



A new species and a new combination in *Tupistra* (Asparagaceae)

Leonid V. AVERYANOV¹, Noriyuki TANAKA^{2,*}, Khang S. NGUYEN³, Tatiana V. MAISAK¹

1. Komarov Botanical Institute, Russian Academy of Sciences, St. Petersburg, Prof. Popov Str. 2, RU-197376, Russia.

2. 98-11 Otsuka, Hachioji, Tokyo, 192-0352 Japan.

3. Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Cau Giay, Ha Noi, Vietnam.

*Corresponding author's email: yukinofude@yahoo.co.jp

(Manuscript received 4 May 2019; accepted 23 June 2019; online published 14 July 2019)

ABSTRACT: *Tupistra tripartita* Aver., N. Tanaka & K.S. Nguyen, a new species from central Lao P.D.R., is described and illustrated. It is closely related to *T. khangii*, *T. patula* and *T. gracilis* from northern Vietnam. The name *Tupistra extrorsandra* (N. Odyuo, D.K. Roy & Aver.) N. Tanaka & Aver. is proposed as a new combination based on *Rohdea extrorsandra* described from northeastern India, since it has several key traits unique to *Tupistra*.

KEY WORDS: Convallariaceae, Flora of India, Flora of Laos, Indochina, Nomenclatural revision, *Rohdea*, Taxonomic identity.

INTRODUCTION

Tupistra (Ker Gawler, 1814) and *Rohdea* (Roth, 1821) are closely related genera belonging to Asparagaceae (Jussieu, 1789, as Asparagi) (Chase *et al.*, 2009, Tanaka, 2010a, b) or Convallariaceae (Link, 1829) (Takhtajan, 1997, Tanaka, 2003a, b). They were later recircumscribed and revised by Tanaka (2010a, b). Currently, *Tupistra* consists of a few more than 30 species occurring chiefly in the subtropical to tropical regions of South and Southeast Asia (Tanaka, 2010a, Averyanov and Tanaka, 2012, Hu *et al.*, 2013, Vislobokov *et al.*, 2014, Averyanov *et al.*, 2015, 2016, 2017, 2018, Nguyen *et al.*, 2017, Tanaka *et al.*, 2018b), while *Rohdea* comprises 20 or a few more species distributed in the warm temperate to subtropical regions of China and its adjacent countries (Tanaka, 2010b, Averyanov *et al.*, 2014, 2017, Tanaka *et al.*, 2018a). The two genera are nearly parapatric with minor overlaps in their ranges. Differing in several characters, they can be regarded as distinct genera. Namely, as compared with *Rohdea*, *Tupistra* usually has longer leaves with a narrowly oblanceolate (vs. usually narrowly elliptic or oblong) blade and a more distinct petiole, purplish, beige or ochreous (vs. green or greenish, later turning apricot) perianths, broader stigmas, longer and thicker styles, larger, warty, spherical, brownish or blackish (vs. smooth, ovoid or ellipsoid, orange or red) berries, inaperturate, spheroidal (vs. monosulcate, ellipsoidal) pollen grains with a verrucate, gemmate or rugulate (vs. foveolate or reticulate) exine sculpture (Huang and Hong, 1997), and bimodal (vs. unimodal) karyotypes (Huang *et al.*, 1989, 1990). Moreover, it has been shown by an analysis of DNA sequences of the *trnK* and *rbcL* regions of the chloroplast (Yamashita and Tamura, 2000) that *Tupistra* is phylogenetically distinct from *Rohdea*, forming sister groups with *Aspidistra* (Ker Gawler, 1822).

Several new species of *Tupistra* have recently been described from eastern Indochina (e.g. Averyanov and Tanaka, 2012, Vislobokov *et al.*, 2014, Averyanov *et al.*, 2015, 2016, 2017, 2018, Nguyen *et al.*, 2017, Tanaka *et al.*, 2018b). In April 2015, three of us made a botanical exploration in central Laos, and encountered one species of *Tupistra*. After a close examination of the collected samples, we found that it differs in several respects from the related species so far known. Hence we describe it here as a new species with photographic illustrations and relevant taxonomic data.

Recently, Odyuo *et al.* (2017) described *Rohdea extrorsandra* N. Odyuo, D.K. Roy & Aver. from northeastern India. However, we consider it to be a species of *Tupistra*, since it has several key characters unique to the latter genus. We therefore propose here a new combination for this species under *Tupistra*. Details for this treatment are presented in the notes below.

TAXONOMIC TREATMENT

Tupistra tripartita Aver., N. Tanaka & K.S. Nguyen, *sp. nov.* **Fig. 1.**

Described from central Laos. **Type:** 6 December 2017, L. Averyanov, T. Maisak, LA-VN1041 / NV 1266 / 15171 (holotype – LE01048461) prepared from cultivated plant collected in central Laos: Xiangkhouang province, Kham district, Huad village, Phou tat Vinh Mt., around point 19°32'31.6"N 103°39'40.4"E, primary or secondary broad-leaved evergreen or semideciduous dry forest on very steep rocky slopes of highly eroded mountains composed of solid marble-like limestone at elevations 1200–1400 m a.s.l., terrestrial herb on mountain slope, locally very common, fruits almost black, 4 April 2015, L. Averyanov, T. Maisak *et al.*, LA-VN 1041 / TM 1266. D-EXSICCATES OF VIETNAMESE FLORA 0303/LA-VN 1041 / TM 1266 / 15171.

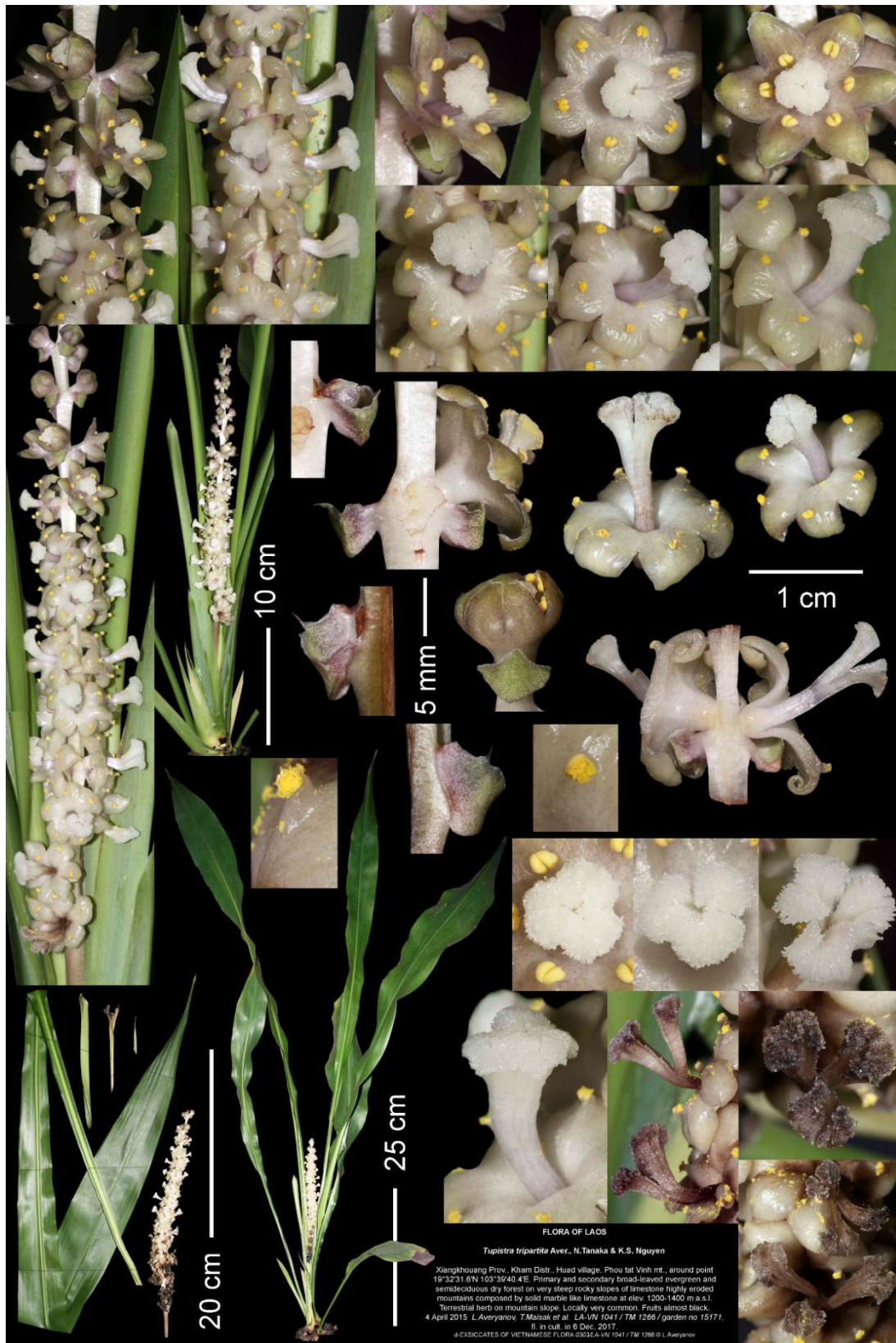


Fig. 1. Habit and various portions of *Tupistra tripartita* Aver., N. Tanaka & K.S. Nguyen. Digital epitype 0303/LA-VN 1041 / TM 1266 / 15171 (image available at: <http://en.herbariumle.ru/?t=occ&s=tripartita&f=%5Ball%5D&id=2652>).



Description: Terrestrial rhizomatous perennial herb. Rhizome erect or ascending, simple or a few branched, terete, 4–6 cm long, (1.5)2(2.5) cm in diameter, stout, densely nodose, dull yellowish. Roots numerous, semi-woody, wiry. Stem erect, 2–4 cm tall, covered densely with cataphylls and leaf bases. Cataphylls equitant, ensiform, lanceolate or narrowly triangular lanceolate, acute, (4)8–22(25) cm long, 1–2 cm wide (when expanded), conduplicate, herbaceous, light pale green, becoming dark dirty-brown and partially disintegrated with aging. Leaves basal, (4)5–6(7), equitant, suberect or arcuate, blade narrowly oblanceolate, (0.8)0.9–1.2(1.3) m long, (5)6–10(12) cm wide, acute or acuminate at apex, leathery, wavy, glossy, uniformly dark green, midvein prominently raised abaxially, gradually tapering to thick, stiff, canaliculate, petiole-like basal part 25–35 cm long. Peduncle axillary in apical part of stem, erect, straight, subterete, irregularly angled longitudinally, (3)4–5(6) cm long, much shorter than inflorescence rachis, (3.5)4–5(6) mm in diameter, fleshy, stiff, glabrous, white to dull pale pinkish. Inflorescence a terminal, subdense spadix-like spike, (15)18–22(24) cm long, 2–2.5 cm in diameter. Floral bracts 1 or occasionally 2 (outer bract and inner bracteole) per flower, persistent; bract situated below flower, bail-shaped, rectangular-ovate, (2.5)3–4(6) mm long and wide, much shorter than flowers, thickened at base, irregularly slightly incised and scarious along margin, obtuse to truncate at apex, whitish to light green, often minutely speckled with purple; bracteole located lateral to flower, (1)1.5–2(2.5) mm long. Flowers sessile. Perianth broadly campanulate, 6-cleft, limb with recurved segments (1)1.2–1.4(1.5) cm in diameter, fleshy, white or pale dirty purplish green, glossy; proximal tubular part funnel-shaped, (2)2.5–3.5(4) mm long and wide; segments triangular-ovate, (3.5)4–5(5.5) mm long and wide, distally strongly recurved in mid anthesis. Stamens 6; filaments inserted at basal or subbasal portion of perianth segments, 0.9–1 mm long and wide, fleshy; anthers dorsifixed, ovoid, (0.7)0.8(0.9) mm long, bilocular, facing upward, bright yellow. Pistil 1, horizontal or ascending, (9)10–11(12) mm long, white, turning dirty purplish gray and eventually black with aging, distal part (style and stigma) cleft or parted into 3 segments at late anthesis. Ovary superior, inconspicuous, shortly cylindrical, (1)1.2–1.4(1.5) mm long and wide, glabrous, glossy, 3-locular. Style clavate, (7)8–9(10) mm long, (1.4)1.5(1.6) mm in diameter in middle, distally shallowly 3-sulcate, sometime slightly tinged purple, smooth, glossy. Stigma roundish, entire or very indistinctly 3-lobed in early to mid anthesis, (2.5)3–5(6) mm in diameter, front nearly flat or slightly convex, papillose, later splitting into 3 recurved lobes. Fruit berry-like, almost globular, rough, (1.6)1.8–2(2.2) cm in diameter, dark dirty green to almost black, indehiscent, 1(3)-seeded.

Habitat, phenology and conservation status: Terrestrial rhizomatous perennial herb with very short erect stem. Primary or secondary, evergreen or semideciduous broad-leaved submontane forest on rocky limestone at elevations 1200–1400 m a.s.l. Flowering in cultivation November–December. Locally very common. Estimated IUCN Red List status (IUCN Standards and Petitions Subcommittee, 2017) – DD.

Distribution: Laos: Xiangkhouang province (Kham district). Endemic to central Laos.

Etymology: The specific epithet refers to the distally tripartite pistil at late anthesis.

Notes: *Tupistra tripartita* appears closely related to *T. khangii* Aver., N. Tanaka & Vislobokov (Vislobokov *et al.*, 2014), but in the former floral bracts are usually 1 for each flower (vs. usually 2; 1 bract and 1 bracteole), and the style is more prominently thickened above, and at late anthesis nearly horizontal or not markedly drooping (vs. drooping) and distally trifid or tripartite (vs. more shallowly and irregularly split into several segments). It also has a close affinity with *T. patula* Aver., N. Tanaka & K.S. Nguyen (Averyanov *et al.*, 2016, Nguyen *et al.*, 2017) and *T. gracilis* Aver. & N. Tanaka (Nguyen *et al.*, 2017), both from northern Vietnam. From *T. patula* it differs mainly by the single bract (vs. two bracts) subtending a flower, and by the clavate, trifid or tripartite (vs. nearly terete, distally only shallowly and irregularly split) style at late or after anthesis. From *T. gracilis* it is distinguishable chiefly by the off-white or dull purplish white (vs. pale dull yellow) perianth and by the clavate, trifid or tripartite (vs. nearly terete) style at late anthesis. In *T. gracilis* the stigma irregularly splits into three lobes at late anthesis, but the style appears to remain nearly unbranched.

Further studies on the variation of these species based on ample samples from various localities are needed for a better understanding of their identity and relationships.

Tupistra extrorsandra (N. Odyuo, D.K. Roy & Aver.) N. Tanaka & Aver., **comb. nov.**

Rohdea extrorsandra N. Odyuo, D.K. Roy & Aver. in *Phytotaxa* **309**(3): 283 (2017). **Type:** INDIA. Dampa Tiger Reserve, Tuichar stream banks in Dampa Hill, Mizoram, 25 September 2016, ex hort. in Garden of Botanical Survey of India (Eastern Regional Centre, Meghalaya, East Khasi Hills, Shillong, Woodland Campus), N. Odyuo 117300 (holotype in ASSAM, n.v., isotype in CAL, n.v.).

Notes: *Rohdea extrorsandra* somewhat resembles *Rohdea* in having a perianth turning from pale green to apricot or creamy-pink during anthesis and strongly inflexed distally, and a small pistil narrowed at the style. However, at the same time it also has several traits unique to *Tupistra* (Tanaka, 2010a), such as long, distinctly petiolate, narrowly oblanceolate leaves, broad (ovate to almost half-circular) stigmatic lobes, meniscoid



or arcuate anthers, and irregularly tuberculate, dark brown fruits. In contrast, in *Rohdea*, leaves are usually shorter and less distinctly petiolate (usually less than 1 m long including the petiole), stigmatic lobes are significantly narrower (linear, oblong or lanceolate), anthers are not or scarcely arcuate, and fruits are invariably smooth and orange or reddish at maturity (Tanaka 2010b). Moreover, in *T. siphonantha* N. Tanaka, Vislobokov & D.P. Hannon (Tanaka *et al.*, 2018b) recently discovered in central Laos, the perianths are strongly inflexed distally and often pale fulvous in color, and the pistils are quite small, which are somewhat similar to those of *R. extrorsandra*. Considering all these respects, we think it more appropriate to refer *R. extrorsandra* to *Tupistra*.

Even among species of *Tupistra*, *T. extrorsandra* is very unusual in having subturbinate-urceolate perianths that are internally many ribbed and distally strongly inflexed, extrorse anther sacs borne on a well-developed connective, and small pistils with a short constricted style (for the details of floral structure and color, see Fig. 2 in Odyuo *et al.*, 2017). Having urceolate, pale apricot flowers implies that the flowers are zoophilous. The small orifice in the frontal center of the perianth may allow only small pollen-vectors to enter the interior. After entering the interior through the orifice, it is likely that the vectors move around over the ribbed perianth wall and are touched and smeared with pollen by the extrorse anthers facing the wall. In the evolutionary course, the pistil must have become sufficiently small for securing pollination in the narrow space inside the perianth. Presumably, all these traits have evolved as a consequence of adaptation to pollen-vectors, although the details of the vectors, such as kinds and behavior, are still to be examined. From these reasons, it appears that *T. extrorsandra* is a highly specialized species, and its floral resemblance to *Rohdea*, which might have stemmed from similarity in their pollination ecology, is only superficial and secondary (i.e. analogous).

As stated in the introduction, *Tupistra* and *Rohdea* sensu Tanaka (2003a, b, 2010a, b) are distinct in karyotype (Huang *et al.*, 1989, 1990, Yang and Zhu, 1990, Yang, 1995, Huang and Liu, 1996, Qiao and Zhang 2008, Hu *et al.* 2013, Tanaka, unpublished), pollen morphology (Ma and Hong, 1990, Huang and Liu, 1996, Huang and Hong, 1997, Hu *et al.*, 2013), and in some DNA sequences of the chloroplast (Yamashita and Tamura, 2000). It is therefore desirable to further study *Tupistra extrorsandra* from these respects to elucidate its taxonomic position more clearly.

ACKNOWLEDGMENTS

This research was financially supported in part by the grants to L.V. Averyanov for the title "Study of the flora of Indochina" (AAAA-A18-118031290070-6) from the Komarov

Botanical Institute of the Russian Academy of Sciences, and to S.K. Nguyen for the grant number 106.03-2018.09 from the Vietnam National Foundation for Science and Technology Development (NAFOSTED), for which we are grateful. We also cordially thank anonymous reviewers for valuable comments and suggestions on our paper.

LITERATURE CITED

- Averyanov, L.V. and N. Tanaka 2012. New species of *Peliosanthes* and *Tupistra* (Asparagaceae) from Eastern Indochina. *Taiwania* **57**(2): 153-167.
- Averyanov, L.V., N. Tanaka and S.K. [K.S.] Nguyen 2014. New species of *Peliosanthes* and *Rohdea* (Asparagaceae) from Eastern Indochina. *Taiwania* **59**(1): 18-25.
- Averyanov, L.V., N. Tanaka, K.S. Nguyen, H.T. Nguyen and E.L. Konstantinov 2015. New species of *Ophiopogon* Ker Gawl., *Peliosanthes* Andrews and *Tupistra* Ker Gawl. (Asparagaceae) in the flora of Laos and Vietnam. *Adansonia*, sér. 3, **37**(1): 25-45.
- Averyanov, L.V., N. Tanaka, K.S. Nguyen, B.V. Truong, D.T. Nghiem and T.H. Nguyen 2016. New species of *Ophiopogon*, *Peliosanthes* and *Tupistra* (Asparagaceae s.l.) in the flora of Vietnam. *Nordic J. Bot.* **34**(1): 23-37.
- Averyanov, L.V., N. Tanaka, K.S. Nguyen, Q.N. Nguyen, T.V. Maisak and T.H. Nguyen 2017. New species of *Peliosanthes*, *Rohdea* and *Tupistra* (Asparagaceae) from Laos and Vietnam. *Nordic J. Bot.* **35**(6): 697-710.
- Averyanov, L.V., N. Tanaka, H.T. Son, K.S. Nguyen, T.V. Maisak, T.H. Nguyen and C.-I. Peng 2018. *Tupistra cardinalis* (Asparagaceae), a new species from limestone areas in northern Vietnam. *Phytotaxa* **334**(1): 60-64.
- Chase, M.W., J.L. Reveal and M.F. Fay 2009. A subfamilial classification for the expanded asparagalean families Amaryllidaceae, Asparagaceae and Xanthorrhoeaceae. *Bot. J. Linn. Soc.* **161**(2): 132-136.
- Hu, G.-W., H. Li, Y. Tan, Y. Liu and C.-L. Long 2013. *Tupistra hongheensis* (Ruscaceae), a new species from Yunnan, China based on morphological, karyotypic, and pollen morphological studies. *J. Syst. Evol.* **51**(2): 230.
- Huang, J.L., H. Li, Z.J. Gu and X.Z. Liu 1989. Karyotype studies in six taxa of *Tupistra* (Liliaceae). *Acta Bot. Yunnan.* **11**(3): 343-349.
- Huang, J.L., H. Li and X.Z. Liu 1990. Karyotype study on four species of *Tupistra* (Liliaceae). *Acta Bot. Yunnan.*, Suppl. **3**: 62-66.
- Huang, J.L. and X.Z. Liu 1996. A new species of the genus *Tupistra* (Convallariaceae), with reference to its karyotype and pollen morphology. *Acta Phytotax. Sin.* **34**(6): 592-596.
- Huang, J.L. and D.Y. Hong 1997. Pollen morphology in the subtribe Aspidistrinae (Liliaceae, s. l.). *Acta Phytotax. Sin.* **35**(2): 117-124, pls. 1-5.
- IUCN Standards and Petitions Subcommittee 2017. Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by Standards and Petitions Subcommittee. 108 pp. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>
- Jussieu, A.L. de 1789. Genera plantarum secundum ordines naturales disposita, etc. Apud Viduam Herissant et Theophilum Barrois, Parisiis, France. 498 pp.
- Ker Gawler, J. B. 1814. *Tupistra squalida*. In: Sims, J. (ed.), *Bot. Mag.*, t. 1655.
- Ker Gawler, J. B. 1822. *Aspidistra lurida*. *Bot. Reg.* **8**: t. 628.



- Link, H.F.** 1829. Handbuch zur Erkennung der nutzbarsten und am häufigsten vorkommenden Gewächse 1. In der Haude und Spenserschen Buchhandlung, Berlin, Germany. 864 pp.
- Ma, L.M. and D.Y. Hong** 1990. Pollen morphology and epidermal characters of leaves in Convallariaceae (s. l.). Acta Phytotax. Sin. **28(3)**: 228-236.
- Nguyen, K.S., L.V. Averyanov, N. Tanaka, E.L. Konstantinov, T.V. Maisak and H.T. Nguyen** 2017. New taxa of *Peliosanthes* and *Tupistra* (Asparagaceae) in the flora of Laos and Vietnam and supplemental data for *T. patula*. Phytotaxa **312(2)**: 199-212.
- Odyuo, N., D.K. Roy and L.V. Averyanov** 2017. *Rohdea extrorsandra* (Asparagaceae), a new species from north-eastern India. Phytotaxa **309(3)**: 283-287.
- Qiao, Q. and C.-Q. Zhang** 2008. *Rohdea lihengiana* (Ruscaceae s. lato), a new species from Yunnan, China. Ann. Bot. Fennici **45(6)**: 481-484.
- Roth, A.G.** 1821. Novae plantarum species praesertim Indiae orientalis. H. Vogleri, Halberstadii, Germany. 411 pp.
- Takhtajan, A.** 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York, U.S.A. 643 pp.
- Tanaka, N.** 2003a. New combinations in *Rohdea* (Convallariaceae). Novon **13(3)**: 329-333.
- Tanaka, N.** 2003b. Inclusion of *Tricalistra* and *Gonioscypha muricata* in *Tupistra* (Convallariaceae). Novon **13(3)**: 334-336.
- Tanaka, N.** 2010a. A taxonomic revision of the genus *Tupistra* (Asparagaceae). Makinoa, n.s. **9**: 55-93.
- Tanaka, N.** 2010b. A taxonomic revision of the genus *Rohdea* (Asparagaceae). Makinoa, n.s. **9**: 1-54.
- Tanaka, N., D.P. Hannon, D.K. Harder, L.V. Averyanov and S.C. Lahmeyer** 2018a. *Rohdea harderi* (Asparagaceae), a new species from northern Vietnam. Kew Bull. **73(3)**: 31 (1-7).
- Tanaka, N., D.P. Hannon and N.A. Vislobokov** 2018b. *Tupistra siphonantha* (Asparagaceae), a new species from Lao P.D.R. with a simple pistil. Kew Bull. **73(2)**: 32 (1-7).
- Vislobokov, N.A., N. Tanaka, L.V. Averyanov, H.T. Nguyen, M.S. Nuraliev and A.N. Kuznetsov** 2014. *Tupistra khangii* (Asparagaceae), a new species from northern Vietnam. Phytotaxa **175(5)**: 287-292.
- Yamashita, J. and M.N. Tamura** 2000. Molecular phylogeny of the Convallariaceae (Asparagales). Pp. 387-400. In: Wilson, K.L. and D.A. Morrison (eds.), Monocots: Systematics and Evolution. CSIRO, Collingwood, Victoria, Australia. 738 pp.
- Yang, D.Q. and X.F. Zhu** 1990. Studies on karyotypes of 5 species of *Rohdea* and *Tupistra*. Acta Phytotax. Sin. **28(3)**: 199-206.
- Yang, Q.** 1995. Karyotypes of *Disporum sessile* and *Tupistra longispica* (Liliaceae). Guihaia **15(2)**: 158-162.