

Taxonomy of Asian *Geranium* L.(Geraniaceae) based on fruit and seed morphology

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Compare to investigate the taxonomic utility of infragenera system and interspecific of Asian *Geranium*, we examined the fruit and seed morphology from 35 taxa. The fruit shape and seed's dispersal way did so that may divide subgenus or some part section to do could reason evolutionary trends. That is, at seed dispersal, the awns of section *Geranium* of subgenus *Geranium*, remains attached at the top of rostrum, though fairly easily broken off, because seed increases awn's elasticity by diffusive way, it is long characteristic seed's dispersal distance, and subgenus *Robertium* observed that seed dispersal distance is short because it is no awn's elasticity by way that seed dispersal is gone as awn drops with rostrum. Also, section *Geranium* of subgenus *Geranium* and subgenus *Robertium* act role that awn keeps temporarily breed swerving with mericarp instead of bristle because section *Tuberosa* of subgenus *Geranium* is not bristled function that keep temporarily breed because mericarp bristled on base at seed dispersal do while. Therefore, is thought that is taxon that when consider formation's development and function regarding this seed dispersal function, subgenus *Geranium* evolves more than subgenus *Robertium*. Seed morphology can divide by 2 subgenera(*Geranium*, *Robertium*) according to pattern of seed coat. and Seed's morphology characteristic(whole shape, color, form of seed apical and base, micropyle area, hilum area, chalaza, and position of seed hilum area), can distinguish some species, but is thought that is not reasonable as for discernment characteristic form and nature by repetition of characteristic form and nature. Especially, infrasection do in fruit and seed's morphology that is handling in this research that know to argue classification system and relationship by repetition of characteristic form and nature difficult. To all reliable truth, cytological, ecological, embryology, and molecular genetics research about taxon is considered that should be achieved section *Geranium* that do not handle yet.

Key words : Taxonomic, *Geranium*, fruit and seed, evolutionary trends

1. Introduction

Geranium L.(Geraniaceae), about 300 species are ranging widely^{1,2)}, northern hemisphere regions and tropical high mountain area, and plant that belong to Geraniaceae^{3~7)}, some species had become research target because value is very high as coronal shape and medical use^{8,9)}. Since research reactor about *Geranium* announces 39 species that

Linneaus¹⁰⁾ is divided by basin degree of leaf and form of leaf, divide of leaf and peduncle. Candolle¹¹⁾ is perennial, and have one pedicel including *G. sibiricum* L. to the group which is perennial and have two pedicel 11 species, 38 species to the group which two pedicel by perennial, 16 species to the group which have two pedicel by annual, published the three groups, 66 species all. Koch¹²⁾ by Germany 18 species 3 section (*Batrachium*, *Batrachioides*, *Columbinum*) established classification system of infragenera for the first time, Boissier¹⁾ by 2 series and 7 group according to hair present and absent of filament and petal, form of root, time of growth, Edgeworth and Hook²⁾ the Britain by 3 section, Reiche¹³⁾

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all 10 section announced. Knuth¹⁴⁾ according to leaf form, divide degree of leaf, radices form, divide form of stem etc. about 90 species, announced 32 section all because established classification system infragenera for the first time because dividing in 30 section and 3 subsection and Knuth¹⁵⁾ adds 2 section of *Fruticulosa* and *Paramensia* announced. Bobrov¹⁶⁾ divided Russia 55 species by 13 section 3 subsection by form of radices, size of petal, divide degree of stem, flower color, stipule and form of leaf, Yeo¹⁷⁾ announced classification system by 3 subgenera according to seed dispersal way, form of leaf, form of leaflet, inflorescence, life history, shape of petal and form etc., 14 section, 2 subsection, the 25 group about 110 species. If base classification system that Yeo¹⁷⁾ divides about the Asian, the Asian is divided by 2 subgenera, 5 section, the 9 group, but Park¹⁸⁾ establishes form of inflorescence, and hair present and absent of pedicel and petal, seed dispersal mode, seed form, and leaf, stem, petiole's anatomical research and 2 group(*Koreanum*, *Wilfordii*) according to form of flowerpot newly except and establish classification system by 2 subgenera, 5 section, the 11 group. Research reactor about seed form of this genus, Murley¹⁹⁾ United States of America 14 species record, and Tokasaki²⁰⁾ classified with morphology and anatomy characteristic form and nature about fruit and seed about Russian 48 taxons, Boewinkel and Been²¹⁾ are *G. pratense* studied about form of seed surface. Brison and Peterson²²⁾ are *G. sylvaticum* did electron microscope scanning research about seed outer skin, and Corner²³⁾ did general recording about seed form. With resulting, the fruit and seed research as limited mainly area's some regions, examination that is synthesis of result or taxonomical survey is unprepared real condition. Therefore, this research examines propriety of taxon establishment because according to fruit and seed form and seed dispersal way that is important characteristic form and nature that divide Asian *Geranium* by 2 subgenera, and wishes to investigate about relation with classification system of real state through this, value as evolutionary trends and classification characteristic form and nature etc.

2. Material and methods

Materials for experiments used collecting from

May, 1993 to August, 2001 and attendant that fruit and seed's morphology mature 20 individual per taxon by anatomy microscope observe, and observe and recorded color etc. of dimension of fruit, shape of fruit, sculpture of fruit, awn's hair, seed's size, seed's form, position on the seed, micropyle area of seed, form of seed chalaza, micropyle of seed. Fixed to 1 % osmium tetroxide after 2th washing by 0.1M phosphate buffer(pH 6.8) choosing schedule region of material that is fixed to FAA to observe seed's outer skin, and metathesis the second by isoamylacetate via gradual dehydration process of 30~100 % alchole, and dry and produced sample ore by critical point dryer. This free medical care by ion sputer(JEOL-1100) 150~200 Å thickness after do gold coating to by scanning electron microscope(Akashi ss 130) observed(Plate 1, 2). Species and collecte site of material are same with Table 1.

3. Results and discussions

3.1. Fruit

Important characteristic that divide subgenus, and can divide as follows according to shape and trichome distribution of fruit.

(1) Surface pattern of mericarp(department) : a) smooth : smooth that wall of mericarp, subgenus *Geranium* is observed. b) sculpture : By taxon that it is to wall of mericarp pattern of wave, subgenus *Robertium* is observed.

(2) Hair of mericarp and present of absent of gland : a) non-trichome : there is seldom gland or hair in mericarp, *G. ibericum* and *G. robertianum* observed. b) hairy : There is no gland in mericarp, and be trichome. it is observed beside taxon that have a) and b) form. c) gland-hairy : be glands and hairs in mericarp ; *G. eriostemon*, *G. eriantham*, *G. pratense*, *G. nepalense*, *G. nepalense* var. *thunbergii*, *G. wlassovianum*, *G. shikokianum*, *G. delavayi*, *G. refractum*, *G. carolinianum*, *G. shikokianum* var. *quealpartense*, *G. wlassovianum* var. *maximowiczii*, *G. koreanum*, *G. koreanum* var. *hirsutum*, and *G. taebaekensis* and so on.

(3) Bristle in base of mericarp : a) non-bristle type : In type that is not bristled on base of exocarp section *Tuberosa* of subgenera *Geranium* and subgenera *Robertium* is observed. b) bristle style (bristle) : be observed in the subgenus *Geranium*

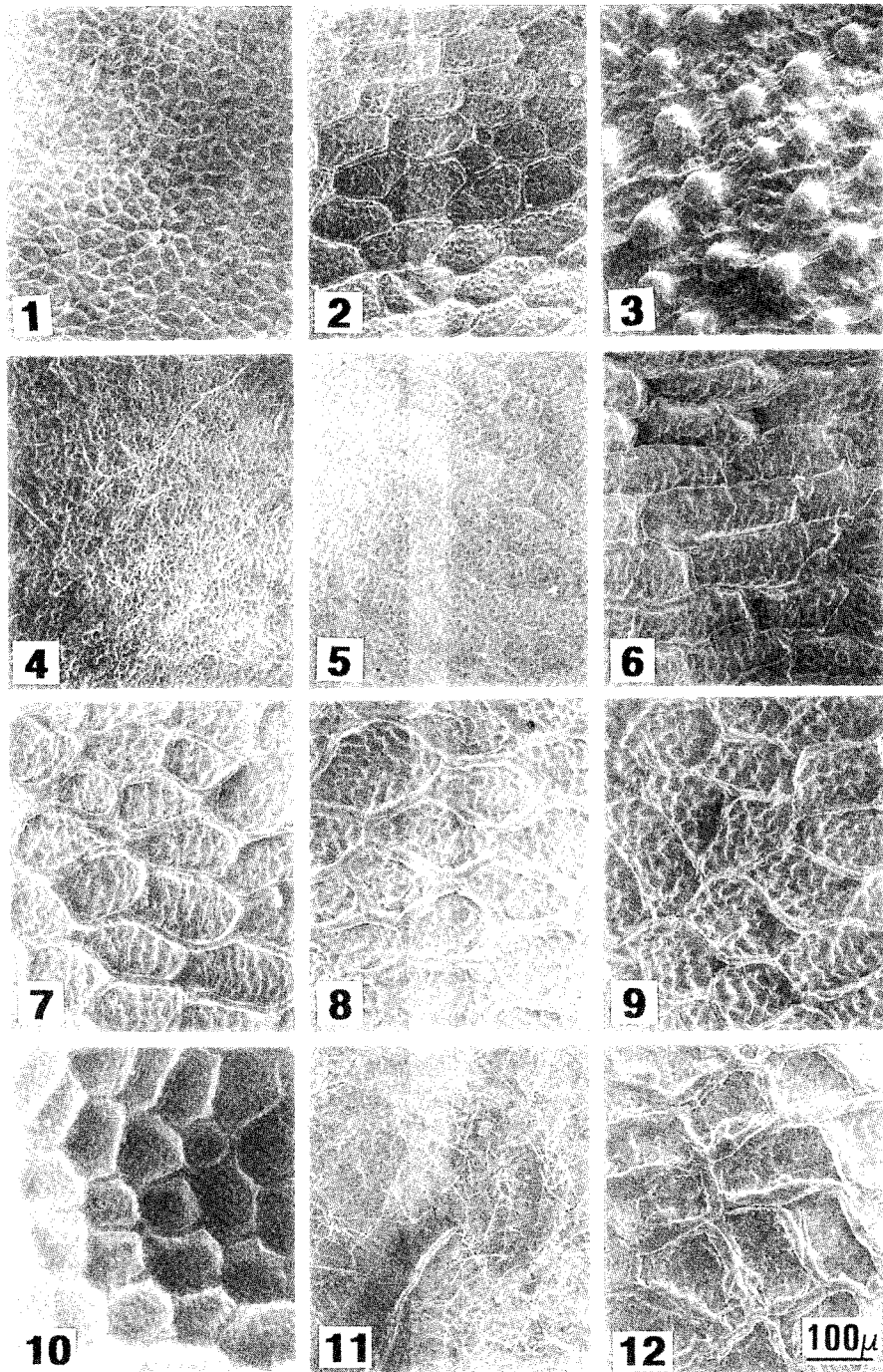


Plate 1. Observation of seed epidermis by SEM

- | | | |
|-------------------------------|------------------------|--------------------------|
| 1. <i>G. dahuricum</i> | 2. <i>G. yesoense</i> | 3. <i>G. robertium</i> |
| 4. <i>G. krameri</i> | 5. <i>G. erianthum</i> | 6. <i>G. pratense</i> |
| 7. <i>G. nepalense</i> | 8. <i>G. sibiricum</i> | 9. <i>G. wilsovianum</i> |
| 10. <i>G. pseudosibiricum</i> | 11. <i>G. palustre</i> | 12. <i>G. farreri</i> |

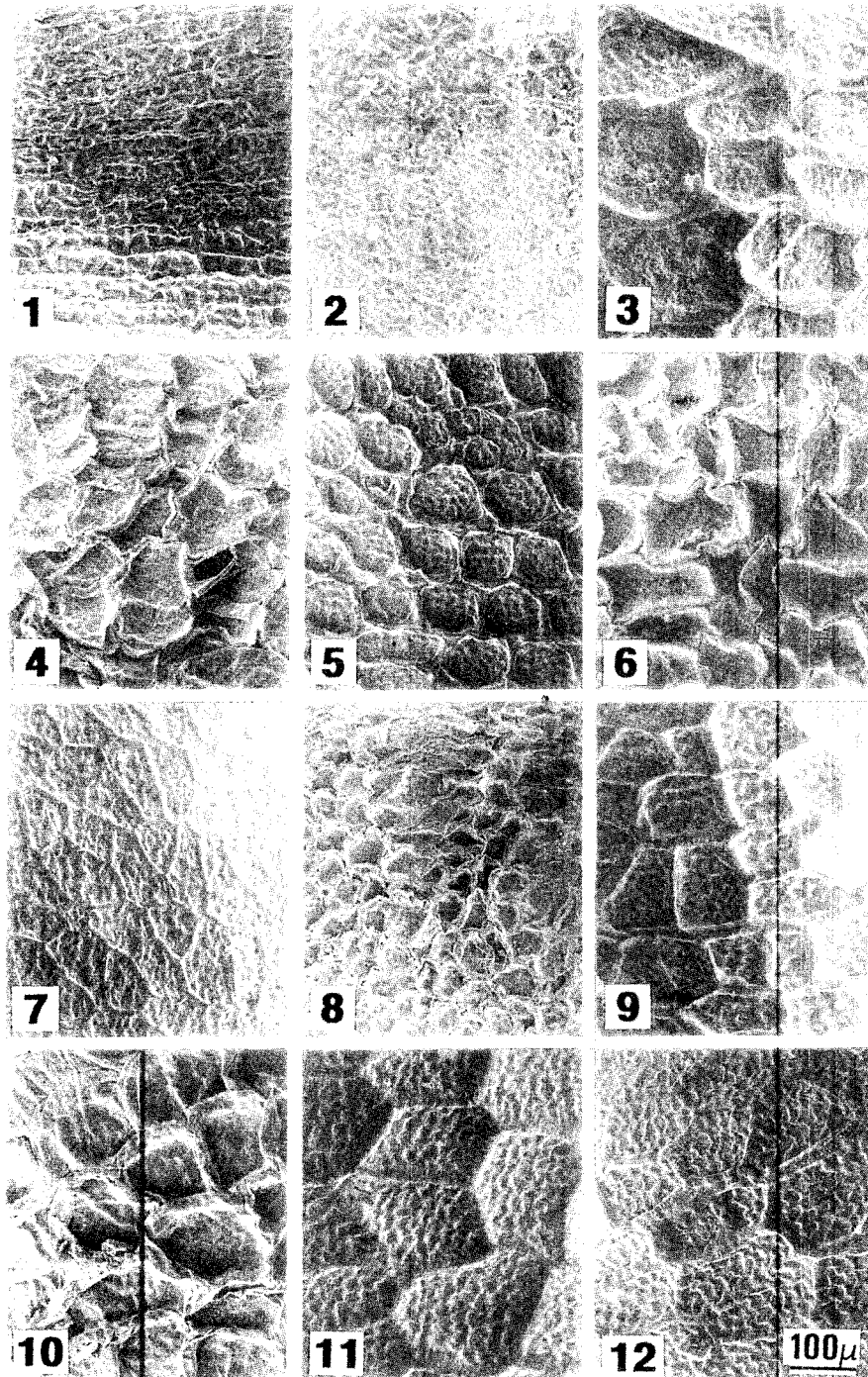


Plate 2. Observation of seed epidermis by SEM

1. *G. carlonianum*

2. *G. henry*

3. *G. wilfordii*

4. *G. knuthii*

5. *G. uniflorum*

6. *G. tripartitum*

7. *G. suzuki*

8. *G. napuligerum*

9. *G. koreanum*

10. *G. koreanum* var. *hirsutum*

11. *G. tabaekensis*

12. *G. shikokianum*

Table 1. Taxa and voucher specimens from which fruit and seed were collected

Taxon	Localities, date, collectors, and source
Subgenus <i>Geranium</i>	
Section <i>Geranium</i>	
<i>Geranium dahuricum</i> L.	Korea : KW ; Mt. Solak(Aug. 13. 1988), J. G. Lee(SKK 15749) China: Hopei(Aug. 9. 1959) ? PE Japan : Iaganoken(Aug. 25. 1930) M. Kume(GH)
<i>G. eriostemon</i> Fisher	Korea : CB ; Mt. Sobaek(July. 4. 1990) Y. J. Jeong(SKK, 15723) Japan: Tgakashi, Shinano(Aug. 19. 1893) ? (BH) China : Kansu(July. 1925.) J. F. Rock(NYBG) U.S.S.R : Czita(July. 13. 1906) G. Stukov(NYBG)
<i>G. erianthum</i> DC.	Japan : Hokkaido(Aug. 17. 1977), D. E. Bouffordand(H) Russia : ? (June. 19. 1753) E. Hulten(PE) U.S.A. : Alaska (Aug. 10. 1892), F. Funston(PE)
<i>G. pseudosibiricum</i> Mayer	China : Shinkiang(Apr, 20, 1957) ? (PE) U.S.S.R : Siberia, Prov. Krasno Jarsk (July 3, 1903) ? (BM) Japan : Kanagawa(? 1886) J. Bisset(BM)
<i>G. henryi</i> Knuth	China: Hopei(Aug. 25. 1980) B. Bartholomens et all(NYBG)
<i>G. pratense</i> L.	China : Hopei, Hsiao-Wy-Tai-Shan(July 7. 1936) Wy et Yang(PE)
<i>G. carolinianum</i> L.	Japan : Hanshu, Pref. Hyogo. Kakogaua-Shi(June. 4. 1969) N. Kurosaki (NYBG) U.S.A : Missouri, Randolph(May. 22. 1956) J. A. Steyer Mark(BM)
<i>G. yesoense</i> Franchet & Savatier	Japan : Hokkaido. Prov, Oshima, Hakodak(July. 10. 1890) R. Miyabe & M. Fokubuchi(BM) China : Li-Hsien(June. ?. 1955) H. L. Tsiang(PE)
<i>G. delavayi</i> Franchet	China : Yunnan(Aug. 17. 1990.) J. Murata, N. Kanayama, Y. Murakami, E. S. Reul, S. W. Yu(GH)
<i>G. nepalense</i> Sweet	Korea : CN ; Gayasan(8. 19. 1993) S. J. Park(KUS) China : Sichuan, Guauxian(July. 21. 1987) Wang Znong-Tao(NYBG)
<i>G. nepalense</i> <i>var. thunbergii</i> (Sieb. & Zucc.) Kudo	Korea : KG ; Mt. Myongi(8. 12. 1993) S. J. Park(KUS)
<i>G. sibiricum</i> L.	Korea : CN ; Mt. Gyeyong(8. 30. 1994) S. J. Park(KUS) China : Mausuuria(July. ?. 1895) Komarov(NYBG)
<i>G. krameri</i> Francher & Savatier	Korea : KB ; Mt. Kaya(Sept. 3. 1991) W. C. Lee. Japan : Sninano, Mt. Ontake(Aug. 11. 1911), Nakai(BH) China : Jinagsu, Lian Yan Gang(Sept. 19. 1981), K. Yao(NYBG)
<i>G. wilfordii</i> Maxim.	Korea : CN ; Mt. Kaya(Aug. 24. 1956), T. H. Cheong

Table 1. Continued

Taxon	Localities, date, collectors, and source
<i>G. soboferum</i> Komarov	Japan : Nagano(Sept. 15. 1968), M. Shimizu(BM) China : Kirin(Sept. 11. 1950), ? (PE)
<i>G. wilsovianum</i> Fischer & Link	China : Mansurica(July. 1. 1905), F. Karo U.S.S.R : Ikonnikov-Galitzky(July. 2. 1928), B. Cykayeb
<i>G. wlassovianum</i> var. <i>maximoiwiczii</i> S. Park & Y. Kim	Korea : KB ; Unnungdo(June. 24. ?) W. C. Lee China : Hopei, Shen Tungkai(? 1976), K. S. Chow(GH) Japan : Yezo(Sep. ? 1904) Tlaurie(GH)
<i>G. shikokianum</i> Masamune	Japan : Shikoku, Pref. Ehime Mt. Higashi-Akaishi(Sept. 13. 1981), T. Yahara (BM)
<i>G. shikokianum</i> var. <i>quelpartense</i> S. Park & Y. Kim	Korea : Chejudo; Mt. Hala(Aug. 5. 1960), W. C. Park
<i>G. uniflorum</i> Hayata	
<i>G. napuligerum</i> Franchet	Japan : Mt. Kiraisyu-nampo, Formosa(Aug. 14. 1929), Suzuki(BM) China : Kilin(July. 29. 1958), ? (PE)
<i>G. tripartitum</i> Knuth	Korea : Chejudo; Mt. Halla(Aug. 11. 1994, S. J. Park(KUS) Japan : Honshu, pref, Kanagawa, Mt Ohyama(sept. 21. 1968), M. Shimizu
<i>G. ocellatum</i> Cambess.	China : Shansi, Kao-Ti-Shan, Fang-San Hsieng(Sept. 6. 1929)
<i>G. suzuki</i> Masamune	Taiwan : Mushe, Nantou co.(Aug. 20, 1984), S. F. Huang
<i>G. palustre</i> L.	Bulgaria : Sofia, Rila Plannina, Musdla(July. 28. 1985), M. F. & S. G. Gardner (BM)
<i>G. knuthii</i> Nakai	Korea : KG ; Mt. Myongi(Aug. 5. 1994), S. J. Park(KUS) Korea : CN ; Weyeondo(Sept. 2. 1977), W. T. Lee
<i>G. koreanum</i> Komarov	Korea : CN ; Mt. Jiri(Sept. 5. 1993), S. J. Park(KUS)
<i>G. koreanum</i> var. <i>hirsutum</i> Nakai	Korea : KW ; Mt. Solak(Aug. 12. 1993), S. J. Park(KUS)
<i>G. taebaekensis</i> Park, S. J & Y. K. Kim	Korea : KW ; Mt. Taebaek(Aug. 25. 1994), S. J. Park(KUS)
<i>G. refractum</i> Edgew. & Hook	China : Qinghai(? 1971) ; Wang ; Szechwan(July. 13. 1914,) Zwischen(GH) ; Yunnan(July 12. 1935), Wang(GH)
<i>G. farreri</i> Staff	China : Gansu(? 12. July. 1914) Tao ; Shaanxi : (Aug. 11, 1972) U.S.S.R : ? (Aug. 25. 1932), H. A. Eyw
Section <i>Tuberosa</i> <i>G. ibericum</i> Cavanlis	China : Shansi, Kao-Ti-Shan, Fang-San Hsieng(Sept. 6. 1929)

Table 1. Continued

Taxon	Localities, date, collectors, and source
Subgenus <i>Robertium</i>	
Section <i>Trilopha</i>	
<i>G. ocellatum</i> Cambess	U.S.S.R. : Substraik(Juun. 6. 1976), J-J. A. van der Walt boomplass,
Section <i>Batracchiodes</i>	Kangorallei, June. 26. 1974), R. O. Moffeft
<i>G. molle</i> L.	China : N. W. Yunnan(June. ?. 1921) G. Forregt(PE)
Section <i>Ruberta</i>	
<i>G. robertianum</i> L.	Japan : Hokkaido. Prov, Kitamim(July. 30. 1969) M. Shimizy(NYBG)

Locality ; CB : Chollanam-do, CN : Chollanam-do, KG : Kyonggi-do, KW : Kangwan-do, KB : Kyongsangbuk-do.

Herbarium ; U.S.A. : New York Botanical Garden(NYBG), Cornell University(BH), Harvard Univ. (GH), England : British Museum(BM), China : Institute of Botany in Beijing(PE), Korea : Korea Univ. (KUS), Sungkunkwan Univ.(SKK).

in bristled type on base of exocarp.

(4) Whether or not sticking of seed dispersal awn : a) seperate style : By taxon that awn is detached from rostrum at seed dispersal, is observed subgenus *Robertium* and section *Tuberosa* of subgenus *Geranium*. b) unseperate type: By taxon that awn is not detached from rostrum at seed dispersal is observed in section *Geranium* of subgenus *Geranium*.

(5) Awn state at seed scattering : a) straighted : In form that seed dispersal awn unfolds wing without swerving regularly section *Geranium* of subgenus *Geranium* and subgenus *Robertium* is observed. b) twisted style : In form that seed dispersal, awn swerves lightly, is observed in section *Tuberosa* of subgenus *Geranium*.

(6) Sticking relation with mericarp and awn : a) unseperate style : In form that seed dispersal mericarp and awn are attached, subgenus *Geranium* observe. b) seperate style : At seed dispersal, mericarp and awn is detached, subgenus *Robertium* observe.

(7) Gland of awn abaxial (back) and hair present and absent : a) non-trichome style : type that there is no hair and glands in awn's back region after seed dispersal, *G. krameri*, *G. robertinum* is observed. b) hairy type : A that is short hair in awn's back region after seed dispersal is observed beside taxon that have type a) and b). c) gland-hairy type : In form that glands and trichome are together in awn's back region after seed dispersal, *G. eriostemon*, *G. erianthum*, *G. pratense*, *G. nepalense* var. *thunbergii*, *G. refractum*, and *G.*

carolinianum is observed.

(8) Hair present and absent of awn adaxial : a) non-trichome type : By taxon that there is seldom hair in awn's adaxial region after seed dispersal, *G. erianthum*, *G. eriostemon*, *G. shikokianum*, *G. pseudosibiricum*, *G. ibericum*, *G. wilfordii*, *G. uniflorum*, *G. tripartitum*, and *G. suzukii* is observed. b) trichome type : In type that hair exists in awn's adaxial region after seed dispersal is observed beside taxon that have type non-trichome.

(9) Whether or not standing erect of pedicel : a) erect style : Immature pedicel erect, *G. soboliferum*, *G. pratense*, *G. eriostemon* is observed. b) horizontal style : Immature pedicel has standing horizontal style is observed beside taxon that immature pedicel has standing erect style.

3.2. Seed

Can divide as follows according to seed's whole shape, form of seed coat, apical and base, and color etc.

1) Seed's whole shape : a) oval (elliptic) : Seed's whole shape is elliptic, observed beside taxon have oblong and ovate type. b) oblong type : Seed's shape is oblong *G. krameri*, *G. pratense*, *G. sibiricum*, *G. pseudosibiricum*, *G. refractum*, *G. robertianum*, *G. wilfordii*, *G. knuthii*, *G. tripartitum*, *G. koreanum*, *G. taebaekensis*, and *G. uniflorum* is observed. c) obovate style : Seed's shape is obovate, *G. yesoense*, *G. erianthum*, *G. henry*, and *G. wlassovianum* var. *maximowiczii* is observed.

2) Surface pattern of seed coat : a) smooth :

smooth that wall of seed coat, subgenus *Geranium* is observed. b) gemmate : By taxon that it is to wall of seed coat of gemmate, subgenus *Robertium* is observed (Plate 1, 2).

3) Seed's color : a) light bright-brown style : Color is light bright-brown *G. pseudosibiricum*, and *G. carolinianum* is observed. b) dark deep-brown style : Is observed beside taxon that have light brown style.

4) Form of the seed apical : a) round type : Seed's apical is round observed beside taxon that have oblique. b) four sides style (oblique) : Seed's apical is oblique is observed in *G. uniflorum*.

5) Form of seed base: a) convex type : By taxon that form of seed's base is convex, *G. yesoense*, *G. eriostemon*, *G. nepalense*, *G. nepalense* var. *thunbergii*, *G. sibiricum*, *G. robertianum*, *G. tripartitum*, and *G. taebaekensis* is observed. b) flat type : In form that seed's base is flat, *G. soboliferum*, *G. wlassovianum*, *G. refractum*, *G. ocellatum*, *G. carolinianum*, *G. knuthii*, *G. uniflorum*, *G. koreanum*, and *G. koreanum* var. *hirsutum* is observed. c) sunken-in style (slightly concave) : Is observed in beside that taxon have convex and flat type.

6) Form of micropyle area : a) convex type : micropyle area is convex type is observed beside that taxon have concave type. b) sunken-in style (concave) : micropyle area is concave type, *G. sibiricum*, *G. ocellatum*, and *G. tripartitum* is observed.

7) Form of hilum area : a) flat type: Seed's hilum area is flat, is observed that taxon have sunken-in style. b) sunken-in style (concave) : Seed's hilum area is concave, *G. yesoense*, *G. soboliferum*, *G. eriostemon*, *G. erianthum*, *G. refractum*, *G. robertianum*, *G. tripartitum*, *G. uniflorum*, *G. wlassovianum* var. *maximowiczii*, *G. koreanum*, *G. koreanum* var. *hirsutum*, and *G. taebaekensis* is observed.

8) Form of seed chalaza (chalaza disc) : a) compression style (compressed) : Seed's chalaza region is compressed, *G. dahuricum*, *G. pratense*, *G. nepalense*, *G. pseudosibiricum*, *G. refractum*, *G. henri*, *G. knuthii*, *G. suzuki*, *G. uniflorum*, *G. koreanum*, and *G. koreanum* var. *hirsutum* is observed. b) cone style (connical) : Seed's chalaza region accomplishes corn shape. *G. yesoense*, *G. robertianum*, *G. wlassovianum* var. *maximowiczii*

is observed. c) sunken-in style (slightly convex) : Seed's chalaza region is slightly convex, is observed beside taxon that taxon have seed's chalaza region compressed and conical type.

9) Position of seed hilum area: a) upper part style (above the half) : Hilum area is in place that is more than 1/2 of seed length is observed in *G. eriostemon*. b) center style (middle) : Hilum area is in place that is 1/2 of seed length is observed in *G. dahuricum*, *G. pratense*, *G. nepalense*, *G. sibiricum*, *G. wlassovianum*, *G. wlassovianum* var. *maximowiczii*, *G. uniflorum*, *G. koreanum*, and *G. koreanum* var. *hirsutum*. c) lower part style (below the middle) : Hilum area is in place that is 1/2 low of seed length, is observed that taxon have above the half and middle.

We are achieved reappraisal to taxonomic characters of the fruit and seed about Asian *Geranium* 2 subgenera, 5 section, 12 group, and these characteristic form and appears commonly between taxons, and relationship between autamorphic characters. and could be relationship as well as evolutionary trends and independence characteristic form. Tokarski²⁰⁾ divided by form of fruit and seed to Russian 48 taxon. According to classification system of Knuth^{14,15)} 48 taxons that live in the Russia established again taxon since Knuth¹⁵⁾ because is divided by 13 section but are not section according to research result and divide by 5 groups, and establishment of these taxon was that become basis in classification system of Yeo¹⁷⁾. The most important characteristic form that divide by 2 subgenus in this genus is form of mericarp and seed dispersal way. First, base of mericarp is bristled, and awn is not detached with mericarp and rostrum, section *Geranium* of subgenus *Geranium*, second, base of mericarp is bristled and awn is detached with mericarp and rostrum, subgenus *Robertium*. third, base of mericarp is not bristled, awn is detached with rostrum, but is not mericarp, section *Tuberosa* of subgenus *Geranium*. At seed dispersal awn of section *Geranium* of subgenus *Geranium*, the awn remains attached at the top of collumella, though fairly easily broken off, because seed increases awn's elasticity by diffusive way, it is long characteristic seed's dispersal distance, and subgenus *Robertium* observed that seed dispersal distance is short because it is no awn's elasticity by way that seed dispersal is

gone as awn drops with rostrum, section *Geranium* of subgenus *Geranium* and subgenus *Robertium* act role that awn keeps temporarily seed swerving with rostrum instead of bristle because section *Tuberosa* of subgenus *Geranium* is not bristled function that keep temporarily seed because department is bristled on base at seed dispersal do while. Therefore, is thought that is taxon that when consider formation's development and function regarding this seed dispersal function, subgenus *Geranium* evolves more than subgenus *Robertium*. Seed morphology can divide by 2 subgenera(*Geranium*, *Robertium*) according to pattern of seed coat. And seed's morphology characteristic(whole shape, color, form of seed apical and base, micropyle area, hilum area, chalaza, and position of seed hilum area) can distinguish some species, but is thought that is not reasonable as for discernment characteristic form and nature by repetition of characteristic form and nature. Especially, infrasection do in fruit and seed's morphology that is handling in this research that know to argue classification system and relationship by repetition of characteristic form and nature difficult. To all reliable truth, cytology, ecological, embryology, and molecular genetics research about taxon is considered that should be achieved section *Geranium* that do not handle yet.

4. Conclusions

Asian *Geranium* is dividied to 2 subgenera by three main types of seed-discharge(first, base of mericarp is bristled, and awn is not detached with mericarp and rostrum, section *Geranium* of subgenus *Geranium*, second, base of mericarp is bristled and awn is detached with mericarp and rostrum, subgenus *Robertium*. third, base of mericarp is not bristled, awn is detached with rostrum, but is not mericarp, section *Tuberosa* of subgenus *Geranium*). and according to pattern of the seed coat is divided to 2 subgenera (*Geranium*, *Robertium*). Seed's morphology characteristic (whole shape, color, form of seed apical and base, micropyle area, hilum area, chalaza, and position of seed hilum area) can distinguish some species, but is thought that is not reasonable as for discernment characteristic form and nature by repetition of characteristic form

and nature. Especially, infrasection do in fruit and seed's morphology that is handling in this research that know to argue classification system and relationship by repetition of characteristic form and nature difficult.

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