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Full Length Research Paper

Morphological, anatomic and karyotypic characteristics of *Peliosanthes teta* Andrew

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***Peliosanthes teta* Andrew, domesticated indigenous vegetable, obtains high potential of commercial production. Huai Hong Khrai Royal Development Study Centre, Doi Saket, Chiang Mai carried out surveys and collections of the plants in the areas of the Upper-North of Thailand. The plants were then grown in the collection plots inside the centre. Samples of 72 accessions were taken for characterization, morphologically and anatomically. Plant parts studies included roots, stems, leaves and flowers. The chromosomes were also investigated. Studies showed that the plant accessions shared similar morphological and anatomic structures. Chromosome number checked from 16 accessions were the same, that is, 2n = 54. Karyotypic formula was $L_2^m + L_2^a + L_2^{sm} + M_2^a + S_4^a + S_{36}^m + S_6^{sm}$.**

Key words: *Peliosanthes teta* Andrew, characterization.

INTRODUCTION

Peliosanthes teta Andrew was earlier placed in family Liliaceae, but currently Convallariaceae (Jessop, 1979; Conran and Tamura, 1998). It can be found in the wild as well as domesticated. The edible part is the inflorescence (Trisonthi and Trisonthi, 1999; Sapchareon, 2005). This indigenous vegetable has become very popular and more cultivated in some rural areas of northern Thailand. Since the plants flower seasonally, to cope with the market demand basic data of this plant species is required to benefit its commercial production development.

Surveys of *P. teta* Andrew genetic resources were carried out in some parts of Chiang Mai, Chiang Rai, Lampang, Lamphun, Mae Hong Son, Nan, Phayao and Phrae, the 8 Upper-Northern provinces of Thailand, and 72 accessions were collected from their natural habitats as well as domesticated fields to be *ex situ* grown at Huai Hong Khrai Royal Development Study Centre, Doi Saket, Chiang Mai (Sirikhum et al., 2009). The plants collected showed a certain extent of species diversity, hence, studies were conducted to obtain their morphological, anatomic and karyotypic characteristics to support the taxonomic work. The data being gathered from the studies would also be useful for phylogenetic analysis of the plants distributed in different habitats and ecosystems. Meanwhile, the growth habit in terms of flowering being observed through the process of plant sampling would also be valuable for the development of the plants' off-season production.

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MATERIALS AND METHODS

Morphological characteristics of stems, leaves, flowers and fruits, were inspected from the samples of mature plants, 72 accessions in number, grown in the plots at Huai Hong Khrai Royal Development Study Centre following the methodology suggested by Chayamarit

Figure 1. *Peliosanthes teta* Andrew: whole plant (A), leaves (B), inflorescence (C), flower (D) and fruits (E).

(2002). The mature parts of plants were measured and recorded their characters and sizes.

Anatomic studies of the same plant parts except the fruits were done from the transverse and longitudinal sections of those samples. Permanent sections were prepared via paraffin embedding techniques described by Johansen (1940). Tissue samples of the plant parts were killed and fixed in formalin/acetic acid/alcohol mixture (FAA) for at least 24 h. The fixed samples were then immersed sequentially in series of the alcohol mixtures of 50, 70, 85, 95 and 100%, each at the durations of 6 to 24 h. They were passed through pure tertiary butyl alcohol (TBA) for at least 24 h, and then immersed in a mixture of TBA and liquid paraffin (1:1) for 3 days at room temperature. The samples were embedded in melted paraffin (paraplast) and positioned. Sectioning was done by rotary microtome. The thickness of the paraffin ribbons was adjusted to fifteen micrometers. Sections were stained with Delafield's hematoxylin dye solution. They were then mounted permanently by glass cover slips with Canada balsam. The tissue samples were investigated under the Olympus BX50 Compound Light Microscope. Microphotographing from DP21 Microscope Digital Camera was conducted for anatomic studies of the sectioned tissues.

Chromosome investigations were done using the root tips from 16 plants. The method of root tip tissue preparation was that proposed by Dyer (1979) modified by Vitayasak (1996). Root tip samples were taken at 10.00 a.m. They were pre-treated in para-dichlorobenzene solutions (PDB) at 10°C for 6 h, and then fixed in Carnoy's solution for 5 min. Maceration of the root-tip samples was done in hydrolytic solution (1N HCl) at 60°C for 5 min. They were then stained in carbol fuchsin dye solution at 10°C for 6 h. Stained samples were thereafter squashed and studied under microscope for chromosome number of the species as well as the karyotypic characters produced from the 2n-chromosomes. Centromeric index (CI) was calculated from the long-armed length (LI) by the chromosome length (LT). Chromosome types were identified as metacentric chromosome (CI = 0.500 to 0.599), submetacentric chromosome (CI = 0.600 to 0.699), acrocentric chromosome (CI = 0.700 to 0.899), and telocentric chromosome (CI = 0.900 to 1.000).

RESULTS

Morphological characters

P. teta Andrew belongs to a monocotyledonous type of plants; root 9 to 12, fleshy and thick, 0.22 to 0.30 cm diameter, and 12.1 to 24.0 cm long. Stem rhizomatous, 1.01 to 1.46 cm diameter, leaf simple, lanceolate, 17.8 to 25.3 × 3.3 to 4.0 cm, with 7 to 10 veins, apex acute to acuminate, margin entire, inflorescence simple raceme, 6 to 11 cm long, peduncle white straight. Flower is bisexual and symmetrical, 0.51 to 0.92 × 0.30 to 0.40 cm; perianth white with pale violet at the tip, obovate to linear; anthers 6 yellow; style short, 0.7 to 1.1 cm long; stigma round; ovary inferior, 3 carpels and fruit drupe, blue, 2.2 to 3.1 × 1.2 to 1.6 cm (Figure 1).

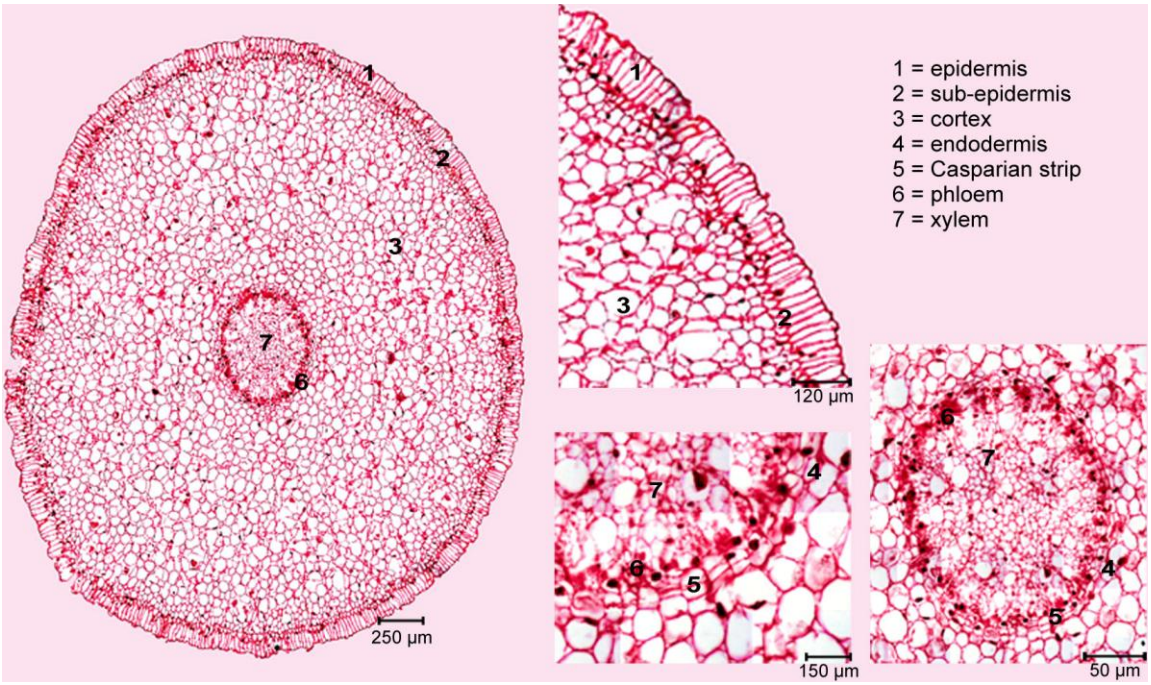

Figure 2. Transverse sections of root.

Anatomic characters

Root

Transverse sections of the roots showed single-layered epidermis composed of vertically elongated cells with thin walls. Sub-epidermal cells, having rather thick walls, were small and almost round. The cortex consisted of parenchymatous cells, irregular in shape and size, covering most of the ground tissue. A Casparian strip was shown on endodermis anticlinal walls. Vascular tissues contained the phloem distributed near the periphery of the vascular cylinder and the xylem formed strands alternating with the thin phloem strand and also occupied the centre of the cylinder (Figure 2).

Stem

From transverse sections of the stems it could be seen that the epidermis was uniseriate, consisting of rectangular cells with cutinized outer walls. The outer cortical cells, 3 to 4 in layers, were rather round in shape with no intercellular spaces while those of the inner were parenchymatous of irregular shapes. The vascular bundles were collateral distributed only in the inner cortex. Three to four layers of small parenchymatous cells were located separating the outer cortical tissue from the inner (Figure 3).

Leaf

It could be observed from the transverse sections that the leaves were of plicate type. Uniseriate epidermal cells were found on both adaxial and abaxial surfaces. The cells were rather round to rectangular with thick cutinized outer walls. Stomata appeared only in abaxial epidermis with subsidiary cells larger than guard cells. The mesophyll was rather homogenous and undifferentiated. The cells varied in size and shape. Crystals of raphide form occurred in some of these cells. Vascular bundles were collateral. The median bundles were larger than the others; with fiber sheaths occupied the phloem tissues (Figure 4).

Flower

Longitudinal and transverse sections of immature flower buds revealed 4 whorls of its floral structure. The male reproductive organs developed faster than the female as could be seen from the almost dehisced anther full of well developed pollens while the ovules appeared in the same sections were still in premature stage. The transactions also showed developing embryo sacs enclosed in the 3-carpelled ovary (Figure 5).

Karyotype

Chromosome counts showed the somatic number being

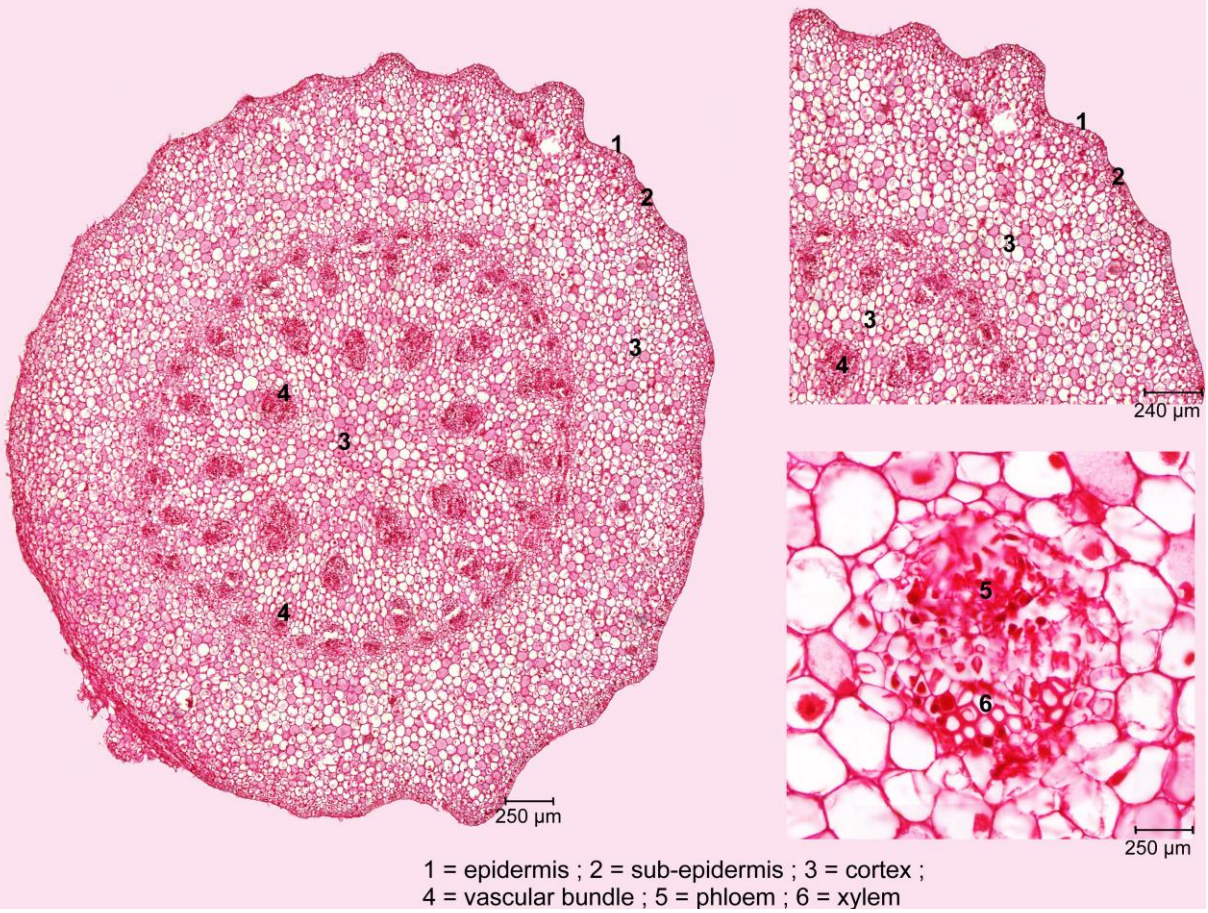

Figure 3. Transverse section of stem.

54. The chromosomes could be allocated into 3 groups, due to their configurations, as large (L), medium (M) and small (S). The large chromosomes were 7.395 to 4.413 µm in length while the medium and the small were 4.412 to 3.698 µm and 3.697 to 1.430 µm, respectively (Figure 6 and Table 1). Karyotypic formula could be produced as $L_2^m + L_2^a + L_2^{sm} + M_2^a + S_4^a + S_{36}^m + S_6^{sm}$.

DISCUSSION

Surveys of *Peliosanthes teta* Andrew in some parts of the provinces around the Upper-North of Thailand revealed that this indigenous plant has been consumed in different amount in various parts of those areas. It is widely cultivated to meet the big demands in local markets of rural Chiang Rai, Lampang, Phayao and Phrae while, despite of rather high demands with high price, less production is made to serve the markets in Chiang Mai, Lamphun, Mae Hong Son and Nan. However, with its high commercial potential and its capacity of being an alternative vegetable, various aspects of studies concerning the plant's natural habitation, accession collections and genetical backgrounds are thus essential for its development and improvement accountable for commercial production.

Concluded characterization results revealed that *P. teta* Andrew collected from the wild obtained larger plant parts than domesticated ones, especially of the leaves and the petioles. The colours of the leaves were also darker, due to habitation environment. Interestingly, it was clearly observed that domesticated plants, being hardened and adapted to environmental stresses of cultivating status flowered earlier and produced more inflorescences. These facts suggested environmental influences on flowering of the plants to a certain extent, thus, leading to further studies of cultivating factors affecting the growth and flowering of the plants.

Anatomically, it could be seen that particular characteristics of the vascular tissues could differentiate the plant accessions into groups while chromosomal characteristics are yet to be studied in more details ever

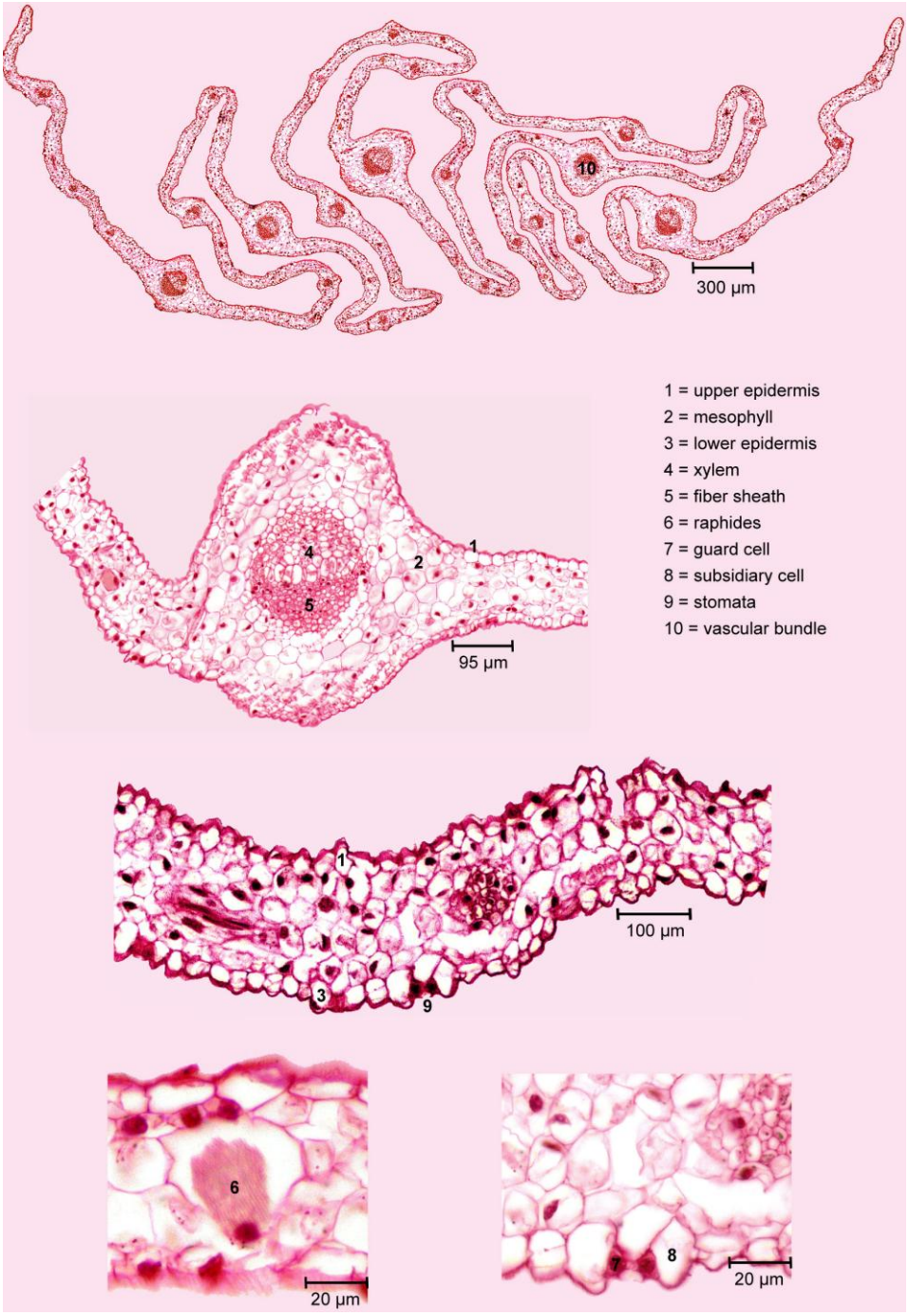

Figure 4. Transverse sections of leaf.

to support those of taxonomical works.

Conclusion

Characterizations of *Peliosanthes teta* Andrew showed that the plant was a monocotyledon. The root was fleshy and thick. The leaf blade was lanceolate with acute to acuminate apex and entire margin. The inflorescence was simple raceme with symmetrical complete flowers. The fruit was of drupe type with blue colour. Anatomic characteristic was that of monocotyledons. Somatic

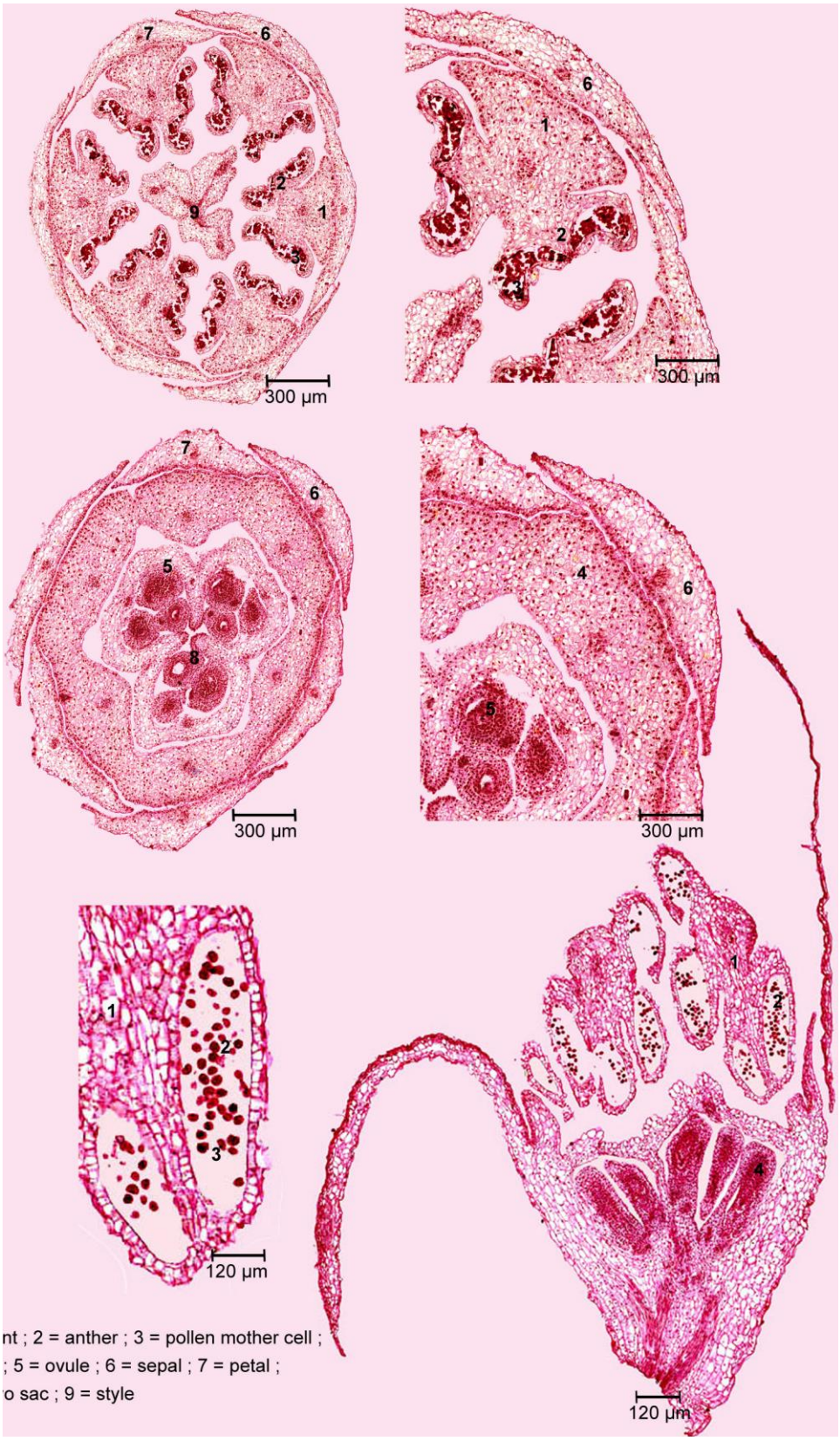

Figure 5. Transverse and longitudinal sections of flower.

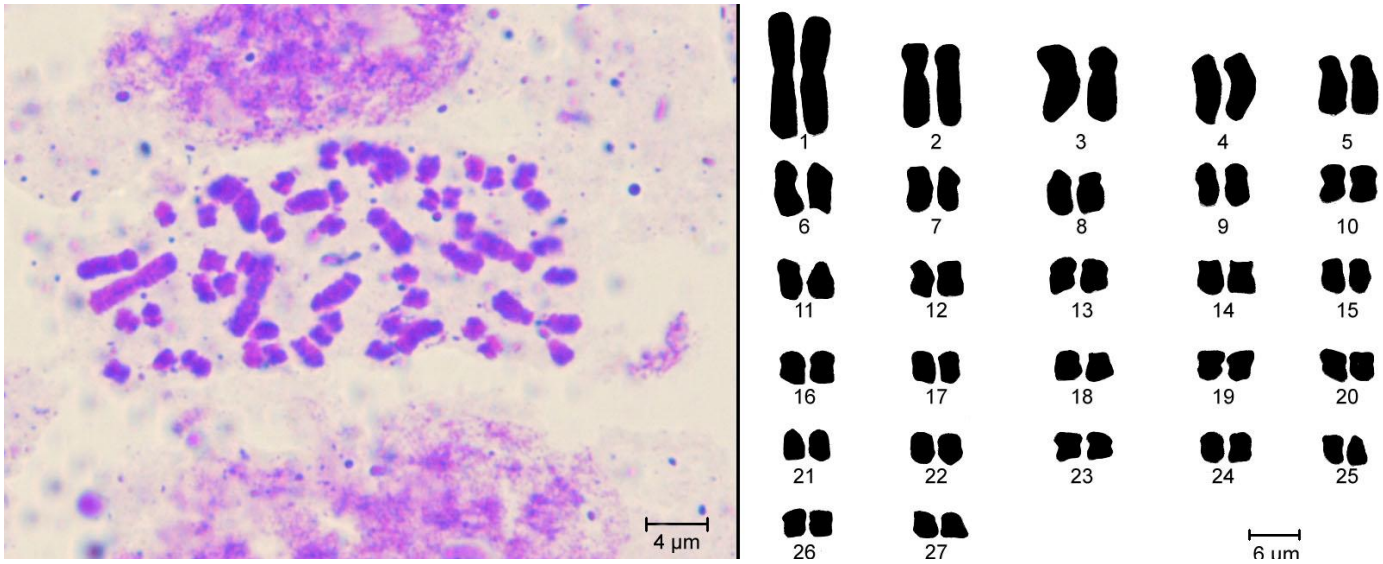

Figure 6. Somatic chromosomes (2n = 54) and karyotype of *Peliosanthes teta* Andrew.

Table 1. Chromosome length and centromeric index.

Number	Short arm length (Ls)	Long arm length (Ll)	Total length (LT)	Centromeric index (CI)
1	3.668	3.728	7.395	0.504
2	1.448	3.380	4.828	0.700
3	1.758	2.670	4.428	0.603
4	1.080	2.983	4.063	0.734
5	0.833	2.560	3.393	0.755
6	1.353	1.870	3.223	0.580
7	0.838	1.843	2.680	0.688
8	0.718	1.733	2.450	0.707
9	0.893	1.550	2.443	0.635
10	0.980	1.205	2.185	0.551
11	0.903	1.150	2.053	0.560
12	0.833	1.200	2.033	0.590
13	0.863	1.070	1.933	0.554
14	0.815	1.075	1.890	0.569
15	0.678	1.188	1.865	0.637
16	0.785	0.918	1.703	0.539
17	0.698	0.955	1.653	0.578
18	0.705	0.905	1.610	0.562
19	0.700	0.895	1.595	0.561
20	0.710	0.870	1.580	0.551
21	0.735	0.838	1.573	0.533
22	0.723	0.825	1.548	0.533
23	0.675	0.810	1.485	0.545
24	0.693	0.775	1.468	0.528
25	0.608	0.850	1.458	0.583
26	0.625	0.825	1.450	0.569
27	0.618	0.813	1.430	0.568

chromosome number was 54. Karyotypic formula could be produced as $L_2^m + L_2^a + L_2^{sm} + M_2^a + S_4^a + S_{36}^m + S_6^{sm}$.

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