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Buchnera nordestina (Orobanchaceae), an overlooked new species from Northeast Brazil, with an updated identification key for *Buchnera* of Brazil

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ABSTRACT

A new species of *Buchnera* (Orobanchaceae) from Northeast Brazil is described and illustrated. *Buchnera nordestina* was first collected by Dr. Francisco Freire Allemão e Cysneiro ca. 160 years ago and remained undescribed until now. We provide notes on morphology, geographic distribution, and conservation status of the new species. Additionally, we present an updated identification key to all species of *Buchnera* from Brazil. *Buchnera nordestina* is characterized by long bracts that are usually two times longer than the calyx tube and by the presence of axillary brachyblasts, both of which are unique features within the genus. The new species occurs in *restinga* and *cerrado* vegetation in the Brazilian states of Ceará, Maranhão, and Piauí, and is assessed as Endangered (EN).

Keywords: Brazil, *Buchnera*, Ceará, *cerrado*, hemiparasitic, Maranhão, Orobanchaceae, Piauí, *restinga*, taxonomy

Introduction

Buchnera is the fourth largest genus of the Orobanchaceae, comprising 100 to 150 species distributed over the tropical region of the globe (Philcox 1965; Morawetz *et al*. 2010; The Plant List 2013; Nickrent 2020). It is characterized by hemi-parasitic herbs or subshrubs with trumpet-shaped corolla, which is usually pink to lilac, sometimes white, purple or redish, with an erect to slightly curved tube, and four monothecous anthers (Philcox 1965; Souza & Giulietti 2009). The genus has its center of diversity in Africa, where more than 100 species have been recorded (Philcox 1965), being less represented in the New World, with only 16 species recognized by Philcox (1965). Souza & Giulietti (2009) accounted for nine species of *Buchnera* native in Brazil; more recently, the publication of two new species rose this number to eleven (Souza & Paula-Souza 2016; Scatigna *et al*. 2017).

During a trip to São Luís, Maranhão, Northeast Brazil, A.V.S. consulted the herbarium MAR, of the Universidade Federal do Maranhão (UFMA), as well as the herbarium SLUI, of the Universidade Estadual do Maranhão (UEMA), and found several specimens from the *restingas* of the metropolitan area of São Luís identified as *B. palustris* Spreng. Later the same day, A.V.S. and three colleagues (Fernanda H. P. Brandão, Lamarck N. G. Rocha, and Lucas C. Marinho) went to the São Marcos beach, in São Luís, where they found specimens in vivo. At that time, A.V.S. started suspecting that those specimens represented an undescribed species of *Buchnera*. After analyzing the material with detail, we noticed that the bracts were unusually long and the stem surface was covered with downwardly oriented trichomes,

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in addition to the presence of axillary brachyblasts. The long bracts and the presence of brachyblasts have not been observed in any known species of the genus. Further search for additional specimens resulted in records from the *cerrado* of Piauí and Ceará, including one gathering by Dr. Francisco Freire Allemão e Cysneiro, housed at R, that was collected in Ceará between 1859 and 1861 (Abreu 1919) and remained identified only up to the generic level until now. These specimens from the *restinga* and *cerrado* of Ceará, Maranhão, and Piauí represent a new species of *Buchnera* which is here described and illustrated. We also provide photos and a distribution map along with notes on taxonomy, distribution, habitat, phenology, and conservation status. Lastly, we present an updated identification key to all species of *Buchnera* from Brazil.

Materials and methods

The description and morphological comparisons were based primarily on field observations and examination of herbarium specimens housed at EAC, ESA, HUEFS, MAR, MG, R, RB, SLUI, and UEC, and complemented with data from literature (Philcox 1965; Souza & Giulietti 2009); herbarium acronyms follow Thiers (2020[continuously updated]). All cited specimens were seen personally, except where indicated by "[digital image]"; measurements were taken exclusively from personally observed specimens. Conservation status assessment followed the IUCN (2012) criteria and subsequent guidelines (IUCN 2019). We estimated the extent of occurrence (EOO) and area of occupancy (AOO) with the Geospatial Conservation Assessment Tool (GeoCAT; Bachman *et al*. 2011) using a cell width of 2 km and based on the coordinates provided on sheet labels. Line drawings were made by Klei Sousa from herbarium specimens, under an Olympus SZH10 stereomicroscope with a drawing attachment, and based on digital photographs of specimens in vivo. The distribution map was generated with QGIS 3.2.2 (https://qgis.org/en/site/).

Results

Taxonomic treatment

Buchnera nordestina Scatigna *sp. nov.* Type: BRAZIL. Maranhão: São Luís, Avenida Litorânea, Praia de São Marcos, 44°16'58" W – 2°29'19" S, 05/IX/2019, *Scatigna & Couto 1239* (holotype: SLUI; isotypes: ESA, K, RB) (Figs. 1, 2).

Buchnera nordestina differs from the rest of the genus by the bracts usually as long as to two times longer than the calyx tube and by the presence of axillary brachyblasts. It is most similar to *B. obliqua* by the shape of leaves, length of the bracts, and hispid indument, but differs from it in the calyx tube being shallowly 10-nerved and straight (*vs.* notoriously 10-nerved and curved), in the calyx indument covering all external surface of calyx tube (*vs.* concentrated on nerves), in the presence of downwardly adpressed trichomes on stems (*vs.* absence), and in the presence of axillary brachyblasts (*vs.* absence).

Herbs or subshrubs ca. 10–60 cm tall. *Stems* usually branched, erect, terete to subquadrangular, greenish to deep-vinaceous, hispid-strigose, with downwardly adpressed (retrorse) trichomes interspersed with some longer patent trichomes and rare, minute, capitate trichomes. *Basal leaves* usually deciduous, oblanceolate, lanceolate or narrow-elliptical, 0.7–7.5 × 0.3–1.5 cm, opposite to sub-opposite, basally 3-nerved, greenish to vinaceous, strigose, with trichomes curved towards leaf apex, scattered over both abaxial and adaxial leaf surfaces, and interspersed with rare, minute, capitate trichomes, margin entire or rarely subentire; cauline leaves narrowly lanceolate closer to base, with margin entire to shallowly lacerate, narrowing towards apex of stem, where they are linear and conduplicate, with margin entire, 1–9 × 0.1–1.2 cm, opposite to alternate, sometimes 3-whorled, sessile, obscurely to clearly 3-nerved closer to base or 1-nerved near apex, greenish to vinaceous, indument same as basal leaves. *Axillary brachyblasts*, a sessile, congested branch up to 1 cm long, distributed throughout; stem with internodes obscure or up to 3 mm long, indument same of stems; leaves 2–10, opposite, slightly shorter and narrower than the basal one, indument same as cauline leaves. *Inflorescences* 2–30 cm long, laxly to densely spicate, erect, with flowers opposite to sub-opposite, indument similar to stems but sparser. *Flowers* sessile; bracts narrowly to linear-lanceolate, 0.5–1.5 cm long, shortening towards the apex of the inflorescence, ciliate, abaxially strigose, adaxially glabrous near base, strigose towards apex, persistent; bracteoles two, narrowly lanceolate to linear, 0.3–0.6 cm long, persistent, indument same of bracts. *Calyx* greenish to vinaceous, tube 4.5–7mm long, up to 10 mm after fruitification, obscurely 10-nerved, lobes narrowly triangular, 1.5–3.5 × 0.3–1 mm, externally entirely strigose, internally glabrous, except for rare, minute, capitate trichomes on lobes. *Corolla* usually white to pinkish, rarely lilac or purple, actinomorphic to slightly zygomorphic; tube 4–8 mm long, externally sparsely pilose on the upper half, slightly papillose, internally pilose and glandular-pubescent, with simple, straight trichomes and shorter, capitate trichomes, throat hirsute; limb 5-lobed, the lobes obovate to broadly elliptical, 1.8–2 × 1.6–1.8 mm, apices emarginate to round. *Stamens* 4, monothecous, didynamous, inserted on corolla tube, included; filaments 0.7–1 mm long; thecae 1–1.2 mm long, dehiscence longitudinal. *Ovary* widely ellipsoid, 1.9–2.1 × 1.3–1.5 mm; ovules numerous; style terminal, solitary, filiform, 0.5–0.6 mm long; stigma clavate, 1–1.1 mm long. *Capsule* loculicidal, oblongoid, 5.4–6.5 × 2.5–3.5 mm, glabrous. *Seeds* dolabriform, wider at apex, ribbed, 0.4–0.6 × 0.15–0.3 mm.

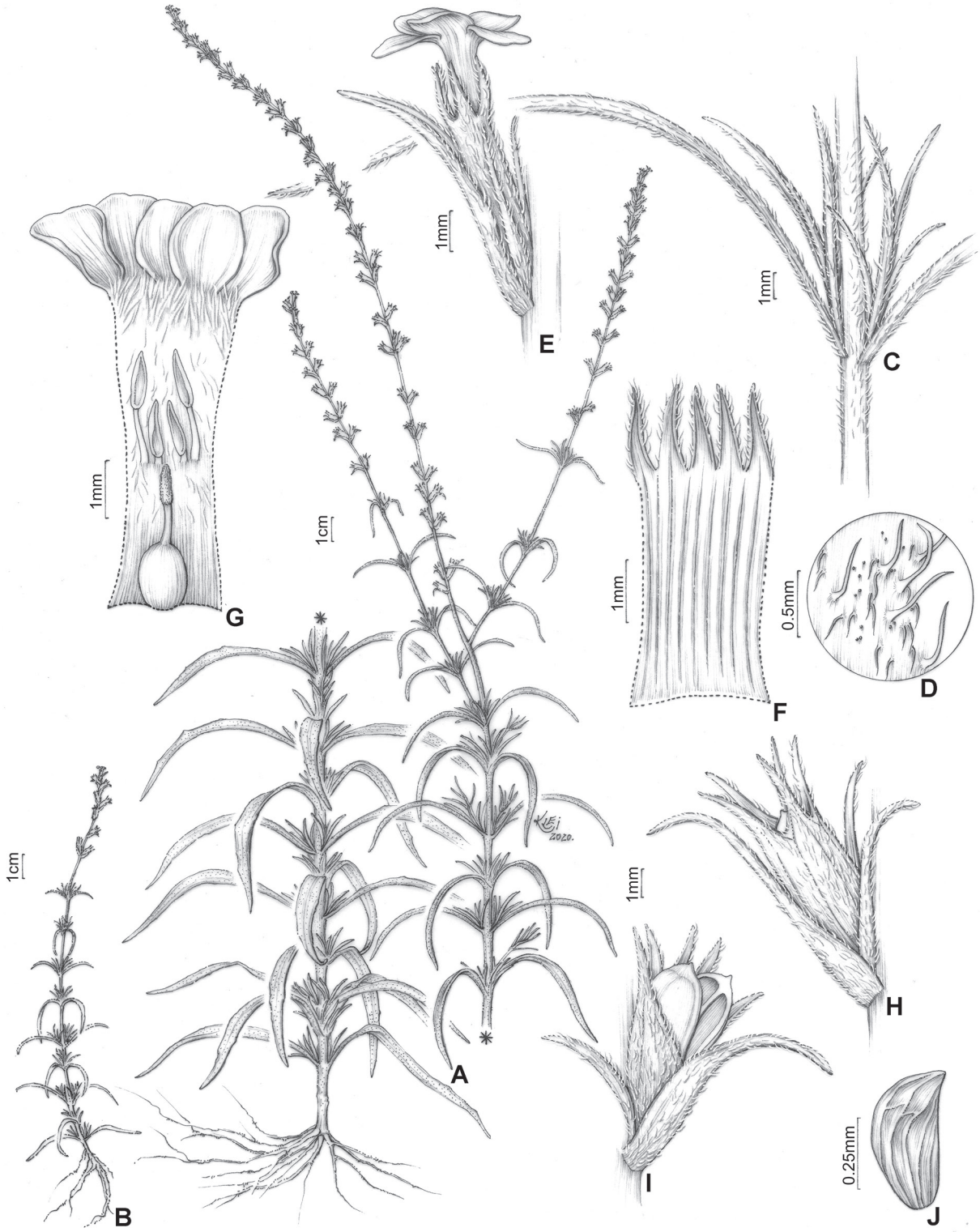

Figure 1. *Buchnera nordestina*. **A.-B.** Habit. **C.** Node with opposite leaves and axillary brachyblasts. **D.** Detail of stem surface with short retrorse trichomes and longer, patent to ascendant trichomes. **E.** Flower in lateral view. **F.** Dissected calyx showing internal surface and ten nerves. **G.** Dissected corolla showing androecium and gynoecium. **H.** Immature fruit covered with the calyx. **I.** Mature capsule with loculicidal dehiscence. **J.** Seed. Drawn by Klei Sousa after *Scatigna & Couto 1239* (ESA).

Specimens examined (Paratypes): BRAZIL. Ceará: w.o. locality, [1859–1861], *Allemão & Cysneiros 1266* (R); Granja, CE-362, de Granja para Martinópole, ca. 10 km de Granja, 40°44'10" W – 3°11'12" S, 3/VI/2016, *Souza et al. 4168, 4178* (EAC, HUEFS[digital images]). Maranhão: Alcântara, Restinga da Praia de Itatinga, 44°24'02" W – 2°24'47" S, 15/VI/2014, *Correia 266* (MAR); idem, 5/IX/2014, *Correia 353* (MAR); Paço do Lumiar, Praia do Araçagy, 44°10'55" W – 2°27'56" S, 25/V/2013, *Amorim 59* (MAR); idem, Praia de Panaquatiara, 44°03'14" W – 2°28'23" S, 2/VIII/2014, *Lima 389, 402* (MAR); idem, 25/VII/2015, *Lima 603* (MAR); Raposa, Restinga da Ilha de Curupu, 44°01'19" W – 2°24'09" S, *Machado 119* (MAR); São José do Ribamar, Praia do Caúra, 44°02'50" W – 2°33'15" S, 28/XI/2016, *Amorim (393) T1P3* (MAR); idem, 8/X/2015, *Guterres 97* (MAR); São Luís, Mirante da Praia do Calhau, Avenida Litorânea, 44°15'57" W – 2°29'08" S, 5/IX/2019, *Couto & Scatigna 54* (RB, SLUI); idem, 28/X/2019, *Saraiva 310* (SLUI); idem, 44°15'55" W – 2°29'05" S, 3/IX/2019, *Scatigna et al. 1237* (MAR, SLUI); idem, Canteiro central do retorno da Via Expressa, em direção ao bairro Renascença, 44°16'58" W – 2°29'42" S, 5/IX/2019, *Scatigna & Couto 1238* (ESA, MG, SLUI); idem, Av. Litorânea, Dunas da Praia de São Marcos, 44°15'59" W – 2°29'07" S, 2/VIII/2014, *Silva 420* (MAR); idem, 11/VII/2015, *Silva 593* (MAR); Serrano do Maranhão, Madre de Deus, 44°58'52" W – 1°51'41" S, 20/VIII/2014, Silva 464 (MAR). Piauí: Campo Maior, 08/V/1991, *Bona 64, 65* (EAC, ESA).

Distribution, habitat, and phenology: *Buchnera nordestina* was recorded exclusively in the Northeast region of Brazil, in the states of Ceará, Maranhão, and Piauí (Fig. 3), ranging from 0 to 120 m a.s.l. It occurs in areas of *restinga* and *cerrado* formations, especially on moist lateritic soil, sometimes close to the beach (Figs. 2E, S1 in supplementary material), being exposed to constant wind and salt air. Several specimens were found as ruderal in

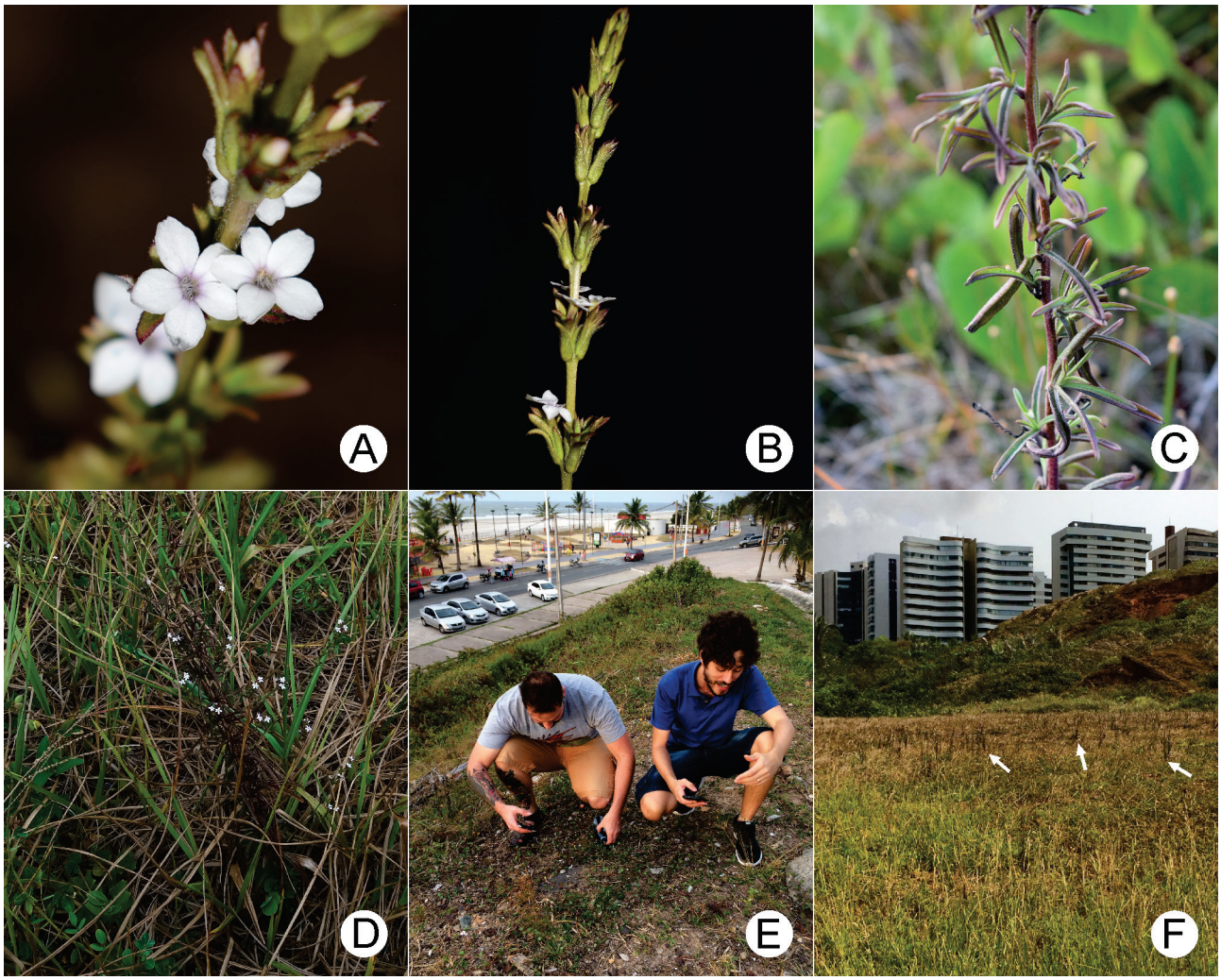

Figure 2. *Buchnera nordestina*. **A.** Flowers with white corolla in frontal view. **B.** Inflorescence. **C.** Stem with vinaceous leaves and axillary brachyblasts. **D.** Habit of a specimen with deep-vinaceous stem and leaves and white flowers. **E.** A.V. Scatigna and L.C. Marinho in a collection site in Av. Atlântica, São Luís, MA. **F.** Habitat in urban area of São Luís; white arrows point specimens (blackish bushes). Photos: A-C by Raysa V.C. Saraiva; D by André V. Scatigna; E and F by Fernanda H.P. Brandão.

recently disturbed areas (Fig. S2 in supplementary material). Plants were collected with flowers and fruits between May and December, during the dry season.

Conservation status: We assessed *Buchnera nordestina* as Endangered (EN) according to criterion B2ab (ii, iii) from IUCN (2019). This species has the AOO = 44 km^2; its suitable habitat is under observed decline of area and quality due to anthropogenic interference, such as deforestation, occupation, and degradation actions in the area; and populations are severely fragmented. Although some populations of *B. nordestina* occur in *restingas*, which are categorized as Permanent Preservation Areas (Brasil 2012), coastal ecosystems are fragile and are highly affected by human action on the coast of Maranhão (Amorim 2017; Lima & Almeida Jr. 2018). We emphasize the occurrence of several specimens inside urban areas to of São Luís and on recent disturbed soil (Figs. 2E- F, S2 in supplementary material), what raises questions whether the deforestation and soil disturbance is harmful to this species.

Etymology: The epithet [*nordestina*] refers to the Northeast region of Brazil, to where the new species is presumably exclusive.

Notes: Specimens of *Buchnera nordestina* housed at MAR were cited in floristic surveys identified as *B. palustris* (Almeida Jr. *et al*. 2017; Lima & Almeida Jr. 2018). Short specimens of *B. nordestina* present narrow and apparently 1-nerved upper cauline leaves (Fig. 1B), which are similar to those of *B. palustris*; however, these species are distinct in the bracts usually longer than the calyx in *B. nordestina* (Fig. 1E; *vs*. shorter than half the calyx tube in *B. palustris*), in the presence of downwardly oriented (retrorse) trichomes in the stems (Fig. 1D; *vs*. absence), and in the broader, 3-nerved lower cauline leaves (*vs*. linear, 1-nerved). A.V.S. provisionally identified the specimens of the new species from Piauí as *B. integrifolia* due to the external surface of the calyx entirely coverer with trichomes (Souza & Giulietti 2009); nevertheless, this species has the stem usually unbranched (*vs*. branched in *B. nordestina*; Fig. 1A), the bracts shorter than the calyx (*vs*. longer; Fig. 1E), leaves concentrated at the base of stem (*vs*. well distributed throughout; Figs. 1A-B, 2D), and lacks retrorse trichomes on the stem (*vs*. presence; Fig. 1D). *Buchnera nordestina* shares the presence of adpressed, downwardly oriented trichomes on the stem surface with the Mexican *B. retrorsa*, but differs from it by being a usually branched plant (*vs*. simple), by the cauline leaf dimensions (1–9 × 0.1–1.2 cm vs. 0.4–1 × 0.05 cm), by the bracts usually longer than the calyx (*vs*. shorter than half the calyx tube), and by the presence of axillary brachyblasts (Figs. 1A-C, 2C; *vs*. absence). Finally, *B. nordestina* is most similar to *B. obliqua*, a species endemic

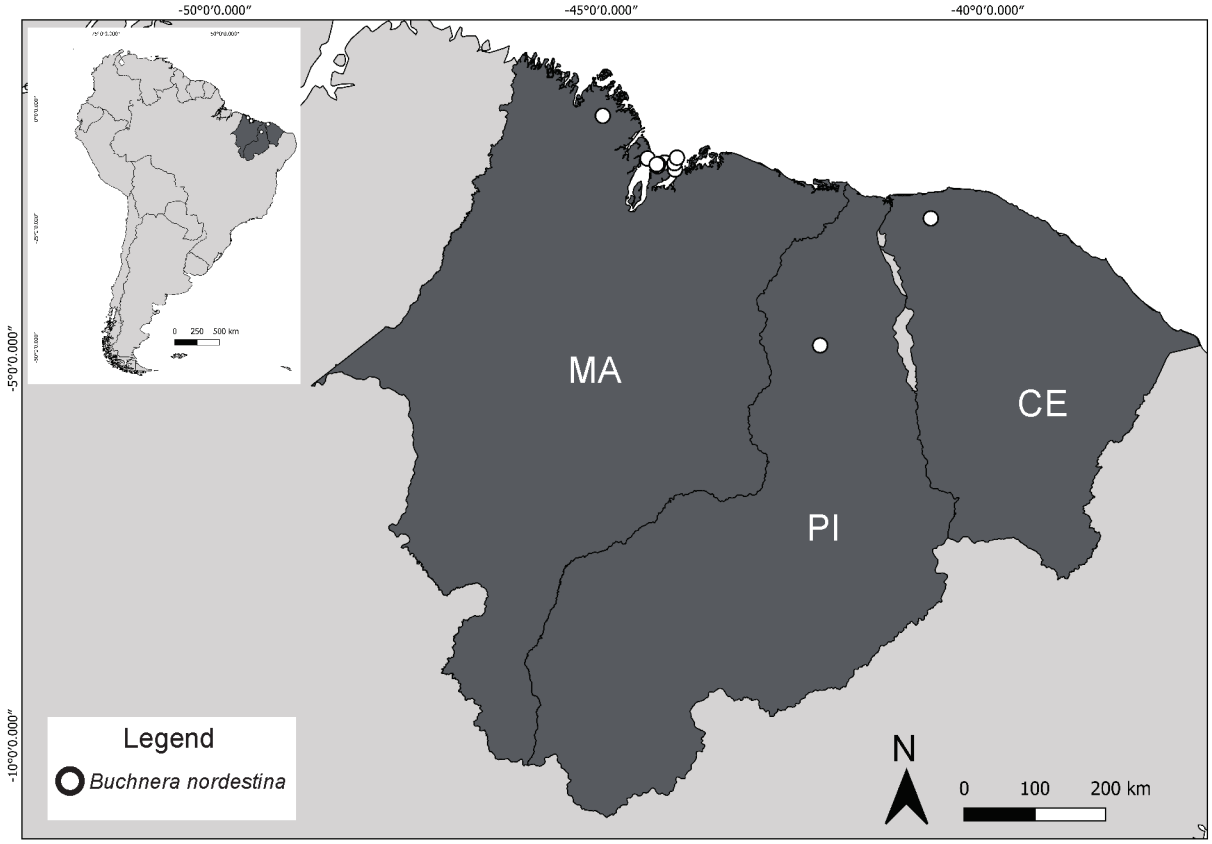

Figure 3. Distribution map of *Buchnera nordestina* in Northeast Brazil. Dark gray area are the states of Ceará (CE), Maranhão (MA) and Piauí (PI). White circles are collection points.

to Mexico; this species differs from *B. nordestina* mainly by the lack of retrorse trichomes on stem surface, by the lack of axillary brachyblasts (*vs.* presence; Figs. 1A-C, 2C) by the strongly marked nerves on the calyx (*vs.* slightly marked; Fig. 1E-H), and by the calyx with curved shape after fructification (*vs.* straight; Fig. 1H).

Discussion

The most recently published species of *Buchnera* from Brazil were described based on few records, *i.e. B. tacianae*, or based on several specimens from a very restricted area, *i.e. B. carajasensis* (Souza & Paula-Souza 2016; Scatigna *et al*. 2017); therefore, the discovery of a new species with relatively broader distribution and that occurs inside urban areas such as São Luís is amazing. The fact that most records of *B. nordestina* were made very recently, with a collection gap of over 130 years between the two first records, indicates that the herbaceous plants have been historically overlooked in botanical surveys, whereas the period of ca. 160 years for the first record to be correctly identified suggests a scarcity of taxonomists studying Orobanchaceae and working in the region. On the other hand, several specimens of this new species were collected thanks to recent efforts to describe and characterize the diversity and ecological interactions in the *restingas* of Maranhão (Amorim *et al*. 2016; Serra *et al*. 2016; Lima *et al*. 2017; Lima & Almeida Jr. 2018; Santos *et al*. 2019), which highlights the importance of floristic studies that encompasses the herbaceous layer.

Identification key to all species of ***Buchnera*** *from Brazil (adapted from Souza & Paula-Souza 2016 and Scatigna et al. 2017)*

1. Bracts usually as long as to two times longer than the calyx tube; stems covered with downwardly adpressed (retrorse) trichomes.....*B. nordestina* Scatigna
1'. Bracts usually shorter than the calyx tube; stems not covered with downwardly adpressed trichomes
2. Leaves 1-nerved
3. Plants glutinous, covered with glandular trichomes.....*B. tacianae* V.C.Souza
3'. Plants not glutinous, not covered with glandular trichomes
4. Inflorescence unilaterally arranged (secund); leaves entirely glabrous, except for sparse glandular trichomes near leaf insertion; calyx up to half the length of the corolla tube..... ..... *B. carajasensis* Scatigna & N.Mota
4'. Inflorescence spirally arranged; leaves scabrid-verrucose, margin sparsely hispid-scabrous; calyx longer than half the length of corolla tube.....*B. palustris* (Aubl.) Spreng.
2'. Leaves 3–5-nerved
5. Stems and leaves covered with uncinate trichomes.....*B. ternifolia* Kunth
5'. Stems and leaves not covered with uncinate trichomes
6. Calyx entirely glabrous or at most ciliate
7. Leaves adpressed to the stem.....*B. juncea* Cham. & Schltdl.
7'. Leaves not adpressed to the stem.....*B. lavandulacea* Cham. & Schltdl.
6'. Calyx entirely pubescent, pubescent exclusively on nerves, or pubescent exclusively between nerves
8. Calyx bearing intermediate nerves between the 10 main nerves.....*B. rosea* Kunth
8'. Calyx without intermediate nerves between the 10 main nerves
9. Calyx entirely pubescent or pubescent exclusively between nerves.....*B. integrifolia* Larrañaga
9'. Calyx pubescent exclusively on nerves
10. Corolla tube externally glabrous.....*B. longifolia* Kunth
10'. Corolla tube externally sparsely pubescent.....*B. amethystina* Cham. & Schltdl.

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