A CYTOTAXONOMIC STUDY OF *VISCUM* ON TAIWAN

by

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The present study is a revision of the genus, *Viscum*, of Taiwan. The work is based mainly on my own collections but also partly on the specimens deposited in the Herbarium of Botany Department of the National Taiwan University and in the Herbarium of the Institute of Botany, Academia Sinica, Nankang (Taipei.)

Many papers dealing with the species of the genus *Viscum* of Taiwan have been published. *Viscum* in Taiwan was first studied by Bunzo Hayata (1915), later by T. Nakai (1939), J. Iwata (1956), and Li Hui-lin (1963). They gave detailed descriptions of the species, but no comprehensive treatment of the genus as a whole has ever been published for Taiwan.

The genus *Viscum* contains about 50 species which are widely distributed around around the world. According to Li (1963) the following four species of *Viscum* exist on Taiwan: *V. angulatum*, *V. articulatum*. *V. alniformosana*, and *V. multinerve*. However, further study by the writer indicates that *Viscum articulatum* can be further divided cytologically into two distinct species, *Viscum articulatum* and *Viscum liquidambaricola*. All these are distributed on high mountains 1000 m. to 2500 m. from the central part to the northern part of Taiwan with the exception of *V. liquidambaricola*. This species grows near sea level in the northern part of Taiwan.

A taxonomic study was followed by a cytological survey of chromosome numbers. Fresh young vegetative and floral buds were fixed in Farmer's fluid. The aceto-carmine smear technique, without hydrochloric acid hydrolysis, was used to make both temporary and permanent slides for chromosome determination. The permanent slides were first treated with 2/3 acetic acid to 1/3 butanol, then 1/2 acetic acid to 1/2 butanol, then 1/3 acetic acid to 2/3 butanol, foilowed by two washes in absolute butanol, and mounted with Canadian balsam. Camera iucida drawings were made at 450 x to 1500 x, and photomicrographs were taken to expand the descriptions.

Cytological studies on these five species, *Viscum angulatum*, *V. articulatum*, *V. liquidambaricola*, *V. multinerve*, and *V. alniformosana* are reported in this paper. Basic chromosomal numbers N=10, N=11, and N=13 have been reported for this genus.

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[1] Contribution from the Botanical Laboratory, The University of Tennessee.

TAXONOMIC TREATMENT

Key to the species on Taiwan

1. Leaves absent when mature.
   2. Stems slender, 4–angled ..... *V. angulatum*
   2. Stems compressed 3
      3. Plants parasitic on *Alnus formosana*, rarely on other trees, distributed at high aititudes..... *V. articulatum*
      3. Plants always parasitic on *Liquidambar formosana*, distributed near sea level ..... *V. liquidambaricola*
1. Leaves always present.
   4. Leaves short, not falcate, mainly with three nerves..... *V. alniformosa*
   4. Leaves elongate, falcate, glabrous, multinerved..... *V. multinerve*

1. V. angulatum Heyen in DC. Prodr. **4:** 283, 1830, Nakai in Journ. Jap. Bot. **15:** 745, 1939.

Viscum diospyrosicollum Hayata, Icon. Pl. Formos. **5:** 192, 1915.

Viscum filipendulum, Hayata, Icon. Pl. Formos. **5:** 193, 1915.

Distribution: On high mountains (1000–2500 m.) of central Taiwan.

Herbarium specimens examined:

Nantou Hsien: Chi-tou, C. S. Feung, & M. T. Kao 325*.

Chiayi Hsien: Mt. A-li, Sasaki 325 (A).

2. Viscum articulatum Burm. f., 311, 1768.

Aspidixia articulata (Burm. f.) B. van Tieghm in Bull. Soc. France **43:** 192, 1896; Nakai in Journ. Jap. Bot. **15:** 745, 1939.

Distribution: On high mountains 1000 m. of central Taiwan.

Herbarium specimens examined:

Taichung Hsien: Mt. Lee, C. S. Feung & M. T. Kao 4981 K*.

Nantou Hsien: Faurie 380 (A. B).

Ilan Hsien: Suzuki 17991 (M); Wilson 10024 (A. B), 4834 (A. K.)

3. Viscum liquidambaricola Hayata, Icon. Pl. Formos. **5:** 194, 1916.

Aspidixia liquidambaricola (Hayata) Nakai in Journ. Jap. Bot. **15:** 746, 1939.

Distribution: On plains near sea level in northern Taiwan.

Herbarium specimens examined:

Taipei Hsien: C. S. Feung & J. M. Chao 304*.

4. Viscum multinerve (Hayata) Hayata, Icon. Pl. Formos: **5**: 196, 1936.

Viscum orientale Willd. var. *multinerve* Hayata in Bot. Mag. Tokyo, **28:** 72, 1906.

Distribution: On high mountains of central Taiwan.

Herbarium specimens examined:

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* These collections are deposited in both the Herbarium of Botany Dept., National Taiwan University and Academia Sinica.

Taichung Hsien: Mt. Lee, C. S. Feung & M. T. Kao 337*; Sun Moon Lake, Nakahara 272; Kudo & Sasaki 25084 (A, U).

Nantou Hsien: Shimada 354 (A).

Chiayi Hsien: Wilson 10109 (A, K, U).

5. Viscum alniformosana Hayata, Icon. Pl. Formos. **6:** 39, 1916.

Viscum coloratum (Komarov) Nakai var. *alniformosana* (Hayata) Iwata in Journ. Agr. Sci. Tokyo. **3:** 179, 1956.

Distribution: On high mountains of central Taiwan.

Herbarium specimens examined:

Taichung Hsien: Mt. Lee, C. S. Feung & M. T. Kao 5080 K*.

Chiayi Hsien: Mt. A-li, Wilson 9713 (A, K, U).

CYTOLOGICAL OBSERVATIONS

Viscum angulatum: (Collection No. 325)

The chromosome number of collection 325 was determined from floral and vegetative buds. Its pollen (microspore) number is N=11, the somatic number is 2N=22. The centromeres of chromosomes are medium or submedium in position as shown in Figure 1.

Viscum liquidambaricola: (Collection No. 304)

The chromosome number of collection 304 was determined from vegetative buds only. Its somatic number is 2N=22. The centromeres of chromosomes of *V. liquidambricola* are medium or submedium in position as shown in Figure 2.

Viscum articulatum: (Collection No. 4891)

The chromosome number of collection 4981 was determined from vegetative and floral buds. Its pollen number is N=11. The somatic number is 2N=22. The centromeres of chromosomes of *V. articulatum* are medium or submedium in position as shown in Figure 3. The sizes of chromosomes are smaller than those of *Viscum liquidambaricola* and certain meiotic abnormalities can be observed in *Viscum articulatum*. As can be seen from the picture, one extra chromosomal segment appears at the portion of the bivalent indicated by the arrow in Figure 3 (b).

Viscum multinerve: (Collection No. 337)

The chromosome number of collection 337 was also determined from both floral and vegetative buds. Its pollen number is N=13. Its somatic number is 2N=26. The centromeres of the chromosome of *V. multinerve* are medium or submedium in position as shown in Figure 4.

Viscum alniformosana: (Collection No. 5080)

The chromosome number of collection 5080 was determined from vegetative buds only. Its somatic chromosome number is 2N=20. The centromeres of its chromosomes are medium or submedium in position as shown in Figure 5.

DISCUSSION

The chromosomes of all species of *Viscum* used in this cytological investigation were quite large and could easily be stained with acetocarmine. The karyotypic study of *Viscum* has not yet been done. However, from the pictures, it can be clearly seen that the karyotypes of the chromosomes of these species are somewhat different. The presence of an extra chromosmal segment in a certain meiotic process in *Viscum articulatum* may be considered as a distinctive feature significantly different from *V. liquidambaricola*. Evidently, Dr. Li did not notice this characteristic difference and, as a result, combined them into one species, *Viscum articulatum*. The presence of the extra chromosomal segment in meiotic metaphase in *Viscum articulatum* may imply that changes in chromosomal structures are still going on at the present time.

Ecologically speaking, *Viscum liquidambaricola* can also be separated from *V. articulatum* by its habitat. This mistletoe is always parasitic on *Liquidambar formosana* near sea level, and has never been found parasitic on other trees. *Viscum articulatum*, on the other hand, grows from 1200–2500 m. high elevation and is parasitic on *Alnus formosana* and also rarely on other trees.

SUMMARY

1. An extra chromosomal segment resulting from certain meiotic abnormalities was observed in the pollen mother cell of *Viscum articulatum*.
2. *Viccum articulatum* is cytologically distinct from *Viscum liquidambaricola*.
3. From an ecological standpoint, as well, *Viscum articulatum* and *V. liquidambaricola* are distinct. The species *Viscum liquidambaricola* is always parasitic on *Liquidambar formosana* near sea level and is never parasitic on other trees. *Viscum articulatum*, on the contrary, is parasitic on *Alnus formosana* on high mountains.

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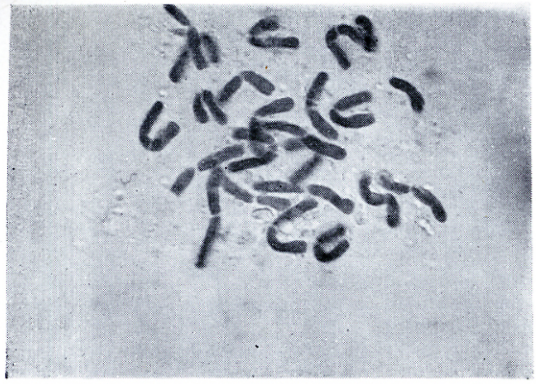
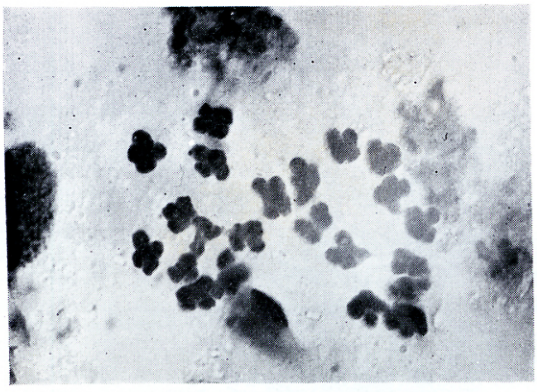


Fig. 1 (a)

(b)



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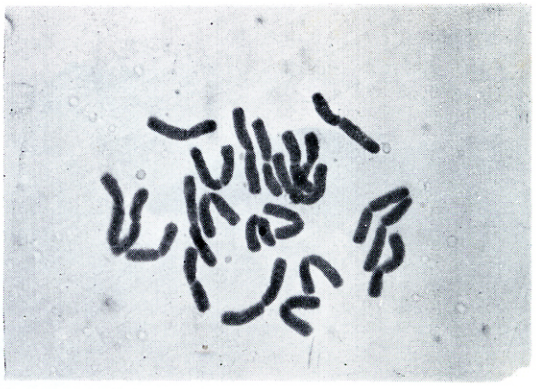


Fig. 2

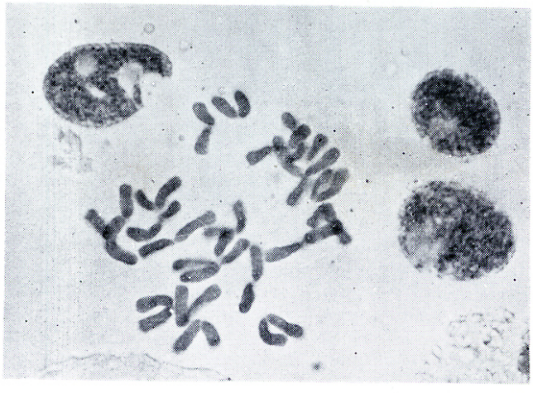
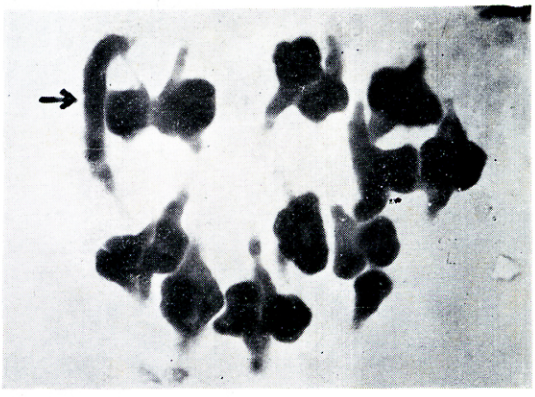


Fig. 3 (a)



(b)

Fig. 1. a. Somatic metaphase of *V. angulatum* showing 22 chromosomes.
b. Metaphase I with 11 bivalent chromosomes.
c. Anaphase of I showing one pair of chromosomes separating.
Fig. 2. Somatic metaphase of *V. liquidambaricola* showing 22 chromosomes.
Fig. 3. a. Somatic metaphase of *V. articulatum* showing 22 chromosomes.
b. Metaphase I with 11 bivalent chromosomes.

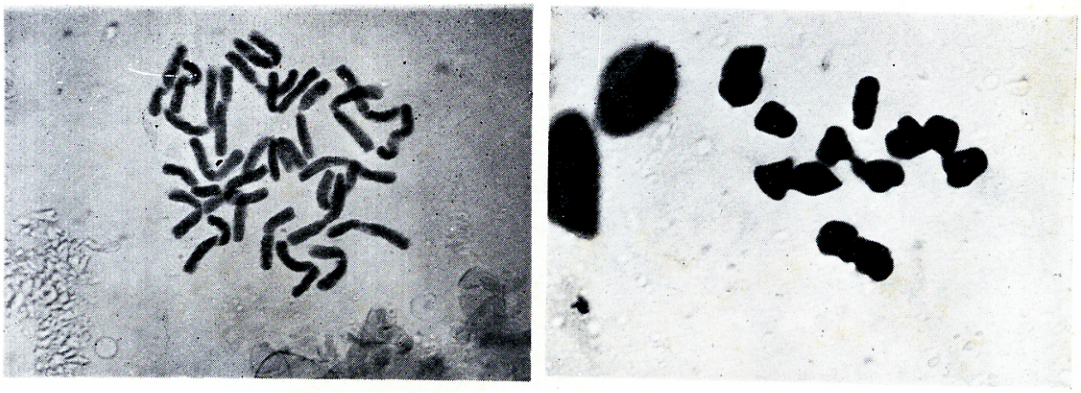


Fig. 4 (a) (b)

Fig. 5

Fig. 4. a. Somatic metaphase of *V. multinerve* showing 26 chromosomes.
b. Metaphase I with 13 bivalents of chromosomes.
Fig. 5. Somatic metaphase of *V. alniformosana* with 20 bivalent chromosomes.