5.0 (3.5-7.0)	0.42 (0.00 -0.80)	0.81 (0.40-1.60)	0.84 (0.40-1.35)
February	1.23 (0.75-1.90)	5.0 (3.5-7.6)	0.42 (0.00-0.80)	0.85 (0.40-1.60)	0.82 (0.45-1.30)
March	1.24 (0.75-1.80)	5.1 (3.8-7.3)	0.43 (0.00-0.82)	0.85 (0.40-1.60)	0.82 (0.50-1.50)
April	1.22 (0.70-1.80)	5.4 (3.8-8.2)	0.43 (0.00-0.80)	0.85 (0.40-1.60)	0.85 (0.40-1.60)
May	1.21 (0.70-1.75)	4.9 (3.1-7.3)	0.41 (0.00-0.80)	0.79 (0.34-1.70)	0.75 (0.39-1.30)
June	1.21 (0.55-1.70)	5.0 (3.1-7.6)	0.44 (0.00-0.80)	0.76 (0.00-1.50)	0.78 (0.00-1.50)
July	1.22 (0.60-1.90)	4.9 (3.5-7.0)	0.44 (0.00-0.82)	0.79 (0.00-1.80)	0.79 (0.00-1.60)
August	1.18 (0.55-1.80)	4.9 (3.1-7.0)	0.41 (0.00-0.80)	0.73 (0.00-1.60)	0.68 (0.00-1.30)
September	1.19 (0.60-1.75)	4.9 (3.1-7.3)	0.43 (0.00-0.83)	0.70 (0.20-1.80)	0.70 (0.15-1.60)
October	1.23 (0.70-1.80)	5.0 (3.5-7.0)	0.43 (0.00-0.80)	0.73 (0.25-1.70)	0.74 (0.35-1.40)
November	1.26 (0.70-1.90)	5.5 (3.8-7.9)	0.44 (0.00-0.82)	0.90 (0.40-1.80)	0.85 (0.50-1.40)
December	1.27 (0.70-1.80)	5.0 (3.5-7.6)	0.41 (0.00-0.80)	0.85 (0.35-1.70)	0.86 (0.40-1.40)
Mean	*1.23*	*5.0*	*0.43*	*0.80*	*0.78*

Source: Daniel Cardoso Brandão (2025)

Throughout the evaluation period, there was virtually no increase in the biometric variables analyzed (Table 2), with annual growth of 1.1 cm, considering the combined average of all these variables. In plants where growth was observed, it was most significant in terms of crown diameter, followed by plant height, height of the first fork, and, lastly, stem diameter, with annual increases of 19 cm, 5 cm, 4 cm, and 0.4 cm, respectively. This low growth rate is probably due to phylogenetic factors or other edaphoclimatic factors, such as a lack of nutrients and water in the soil (Durigan et al. 2018). However, this characteristic may indicate a positive aspect for the use of the species in landscaping projects. When planning a green area, working with slow-growing plants will keep the garden looking intact for longer, requiring less maintenance, such as pruning.

In terms of phenological behavior, the plants remained leafy throughout the year, with an overall score of 9.1, corresponding to about 90-100% leafiness (Table 3). Foliage is one of the aesthetic characteristics evaluated in ornamental plants, as it influences the determination of shape, size, structure, and symmetry, in addition to being associated with the visual effect that the plant can produce in the environment (Biondi et al. 2007).

In this species, foliage was more intense in spring/summer (October to February), when no or few plants (up to a maximum of 30%) received scores other than ten, the lowest being 9.7 (Table 3). During this period, there was high rainfall, relative humidity, and cloud cover (Figure 2). Between June and August, probably due to burning, one of the plants lost all its leaves and was therefore not considered in the calculation of the average.

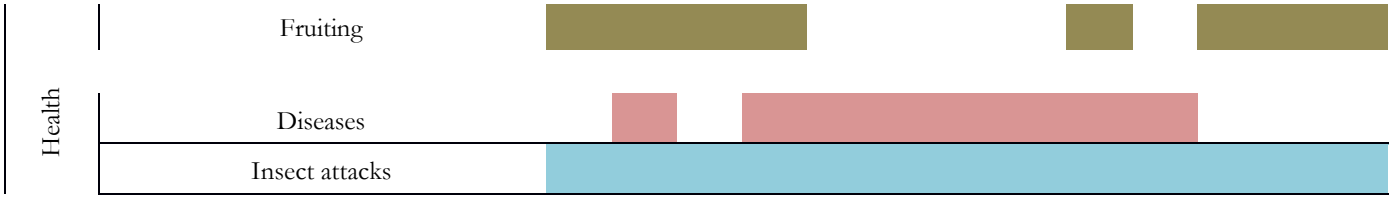

Figure 3. Phenology and health aspects of *Palicourea rigida* Kunth , in a natural population in the Serra dos Pireneus State Park, GO. December 2013 to December 2014. Source: Daniel Cardoso Brandão (2025)

In March and April, 90% and 80% of the plants received foliage scores other than ten, with 5.0 and 7.0 being the lowest individual scores, respectively. From May to August, there was an increase in the number of plants with maximum scores. However, the lowest foliage intensity (average score of 5.1) occurred in September, when only one plant received a maximum score, with 1.0 being the lowest individual score. From October to December, the plants showed renewed foliage. This may suggest the occurrence of partial leaf fall in September, with subsequent sprouting in October, although the literature indicates that this is a perennial species.

According to Oliveira (2008), most herbaceous/shrubby species in the Cerrado are evergreen, as they maintain active leaves throughout the year and produce new leaves for long periods. This characteristic of maintaining leaf organs is intrinsically linked to the physiology of these plants, which have developed organs specialized in supplying their demand for reserves even during critical periods, such as water stress, due to the shallowness of the root system when compared to deciduous species (Pilon et al. 2015).

The phenophases in Cerrado species occur according to climatic seasonality to avoid energy expenditure (Oliveira 2008), especially in the case of herbaceous-shrubby plants, with a more superficial root system, even when considered perennial, would be exposed to fluctuations in soil water content and nutrient availability (Franco 2005). Thus, in this study, interactions between climatic factors and the phenological processes of the species were observed. Leafing showed a positive correlation with cloudiness and, especially, with minimum temperature, i.e., in periods of greater cloudiness and minimum temperature, the plants had more leaves (Figure 4).

The floral structures (Figure 2C) did not have a noticeable odor and were present for a long period (nine months of the year), from May to January (Figure 3), with greater intensity and in greater numbers of plants from October to December. In January and from May to September, flowering occurred in only one or two plants and with less intensity (Table 3). The plant did not flower for only three months, from February to April (Figure 3). The presence of flowers in the dry season could be considered a strategy to maintain pollinators (zoochory) during the less favorable months of precipitation and would serve as food support for fauna and maintain pollination even in times of scarcity, as noted by Silva (1995).

The higher flowering intensity from October to December can be explained by its positive correlation with average and minimum temperatures, such that as these variables increased, the number of flowering plants and the intensity of flowering in the population also increased (Figure 4). According to Silva (1995), the phenological events of the species are related to the rainfall regime and associated climate changes. Thus, the main reproductive period occurs during the rainy season.

Table 3. Scores assigned to *Palicourea rigida* Kunth plants according to phenological stages, in the Serra dos Pirineus State Park, GO, from December 2013 to December 2014

Value	Year/month													
	2013	----------2014----------												
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Folhação														
Medium	9.8^{10}	9.7^{10}	9.7^{10}	7.9^{10}	9.1^{10}	9.5^{10}	8.8^{9}	9.1^{9}	9.2^{9}	5.1^{10}	10.0^{10}	9.9^{10}	10.0^{10}	*9.1*
Maximum	10.0	10.0	10.0	10	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	*10.0*
Minimum	8.0	8.0	9.0	5.0	7.0	7.0	6.0	7.0	3.0	1.0	10.0	9.0	10.0	*6.9*
Flowering														
Average	7.5^{7}	3.0^{1}	---	---	---	1.5^{2}	3.0^{1}	2.0^{2}	3.0^{1}	2.5^{2}	5.9^{5}	7.2^{10}	8.0^{8}	*4.3*
Maximum	10.0	3.0	---	---	---	2.0	3.0	2.0	3.0	3.0	10.0	10.0	10.0	*5.6*
Minimum	1.0	3.0	---	---	---	0.0	0.0	0.0	0.0	0.0	0.5	2.0	0.0	*0.4*
Fruiting														
Medium	8.0^{1}	6.4^{5}	2.0^{5}	3.0^{5}	---	---	---	---	2.0^{1}	---	1.0^{1}	3.0^{1}	7.5^{6}	*4.1*
Maximum	8.0	9.0	3.0	8.0	---	---	---	---	2.0	---	1.0	3.0	10.0	*6.0*
Minimum	0.0	0.0	0.0	0.0	---	---	---	---	0.0	---	0.0	0.0	0.0	*0.0*
Symptoms of diseases														
Medium	---	1.0^{2}	---	1.0^{4}	1.0^{10}	1.0^{10}	1.0^{9}	1.0^{9}	1.0^{9}	1.0^{8}	---	---	---	*1.0*
Maximum	---	1.0	---	1.0	1.0	1.0	1.0	1.0	1.0	1.0	---	---	---	*1.0*
Minimum	---	1.0	---	1.0	1.0	1.0	1.0	1.0	1.0	1.0	---	---	---	*1.0*
Insect attacks														
Medium	1.9^{8}	1.9^{8}	1.9^{10}	2.8^{10}	1.5^{10}	2.8^{10}	3.6^{9}	2.2^{9}	2.2^{9}	2.1^{9}	1.0^{3}	0.8^{8}	1.2^{9}	*2.0*
Maximum	1.0	1.0	0.5	1.5	0.5	1.0	2.0	1.0	1.0	1.0	1.0	0.5	1.0	*1.0*
Minimum	4.0	4.0	5.0	6.0	4.0	4.0	6.0	5.0	4	4.0	1.0	1.0	2.0	*3.8*

The superscript number indicates the number of individuals that presented the phenomenon and were used in calculating the average. Source: Daniel Cardoso Brandão (2025)

According to Gavilanes et al. (2016), in remaining areas of cerrado *sensu stricto* and rocky fields in Lavras, *Palicourea rigida* blooms from August to December. According to Silva (1995), working in a savanna field area in the Federal District, the species has seasonal flowering, with two annual cycles of different intensities, the main one occurring in the rainy season, beginning at the end of September, peaking in November, and ending at the end of January. The first cycle begins in May, peaking at the end of the month and ending in early September. In this study, the existence of these two flowering periods was not verified, possibly due to the longer evaluation interval, as it was monthly, or even due to factors intrinsic to the plant or climatic aspects.

Knowledge of the season and duration of flowering are aspects of fundamental importance for landscaping and ornamentation, given that sight is the most acute sense in humans. Thus, flowers and inflorescences are primarily responsible for this aspect, being the attributes most demanded by customers (Santos et al. 2013). According to Silva (1995), visual attraction is exerted indiscriminately by floral morphs, especially through the chromatic variability of inflorescences, which extends from the stems to the internal floral whorls. Thus, plants that remain in bloom for longer periods are sought after. In addition, flowers can attract birds, which is often desirable, and also contribute to the preservation of the environment. According to the author, *Palicourea rigida* Kunth is pollinated mainly by hummingbirds, bees, and lepidoptera, as also verified by Coelho & Barbosa (2003) with another species of the same genus, P. *macrobotrys*.

Fruiting began in August on one of the plants evaluated and continued until March (Figure 3). In general, greater fruiting intensity and a greater number of plants were observed in December and January (Table 3), corroborating previous descriptions of the species (Gavilanes et al. 2016).

The absence of fruits in September, as in the previous month there was only one plant with fruits, may probably be related to some isolated event that caused them to fall. This could be the high wind speed during this period, the presence of birds, or even human interference and/or the entry of cattle, since the sampled plants were close to an ecological climbing trail and the access road to the area. There were no fruits between April and July (Figure 3). According to Silva (1995), fruit formation in the species occurs 10 days after pollination; however, its development is slow, taking an average of 75 days to reach maturity. The fruits begin to ripen at the end of February, intensifying in March and continuing until April.

There was a positive correlation between fruiting and precipitation and especially with relative humidity; and a negative correlation with maximum temperature, insolation, and especially wind speed. This shows a greater number of plants with fruits and more intense fruiting in periods of higher relative humidity and precipitation, and lower values of wind speed, maximum temperature, and insolation (Figure 4).

For many species, as is the case with *P. rigida*, there is a concentration of reproductive organs in the months with the highest rainfall. This is due to the habit of seed dispersal, with most plants in the Cerrado exhibiting zoochoric dispersal syndrome (Pilon et al. 2015), depending on fauna for the collection and distribution of their seeds. Another factor that favors the presence of reproductive organs during this period is the greater availability of nutrients and the reduction in soil matric potential (in this case, the soil would not require as much water and would not simply drain water from the atmosphere) (Silva 1995).

It was observed that the stem, leaves, and inflorescences had ornamental value. However, considering each plant individually, when it was in bloom, its flowers, arranged in inflorescences, stood out and were more prominent than the other parts mentioned. This was due to their intense coloration, being yellowish at the upper end and orange at the lower end (Figure 2C). The same occurred with the leaves (Figure 2B), which stood out on the plant in contrast to the stem, possibly due to their intense green coloration and yellowish veins, which were lighter than the leaf blade, contrasting with it (Figure 2B).

However, the fruits were not mentioned at any time, even considering the months of February and March, when the plants had no flowers and only fruits. During this period, the foliage was more prominent. However, its beauty may have been masked by the other parts of the plant. It is believed that when considered in isolation, the fruits may have potential for use. Currently, not only flowers but also fruits are being used in the preparation of arrangements and decoration of environments at events and dinners, providing light, fresh, and natural arrangements, depending on their behavior and post-harvest durability.

Thus, this may be a potential use for the fruits of *Palicourea rigida* Kunth, which, although small, are arranged in an infructescence (Figure 2D), making them more attractive and eye-catching, with a green color when immature and purplish-black when ripe. In terms of use in landscaping, in addition to standing out against the greenish foliage, their presence can be attractive to native birdlife. And , a small amount of the species' fruits are used as food by generalist birds (Silva 1995).

However, when considering the population as a whole, it was observed that flowering only stood out in relation to the leaves from October to December, when most plants were in bloom.

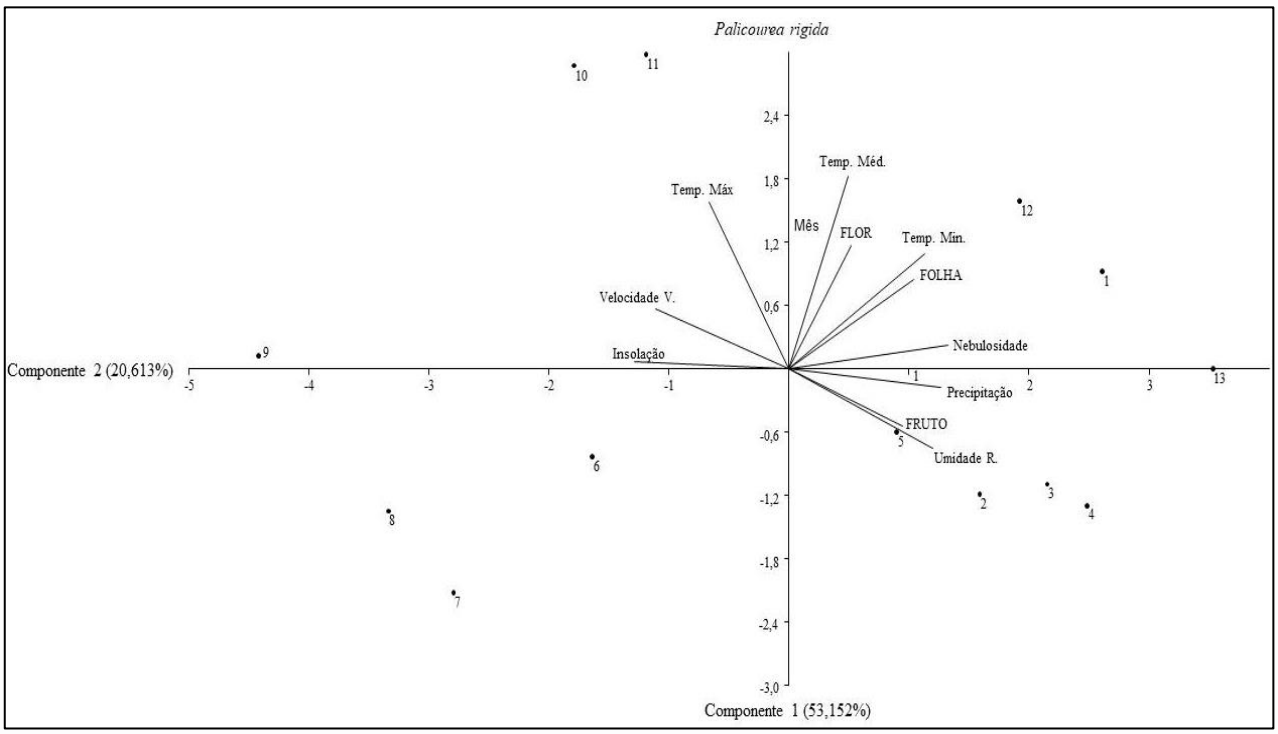

Figure 4. Interactions between climatic factors and phenological processes in *Palicourea rigida* Kunt plants in the Serra dos Pireneus State Park, GO, from December 2013 to December 2014. Source: Daniel Cardoso Brandão (2025)

In terms of health, disease symptoms were only observed in the leaves from January to March in a few individuals, starting in 20% of them and reaching 40%, but being observed in most plants from April to September. However, the scores assigned in these periods were lower (score 1), showing low incidence. From October onwards, these symptoms were no longer observed (Table 3). This reinforces the fact that the plant underwent leaf renewal during this period.

In terms of insect attacks, these were observed throughout the evaluation period, on average, in 85% of the plants, but with an average score of 2.0 (ranging from 0.5 to 6.0), indicating low attack intensity. The most intense incidence was observed in June, when the average score for the population was 3.6. Silva (1995), working with the same species in the Federal District, observed some plants with symptoms of anthracnose and damage by insects and/or fungi in green fruits in April.

There is a growing trend toward replacing exotic species with native species (Heiden et al. 2007; Stumpf et al. 2012), since their adaptation to local environmental conditions is favored by the natural selection of more adapted individuals. According to Silva (1995), the characteristics of the species *Palicourea rigida,* such as the architecture of the stem, branches, and leaves, and the conspicuous presence of its flowers, show potential for it to be used as an ornamental plant.

In general, *P. rigida* was observed in full sun, with twisted stems, cylindrical branches, suberose, glabrous, and dark brown in color. According to Goodland (1971), the scleromorphism of native Cerrado plants ( ) is due to aluminum toxicity. And according to Haridasan (1982), P. *rigida* is an aluminum-accumulating species.

The plant also has a small, rounded crown, remaining well leafed throughout the year, with leathery leaves, prolonged flowering, and striking colors on the leaves and especially on the flowers. Added to these characteristics are its architecture and small size, which are interesting from the point of view of possible inclusion in landscaping for smaller areas.

According to Whistler (2000), a plant is considered ornamental when its greatness, value, usefulness, and function lie more in the beauty of its leaves or flowers, in its pleasant shape or configuration, or in its innovative pattern, than in meeting the basic needs of human beings. Thus, a plant species is ornamental when certain characteristics of its form initially appeal to people's aesthetic perception, causing a feeling of delight or contemplative pleasure.

Every plant can have ornamental use. The important thing is that it harmonizes with the environment in which it will be used and/or that it meets the consumer's intended use, whether for indoor or outdoor gardens, decoration, gifts, or crafts, generating benefits to the quality of life of the people who live in that place (Lohr 2011). Therefore, characteristics such as size, texture, color, phenology, adaptability to the environment, cycle, or attraction of native birdlife motivate the preference for certain plants (Tombolato 2008). In addition, plants with low maintenance requirements are preferred, as they require less specialized labor.

In view of this, the species is considered to be versatile for ornamental landscaping, making outdoor environments more distinctive. Due to its colors and textures, it can provide contrast with other plants in the garden, making it suitable for use as a backdrop in a composition; to compose sensory gardens, especially considering the texture of the stem and leaves, in addition to the sound produced by the leaves when touched; as a highlight plant in certain environments, used alone; in the formation of massifs, and for cultivation in larger pots.

Conclusions

The species *Palicourea rigida* Kunt is slow-growing, small in size, with a low, small, rounded crown and few branches.

P. rigida has evergreen foliage and inflorescences with warm, orange-yellow flowers. The species flowers for nine months and fruits for eight months.

The species has characteristics that indicate high ornamental potential for use in landscaping projects.

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