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A Revision of *Osmocitrus*, a section of the genus *Citrus*¹⁾

(Revisio Aurantiacearum XIII)

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FOREWORD

OSMOCITRUS is a section of subgenus METACITRUS of the genus *Citrus*, flourishing in Eastern Asia, especially in Japan and China. Recent finding of the presence of *Citrus ichangensis* in Naga Hills, Assam^{1,2,11,12)}, proved that the section penetrates into the heart of the Center of Origin of Citrus fruits—the eastern Himalaya foothills. Its distribution in China is rather limited, spreading only in Hupeh, Kweichow, and Szechwan, but not in Yunnan, the fact showing its early termination by the lack of wide adaptability. *Citrus Junos* is another member of the section having exceedingly wide distribution but not reaching India, although penetrating the paths of the Yangtze and the Mekong rivers westward^{12,13)}. It has been collected in Yunnan, Hupeh, Kweichow, Kiangsu, and through Korea into Japan, with its cultivated distribution as north as Kansu and Peipin⁵⁾. In China, *Citrus Wilsonii*⁶⁾ occurs in Hupeh, which is often cultivated in Chekiang under the name Hsiangyuan. HU³⁾ reports it also from Anhui and Kiangsu, and grows very well under Japanese conditions with meritorious rootstock behavior¹⁴⁾. *Citrus Junos*, or the Yuzu, is widely cultivated in Japan for its fruits as a valuable seasoning material and for invigorating rootstock. Its history dates back to Man-yo period (around 750 A.D.) and since then there developed a series of cultigens having certain distinct characters not known other than the Yuzu, which include earliest known Hanayu (*Citrus Hanaju*) and locally known Yukô (*Citrus Yuko*), Sudachi (*C. Sudachi*), Kizu (*C. Kizu*) and Mochiyu (*C. inflata*). More recently a large fruiting Ôsudachi form Hiroshima, Kôchi and Tokushima became known, which was provisionally named as *Citrus Takuma-sudachi* HORT^{8,9)}. Later study showed that the Henka-Mikan named by Y. TANAKA as *Citrus pseudo-Aurantium*¹⁵⁾ was nothing but a very close relative of *C. Junos*, and that totaling 10 species to comprise the Subsection EUOSMOCITRUS of this botanical Section.

In addition to this subsection, the senior author⁷⁾ added *Citrus nipponkoreana* to be worth-while to create another subsection OSMOCITRUS-PSEUDOACRUMEN. This

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is a very peculiar *Citrus* indigenous to Querpant and Yamaguchi Prefecture¹⁰⁾, unquestionably derived from OSMOCITRUS through modification by chance seedling to MICROACRUMEN of the section ACRUMEN of the same subgenus METACITRUS.

SYSTEMATIC SUBDIVISION OF OSMOCITRUS

The presence of acrid oil thread in the pulp vesicles of *Citrus ichangensis* confirmed by DUTTA and BHATTACHARIA¹⁾ brought a conclusion of its approach to the Section PAPEDA of the subgenus ARCHICITRUS¹¹⁾, making it necessary to segregate it out from other members of the subsection EUOSMOCITRUS. SWINGLE⁴⁾ placed it into subgenus PAPEDA section PAPEDOCITRUS, including *C. ichangensis*, *C. Junos*, *C. Wilsonii*, and *C. latipes* admitting that the flowers are large and stamens are connate at the base, not mentioning the presence or absence of the inflorescence. Since paniculate flowers are predominating in *C. latipes*, it belongs to true PAPEDA without doubt, but other members he mentioned have solitary flowers and should remain within METACITRUS. It is proper, therefore, to create a new subsection PROTOSMOCITRUS for *Citrus ichangensis*, besides subsections EUOSMOCITRUS and PSEUDOACRUMEN mentioned by the senior author¹⁰⁾, the systematic subdivision being as follows:

- A Lamina as large as or smaller than the petiole wing, flowers very large, solitary or binary, hanging; fruit medium, yellow, somewhat oblong, devoid of Yuzu aroma when young, with well-cut large calyx lobes when young; pulp reticulate, melting, full of very large short subangular seeds having whitish monoembryo and light colored tegmen; vesicles hyaline, very short, containing acrid oil thread at the middle...Subsection PROTOSMOCITRUS (Type species: *Citrus ichangensis* SWINGLE)
- AA Lamina much larger than the petiole wing; flowers mostly large and hanging; fruit either large or small sized with not very well-cut large calyx lobes; pulp vesicles not containing acrid oil thread; seeds generally large but never subangular, embryos being whitish or greenish, mono- or polyembryo.
- B Oil cells of the fruits mostly deeply foveolate almost in one grade, stem-end always with fine radial striations and apically more or less areolate, rind thick and yellow to reddish with Yuzu aroma at least when young, never corrugate in early stage, albedo soft, often porous, segments easily detached with tenacious thin wall easily torn, pulp mostly melting, acid but not acrid, seeds generally large and conspicuously keeled, chalaza part of tegmen always deep colored. The lamina tip not conspicuously attenuate...Subsection EUOSMOCITRUS (Type species: *Citrus Junos* SIEB. ex TANAKA)
- BB Oil cells of the rind crowded or rather dispersed, uni-grade, surface often very rough, corrugated rind yellow, thick and soft, almost without Yuzu aroma; pulp as above but segment wall thick, not tenacious and torn, seeds plump but not conspicuously keeled, chalaza part of tegmen never deep-colored. The lamina always attenuate into a distinctly emarginate tip...Subsection PSEUDOACRUMEN (Type species: *Citrus nipkokoreana* TANAKA)

MEMBERS OF EUOSMOCTIRUS

The Yuzu (*Citrus Junos* SIEB. ex TANAKA) and the Hanayu (*C. Hanaju* SIEB. ex SHIRAI) are very well known together with the Sudachi (*C. Sudachi* HORT. ex SHIRAI) abundantly grown in Tokushima Prefecture. The Yukō is also much grown in the

same prefecture, the smaller fruits being often used as the substitute of Sudachi in the market. The remainders of the subsection are only sparingly cultivated in warmer part of the country, of which none merits for large scale planting. In the present study, the Kizu of Kyūshū Island was found to be a relative of the Sudachi, entirely different from the Mochiyu (*C. inflata* HORT. ex TANAKA) of Kōchi Pref., deserving to reserve Y. TANAKA's specific name *Citrus Kizu* published in 1948¹⁵). From this point of view, nine members are designated to constitute the present taxon, the conventional key of which is to be as below:

- A Fruits yellow, never getting orange or reddish orange in color, areola generally being very conspicuous.
- B Fruit large sized, nearly globose to oblate.
- C Fruit never oblate with very significant areola and somewhat projected apex; central column comparatively small and closed with narrow carpel ends. Segments 8-12, generally 10-11, pulp abundant, more or less like a shaddock, extremely acid, soft, constituting of a large number of narrow fusoid pulp vesicles. Seeds abundant, very large, closely filled near the center, round topped, dentate and ending with wedge, white polyembryonic.....
Citrus Wilsonii TANAKA ("Ichang lemon, Hsiangyuan")
- C C Fruit oblate, areolate insignificantly and concave at the apex (never projecting). Central column large, often wide open without closely attached carpel ends, segments large, 10-14, averaging 11. Pulp abundant, soft, acid, not melting away, constituting of broadly fusoid not very abundant vesicles. Seeds large but not very many, rather smooth and narrow based, containing white monoembryo.....
Citrus Takuma-Sudachi HORT. ex TANAKA ("Sudachi" or "Ōsudachi" in Hiroshima and Tokushima, "Naoshichi" in Kōchi)
- B B Fruit medium to small-sized, globose or depressed globose.
- C Fruit small sized, not exceeding 6 cm in diam., distinctly areolate and apically somewhat projected. Central column small, with narrow carpel ends, segments 8-10, pulp acid and melting, seeds large, plump with acute base, containing white primary embryo with or without greenish secondary embryo, tegmen light colored, chalaza part simply pink-stained
Citrus Hanaju SIEB. ex SHIRAI ("Hanayu or Tokoyu")
- C C Fruit medium sized, always exceeding 6 cm or more in diam.
- D Fruit smooth with rounded apex, areolate but not projecting at the stylar end, segments many, often as many as 15, inner end broad, central column rather large, filled, pulp coarsely netted, acid, not inedible, seeds large, not very round, containing green monoembryo
Citrus pseudo-Aurantium HORT. ex Y. TANAKA ("Henka-Mikan")
- D D Fruit rather rough, with somewhat projected apex providing very conspicuous narrow areola, segments 10-13, central column not very large, inner ends of segment not broad, pulp acid, inedible, melting and easily dried, very coarse grained, seeds large, very much rounded with most conspicuous keel, containing white polyembryo
Citrus Junos SIEB. ex TANAKA ("Yuzu, Yunosu, Yu")
- A A Fruit orange to reddish orange in color, areola often quite inconspicuous.
- B Fruit small, roundish or depressed globose, not exceeding 6 cm in diameter, oil cells not graded, calyx almost not lobed. Segments 8-10, often 8, with small central column, pulp not deep-colored, very acid, vesicles linear fusoid.
- C Fruit partly reddish, apex almost not concave, areolate, remaining calyx nearly

- unlobed, seeds not very plump, with short pointed base, sometimes striated, testa rather thick, tegmen rather deep colored, containing white primary embryo and pale greenish secondary embryos. Branch mostly spiny, leaf apex attenuate in acuminate end.....
- Citrus Sudachi* HORT. ex SHIRAI ("Sudachi")
- C C Fruit orange colored, not reddish, apex always concave with inconspicuous areola, remaining calyx divided into five connate lobes, with occasional narrow tips. Seeds large, smooth and plump, with somewhat elongate base, testa thin, tegmen light-colored, always containing green polyembryo. Branch mostly inermis, leaf apex simply acute.
- Citrus Kizu* HORT. ex Y. TANAKA ("Kizu" or "Kinosu")
- B B Fruit medium sized or rather large, of the shape and size of *C. Unshiu*, depressed globose or more or less oblate, with concave apex and faint areola, always exceeding 6 cm in diam., calyx shallowly lobed, lobes distinct. Segments 8-12, rarely 13, central column small to large, pulp deep colored, acid with fusoid vesicles generally reticulate in the cross section.
- C Fruit oblate or more or less obconical, mostly very regular, color yellowish orange. Rind sometimes thinner and tight. Central column often small and closed, segments generally attached. Seeds not extremely large often with elongated base, smooth or faintly striated, tegmen not very intensely colored, chalaza part also not deeply purple, containing greenish polyembryo.....
- Citrus Yuko* HORT. ex TANAKA ("Yukō, Iyo-yukō, Awa-yukō")
- C C Fruits simply oblate, never obconical, generally soft and sometimes more or less buckled, orange to deep orange. Rind thick and always soft and porous, central column often wide open, segment soon loosened. Seeds extremely large, occasionally orbicular with round apex and very shortly cut base, smooth, tegmen deep colored, chalaza part intensely purplish, containing green mono-embryo.....
- Citrus inflata* HORT. ex TANAKA ("Mochiyu, Bushukan")

AMENDED LIST OF SPECIES

CITRUS-METACITRUS-OSMOCITRUS

- I. Subsect. **PROTOSMOCITRUS**, TANAKA & TANINAKA, nov.
- Citrus ichangensis* SWINGLE in Journ. Agr. Res. 1 (1) 1, 1913, pro parte; TANAKA, Sp. Prob. Citr. 127, 1954; BHATT. et DUTTA, Classif. Cit. Fr. Assam, 80, 1956; DUTTA in Ind. Jour. Hort. 15 (3/4) 151, 1958.
- II. Subsect. **EUOSMOCITRUS**, TANAKA
- Citrus Junos* SIEB. ex TANAKA in Siebold Cent. Celebr. Mem. Works, 65, 1924: TANAKA, Sp. Prob. Citr. 126, 1954.
 - Citrus Wilsonii* TANAKA in Mem. Tan. Cit. Exp. Sta. 1 (2) 37, 1932; TANAKA et al. in Stud. Citrol. 11: 63-66, 1949; TANAKA, Sp. Prob. Citr. 127, 1954.
 - Citrus Hanaju* SIEB. ex SHIRAI Jap. Nam. Tr. 44, index 3, 1933; TANAKA Sp. Prob. Cit. 127, 1954.
 - Citrus Sudachi* HORT. ex. SHIRAI Jap. Nam. Tr. 114, index 8, 1933; TANAKA Sp. Prob. Cit. 128, 1954.
 - Citrus Kizu* HORT. ex Y. TANAKA Jcon. Jap. Cit. Fr. 2: 411, 1948.
= *Citrus inflata* pro parte, ex TANAKA Sp. Prob. Cit. 128, 1954.
 - Citrus inflata* HORT. ex TANAKA in sensu strictu, in ISHII Cycl. Hort. 1: 534, 1944.

8. *Citrus pseudo-Aurantium* HORT. ex Y. TANAKA *Icon. Jap. Cit. Fr.* 2: 394 1948; TANAKA *Sp. Prob. Cit.* 128, 1954.
9. *Citrus Yuko* HORT. ex TANAKA *in* ISHII, *Cycl. Hort.* 1: 535, 1944; TANAKA *Sp. Prob. Cit.* 128, 1954.
10. *Citrus Takuma-Sudachi* HORT. ex TANAKA *in* Tachibana 15 (6) 20, 22, 1954; TANAKA *in* Kankitsu 6 (8) 7, 8, 1954.

III. Subsect. PSEUDOACRUMEN, TANAKA

11. *Citrus nippokoreana* TANAKA *in* *Stud. Citrol.* 12: 58, 1951; TANAKA *Sp. Prob. Cit.* 128, 1954.

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