Chromosome count in *Dendrobium* Ⅲ. 43 species*

Kiyoshi Hashimoto**

デンドロビウム属の染色体数　Ⅲ. 43種*

橋　本　清　美**

In Series I and Ⅱ of the present paper (Hashimoto 1981, 1982), the chromosome numbers of 117 species of the genus *Dendrobium* were studied. The chromosome numbers of 50 species of them were recorded for the first time and those of 18 species were redocumented. On the other hand, karyomorphological observations in 82 taxa of the genus *Dendrobium* were studied and those taxa were grouped into 14 karyomorphological types according to chromosome numbers and characteristics of resting nuclei, prophase and metaphase chromosomes (Hashimoto 1987). The present paper, continued from the previous papers, was undertaken to expand the chromosome number and karyomorphological determination of 43 taxa in 13 sections of the genus *Dendrobium*.

Materials and Methods

Validating specimens and cytological data of the plants were deposited in the Hiroshima Botanical Garden. The taxonomy of the materials was mainly followed to Schlechter (1912).

The methods for the observation of the chromosomes were the same as those described in Series I and Ⅱ.

Karyomorphological types of each taxa studied were determined by the category of the definition of the karyomorphological types in *Dendrobium* proposed by Hashimoto (1987).

Results and Discussion

The somatic chromosomes observed in the present investigation were shown in Fig. 1-43. Results of the chromosome numbers and karyomorphological types of the species in the genus *Dendrobium* investigated were listed in alphabetical orders in each sections in Table 1. In Table 1 the previous counts appeared in the present paper were also listed.

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Table 1. Chromosome numbers and karyomorphological types of the species of *Dendrobium* studied

Species	Chromosome number Present count 2n	Previous count 2n	Previous count n	Karyomorphological type	Reference
Section Bolbidium					
Dendrobium pachyphyllum (Krzl.) Bakh. f.	38			C	
Section Rhizobium					
D. lichenastrum (F. Muell) Krzl. var. *prenticei* Dockr.	38	38		E	Jones *et al.* 1982
D. racemosum (Nich.) Clemesha et Dockr.	76			H	
D. toressae Dockr.	38	38		E	Jones *et al.* 1982
		Ca.36			Lim 1983
Section Dendrocoryne					
D. adae F. M. Bail.	38	38		C	Lim 1983
D. × *delicatum* F. M. Bail.	57	C.57		C	Jones 1963
		38			Lim 1983
D. falcorostrum Fitz.	38			C	
D. fleckeri Rupp. et C. T. White	38	38		C	Lim 1983
D. kingianum var. *silcockii* F. M. Bail.	76	C. 76		C	Jones 1963
D. speciosum var. *hillii* F. M. Bail.	38	38		C	Jones 1963
Section Latourea					
D. aberans Schltr.	40			N	
D. atroviolaceum Rolfe	38	38		G	Wilfret & Kamemoto 1971
		38			Lim 1983
D. johnsoniae F. Muell.	38	38		G	Lim 1983
Section Callista					
D. capillipes Rchb. f.	40	38		I	Jones 1963
D. griffithianum Lindl.	40	40		I	Jones *et al.* 1982
		40			Kamemoto *et al.* 1987
Section Eugenanthe					
D. arachnites Rchb. f.	38	38		C	Pancho 1965
		38			Wilfret & Kamemoto 1971
		38			Singh 1981
D. bensoniae Rchb. f.	38			B	
D. chrysanthum Wall.	38	38	19	C	Vajrabhaya & Randolph 1960
		38			Kosakai & Kamemoto 1961
		38			Jones 1963
		38			Kamemoto & Sagarik 1967
		38			Vij *et al.* 1976
			20		Mehra & Sehgal 1976
		40			Sharma 1970
		40			Mehra & Kashyap 1978
		40	20		Sau & Sharma 1983
		38			Sau & Sharma 1983
D. clavatum Lindl. et Wall var. *aurantiacum* Tang et Wang	38			B	

Table.1 (continued)

D. crepidatum Lindl.	38	38		B	Jones 1963
		38			Kamemoto & Sagarik 1967
		38			Hedge & Boraiah 1973
		38			Lim 1983
D. devonianum Paxt.	38		19	B	Chardard 1963
		38			Banerji & Chaudhuri 1972
D. hercoglossum Rchb. f.	38	38		C	Jones *et al.* 1982
D. hildebrandii Rolfe	38	38		C	Kosaki 1958
		38+1f			Kosaki 1958
		38			Kosaki & Kamemoto 1961
		38+1f			Kosaki & Kamemoto 1961
		38			Jones 1963
		38			Kamemoto & Sagarik 1967
		38			Lim 1983
D. linawianum Rchb. f.	38			C	
D. lohohense Tang et Wang	38			D	
D. okinawense Hatusima et Ida	38			C	
D. primulinum Lindl. var. *giganteum* Veitch.	38			H	
D. transparens Wall.	38	38		B	Jones 1963
		40	20		Sharma & Chatterji 1966
			20		Mehra & Vij 1970
			20		Sharma 1970
			20		Roy & Sharma 1972
			19		Mehra & Sehgal 1980
		38	19		Sau & Sharma 1983
Section Pedilonum					
D. chrysoglossum Schltr.	38			B	
D. dichaeioides Schltr.	38	38		B	Lim 1983
D. hughii Rchb. f.	40			N	
D. leucayanum T. M. Reeve	38	38		C	Lim 1983
D. parcum Rchb. f.	40			L	
Section Oxyglossum					
D. coerulescens Schltr.	38			B	
Section Stachyobium					
D. eriaeflorum Griff.	80			I	
Section Ceratobium					
D. antennatum Lindl.	38	38		D	Jones *et al.* 1982
D. cincinnatum F. Muell.	38			D	
D. discolor Lindl.	38	38		D	Kamemoto *et al.* 1987
D. lineale Rolfe	38	38		D	Jones *et al.* 1982
Section Oxygenianthe					
D. schuetzei Rolfe	40	40	20	J	Shindo & Kamemoto 1967
D. virgineum Rchb. f.	40			J	
Section Rhopalanthe					
D. linearifolium Teijsm et Binn.	38			G	
Section Aporum					
D. anceps Sw.	38		19+(0+2B)	G	Mehra 1970

Among the 43 taxa in 13 sections in the genus *Dendrobium*, 32 were 2n=38. 7 were 2n =40 and the rest were other numbers such as 2n=57 in *D. delicatum*, 2n=76 in *D. racemosum* and *D. kingianum* var. *silcockii* and 2n=80 in *D. eriaeflorum*.

The chromosome numbers of 18 taxa, *D. pachyphyllum* 2n=38, *D. racemosum* 2n=76, *D. falcorostrum* 2n=38, *D. aberans* 2n=40, *D. bensoniae* 2n=38, *D. clavatum* var. *aurantiacum* 2n=38, *D. linawianum* 2n=38, *D. lohohense* 2n=38, *D.okinawense* 2n=38, *D. primulinum* var. *giganteum* 2n=38, *D. chrysoglossum* 2n=38, *D. hughii* 2n=40, *D. parcum* 2n=40, *D. coerulescens* 2n=38, *D. eriaeflorum* 2n=80, *D. cincinnatum* 2n=38, *D. virgineum* 2n=40, and *D. linearifolium* 2n=38, were recorded here for the first time. The chromosome numbers of the rest 25 taxa were re-confirmed.

Chromosomes in the resting nuclei of 43 taxa shown in Figures B of each plates showed the different four karyotypes according to Tanaka's classification (1971): The simple chromocenter type, the complex chromocenter type, the intermediate type between those two types and the prochromosome type.

Morphological characteristics of the prophase chromosomes were found to be corresponded to those of resting nuclei.

The metaphase chromosomes of 43 taxa in 13 sections studied showed the two different karyotype according to chromosome length: 29 taxa in nine sections showed the gradual karyotype, the other 14 taxa in eight sections showed the bimodal karyotype.

The major-sized chromosome, which have been noted several authors (Vajrabhaya & Randolph 1960, Jones 1963, Wilfret & Kamemoto 1971, Jones *et al.* 1982) were observed in *D. parcum* in section Pedilonum (Fig. 33-D).

Thus, 43 taxa studied could be grouped into ten karyomorphological types according to the category of the definition of previous paper (Hashimoto 1987): *D. bensoniae, D. clavatum* var. *aurantiacum, D. crepidatum, D. devonianum* and *D. transparens* in sect. Eugenanthe, *D. chrysoglossum* and *D. dichaeioides* in sect. Pedilonum and *D. coerulescens* in sect. Oxyglossum for Type B, *D. pachyphyllum* in sect. Bolbidium, *D. adae, D.* × *delicatum, D. falcorostrum, D. fleckeri, D. kingianum* var. *silcockii* and *D.speciosum* var. *hillii* in sect. Dendrocoryne, *D. arachnites, D. chrysanthum, D. hercoglossum, D. hildebrandii, D. linawianum* and *D. okinawense* in sect. Eugenanthe, *D. leucayanum* in sect. Pedilonum for Type C, *D. lohohense* in sect. Eugenanthe, *D. antennatum, D. cincinnatum, D. discolor* and *D. lineale* in sect. Ceratobium for Type D, *D. lichenastrum* var. *prenticei* and *D. toressae* in sect. Rhizobium for Type E, *D. atroviolaceum* and *D. johnsoniae* in sect. Latourea, *D. linearifolium* in sect. Rhopalathe and *D. anceps* in sect. Aporum for Type G, *D. racemosum* in sect. Rhizobium and *D. primulinum* var. *giganteum* in sect. Eugenanthe for Type H, *D. capillipes* and *D. griffithianum* in sect. Callista and *D. eriaeflorum* in sect. Stachyobium for Type I, *D. schuetzei* and *D. virgineum* in sect. Oxygenianthe for Type J, *D. parcum* in sect. Pedilonum for Type L and *D. aberans* in sect. Latourea and *D. hughii* in sect. Pedilonum for Type N.

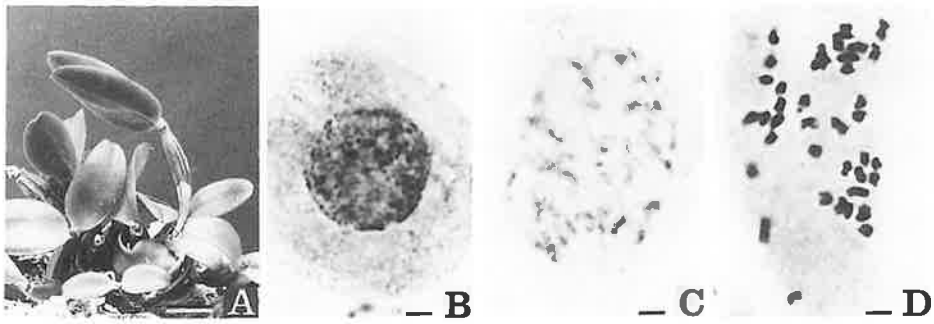

Fig.1. *Dendrobium pachyphyllum*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.0 cm in A and 2.0 μm in B-D.

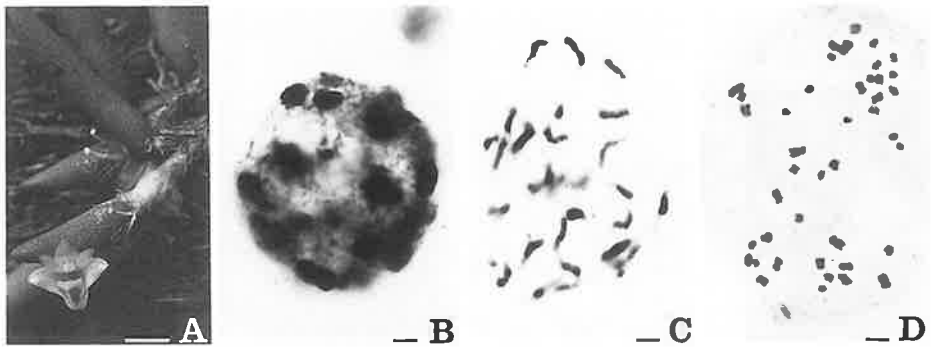

Fig.2. *Dendrobium lichenastrum* var. *prenticei*, 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.3 cm in A and 2.0 μm in B-D.

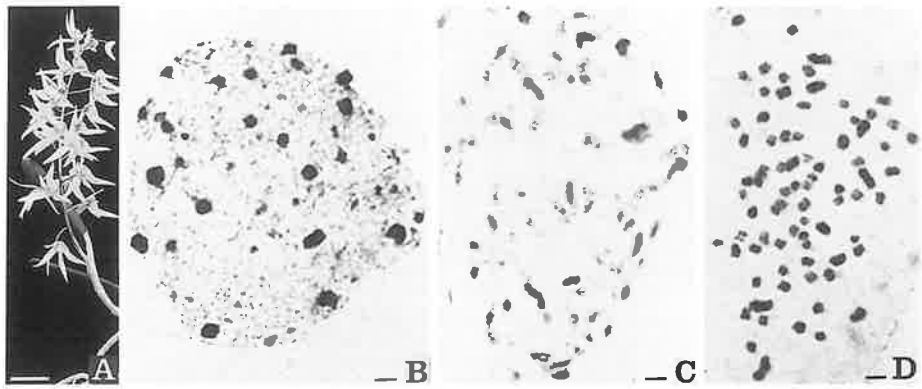

Fig.3. *Dendrobium racemosum*, 2n=76. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.5 cm in A and 2.0 μm in B-D.

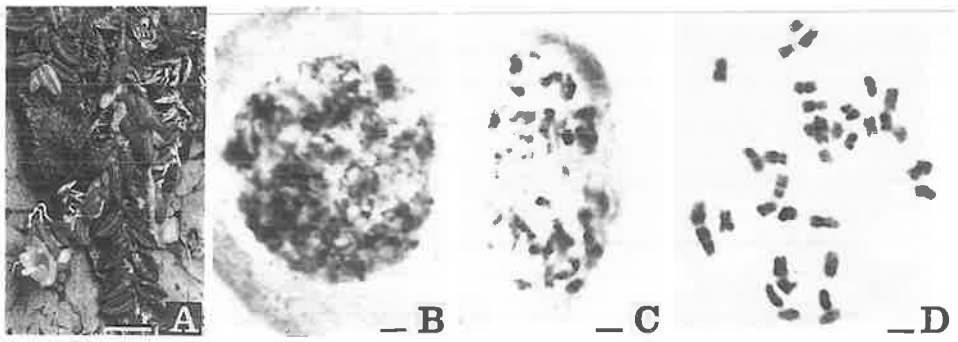

Fig.4. *Dendrobium toressae*, 2n = 38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.9 cm in A and 2.0 μm in B-D.

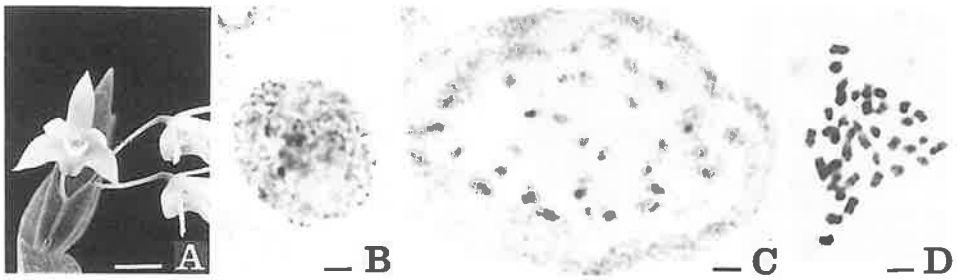

Fig.5. *Dendrobium adae*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.9 cm in A and 2.0 μm in B-D.

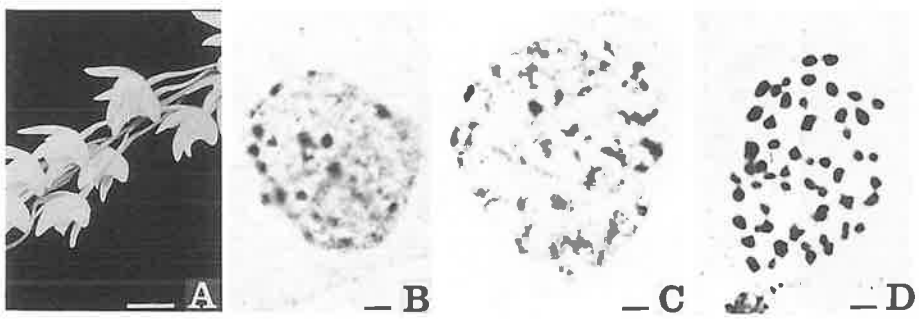

Fig.6. *Dendrobium* × *delicatum*, 2n = 57. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

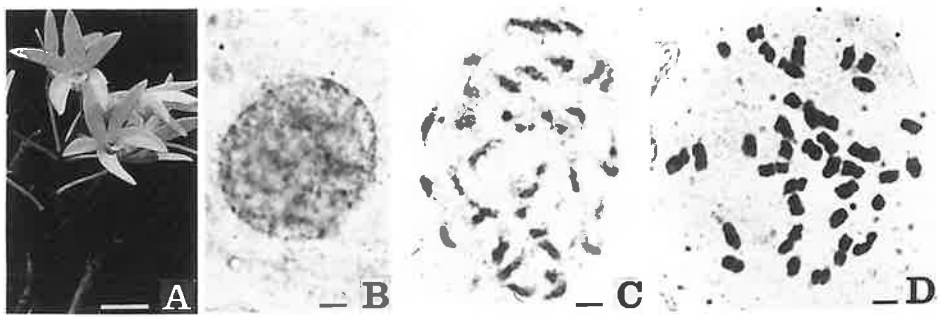

Fig.7. *Dendrobium falcorostrum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

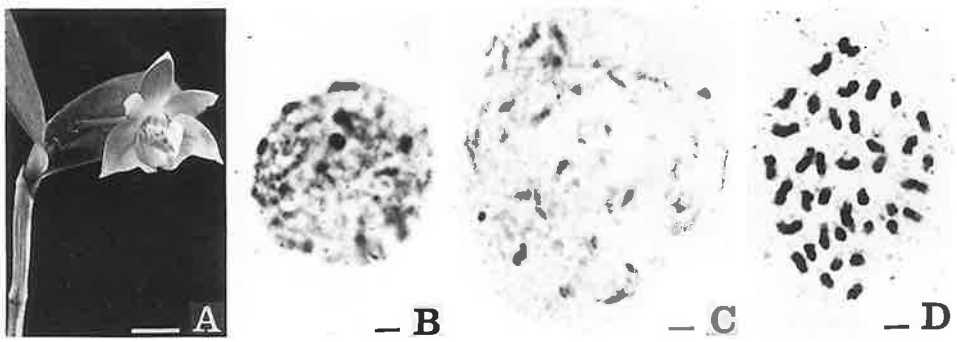

Fig.8. *Dendrobium fleckeri*, 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.1 cm in A and 2.0 μm in B-D.

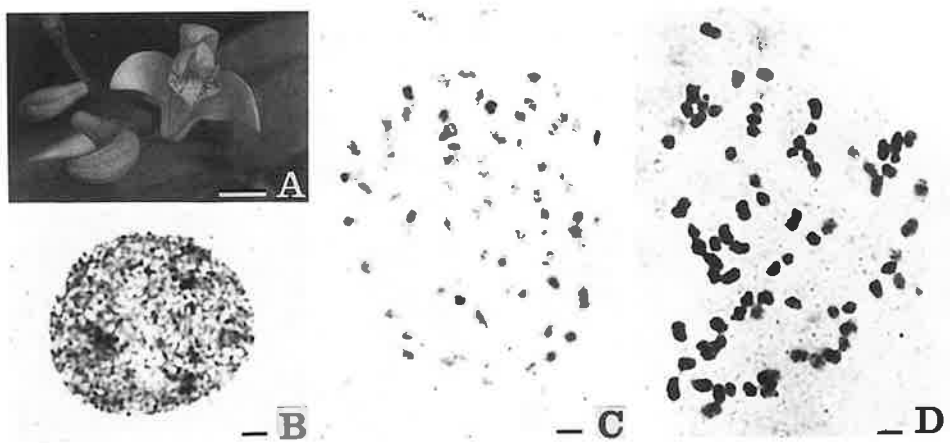

Fig.9. *Dendrobium kingianum* var. *silcockii*, 2n=76. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.6 cm in A and 2.0 μm in B-D.

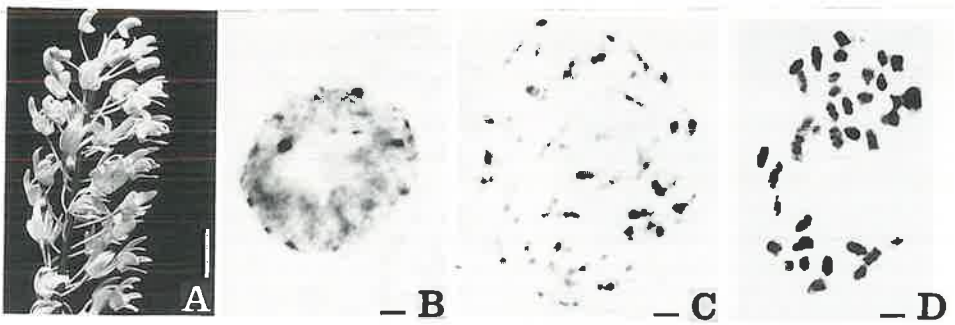

Fig.10. *Dendrobium speciosum* var. *hillii*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 2.3 cm in A and 2.0 μm in B-D.

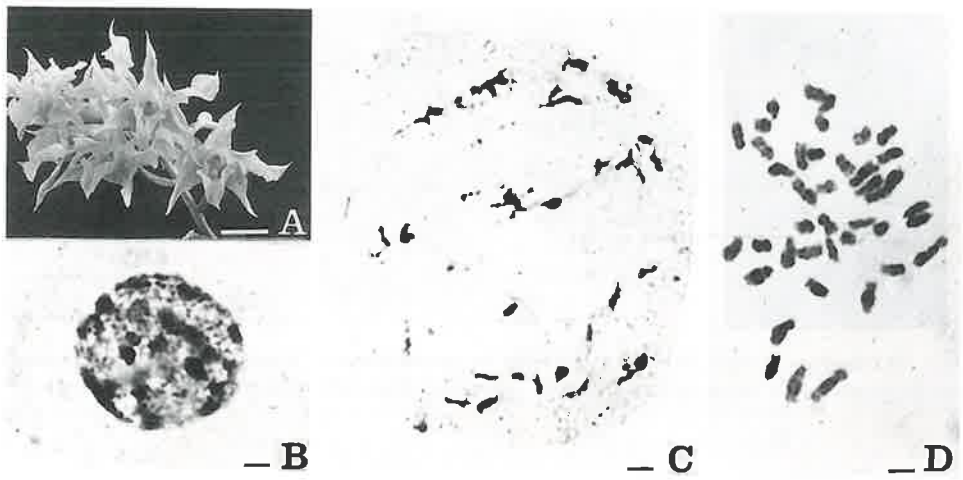

Fig.11. *Dendrobium aberans*, 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

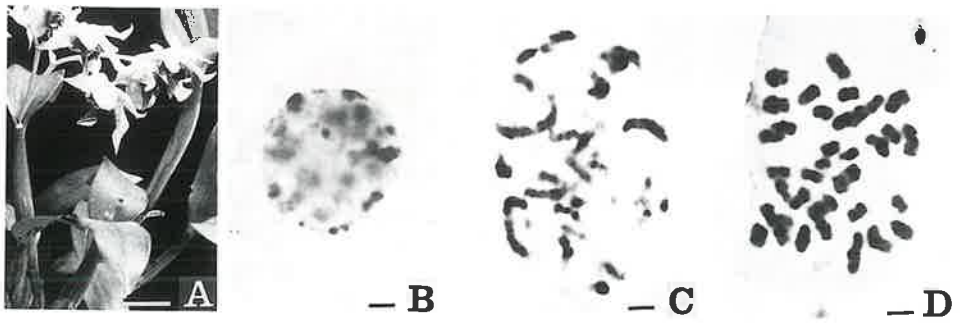

Fig.12. *Dendrobium atroviolaceum*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 2.3 cm in A and 2.0 μm in B-D.

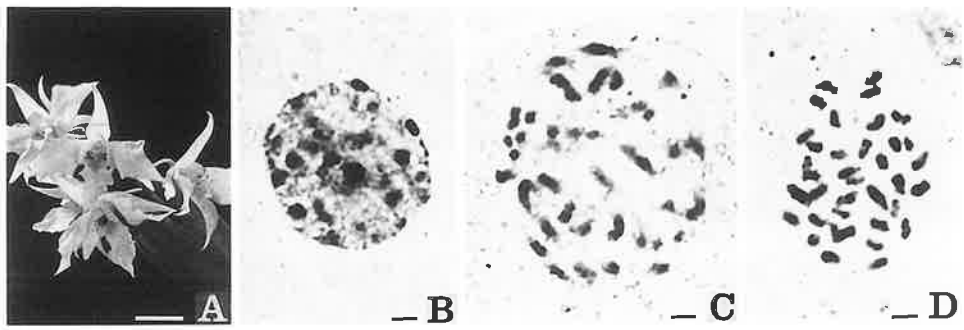

Fig.13. *Dendrobium johnsoniae*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

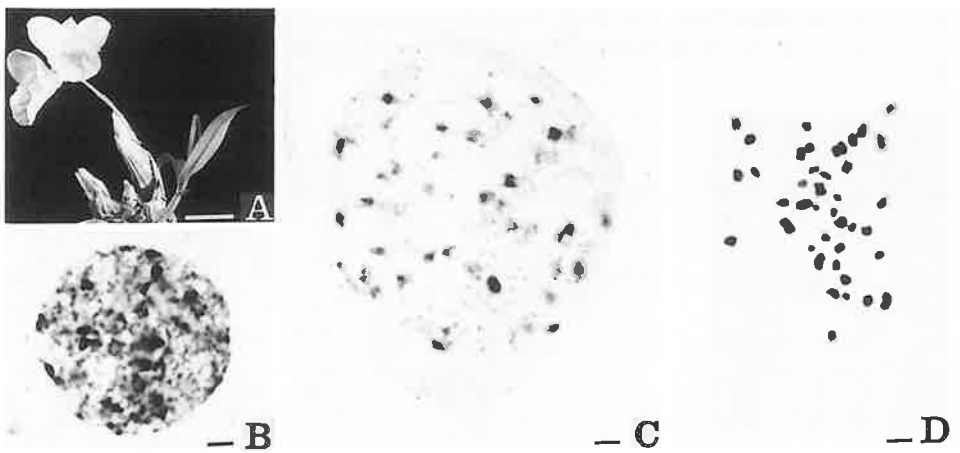

Fig.14. *Dendrobium capillipes*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.5 cm in A and 2.0 μm in B-D.

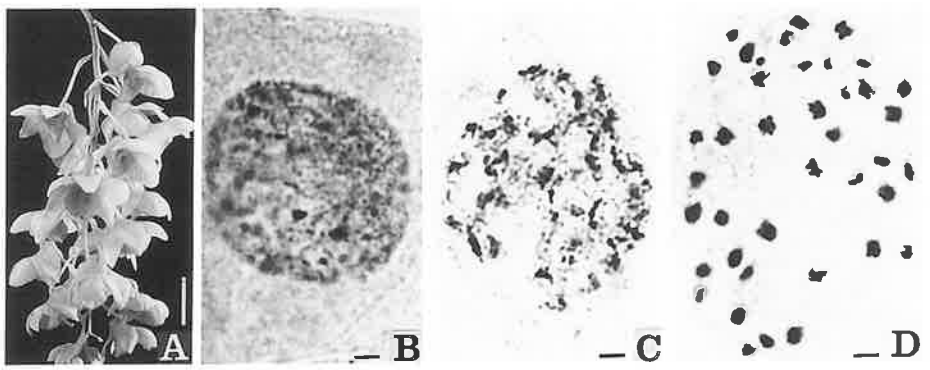

Fig.15. *Dendrobium griffithianum*, 2n = 40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

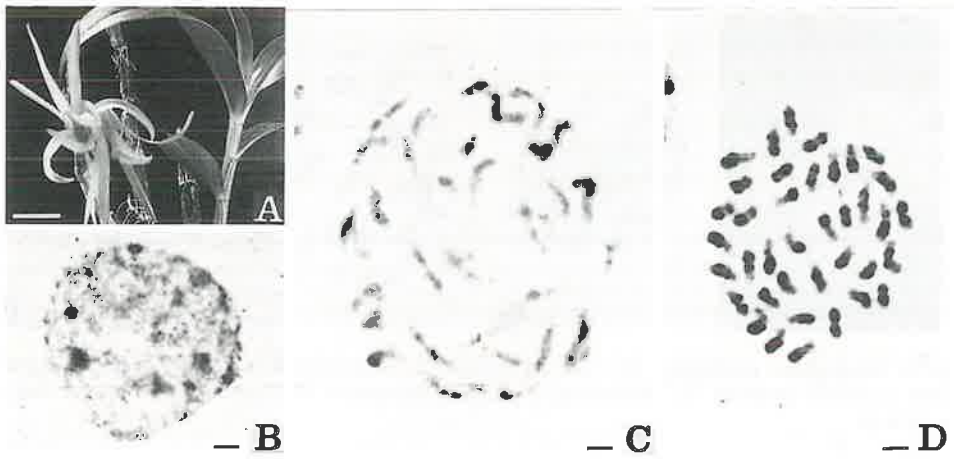

Fig.16. *Dendrobium arachnites*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

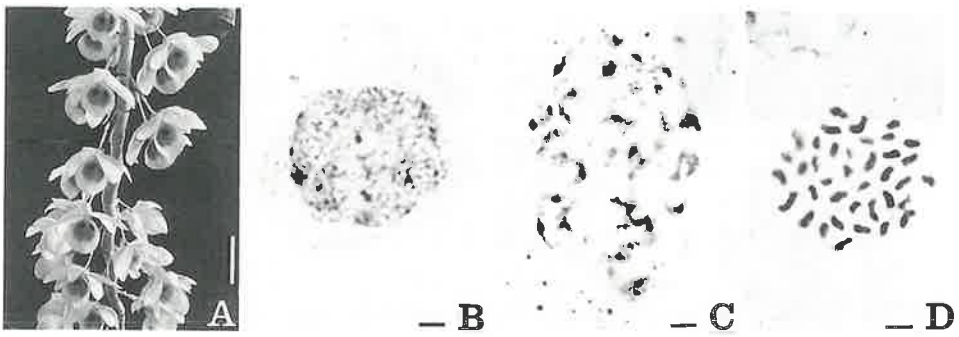

Fig.17. *Dendrobium bensoniae*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 2.3 cm in A and 2.0 μm in B-D.

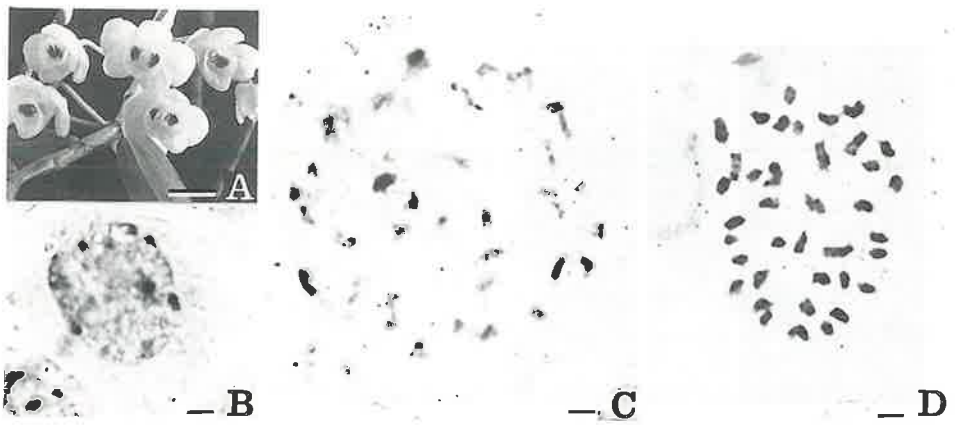

Fig.18. *Dendrobium chrysanthum*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 2.3 cm in A and 2.0 μm in B-D.

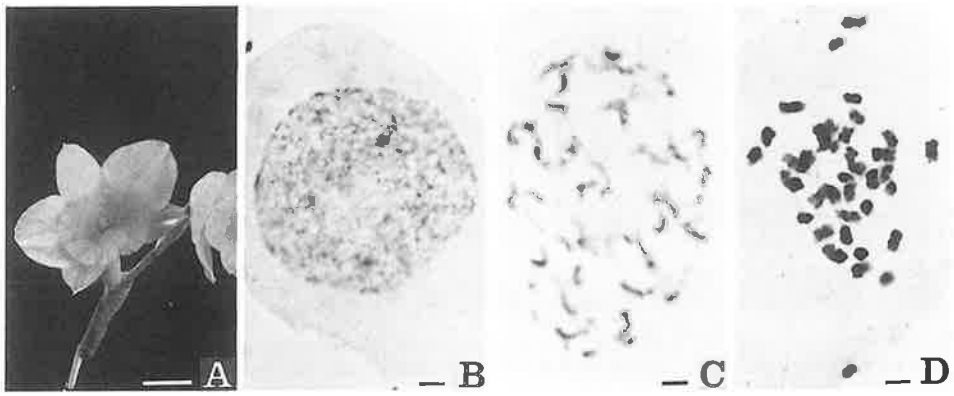

Fig.19. *Dendrobium clavatum* var. *aurantiacum*, 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

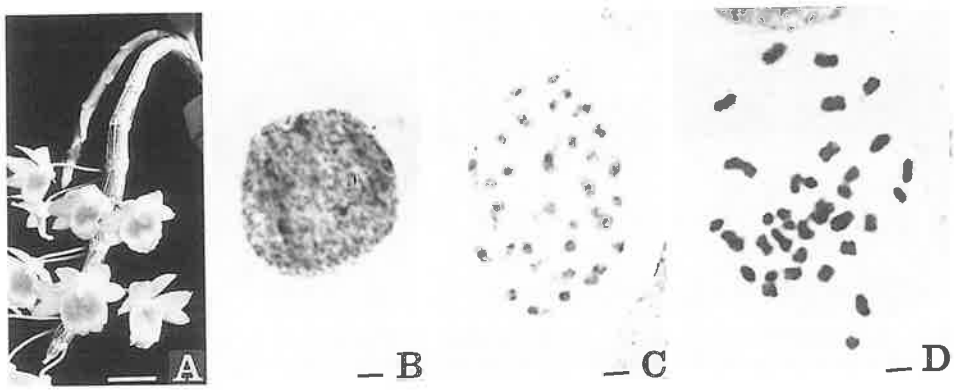

Fig.20. *Dendrobium crepidatum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 2.3 cm in A and 2.0 μm in B-D.

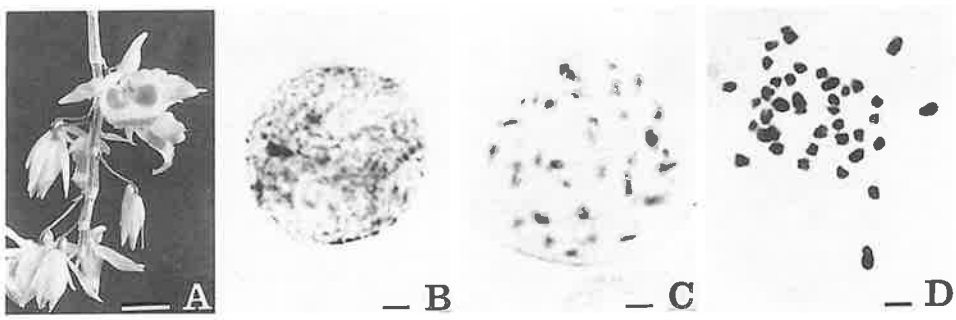

Fig.21. *Dendrobium devonianum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

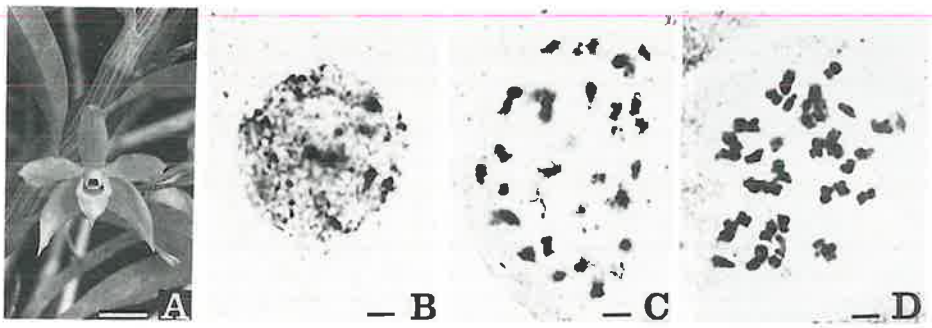

Fig.22. *Dendrobium hercoglossum*, 2n=38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.8 cm in A and 2.0 μm in B-D.

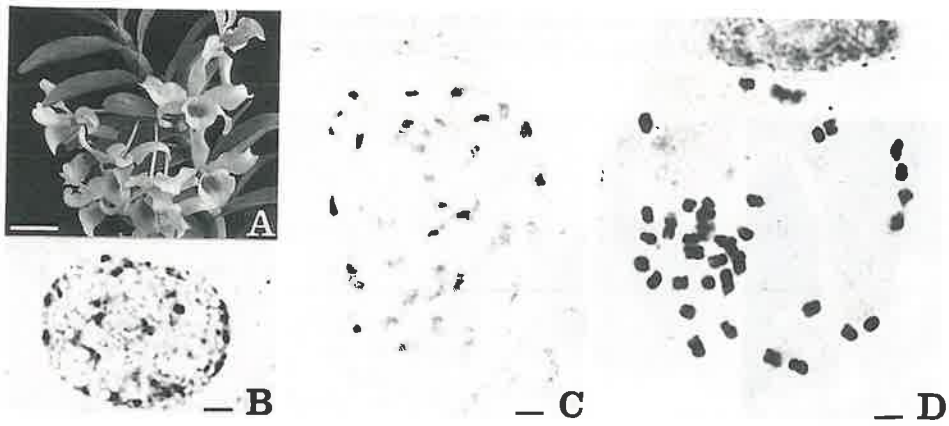

Fig.23. *Dendrobium hildebrandii*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 3.0 cm in A and 2.0 μm in B-D.

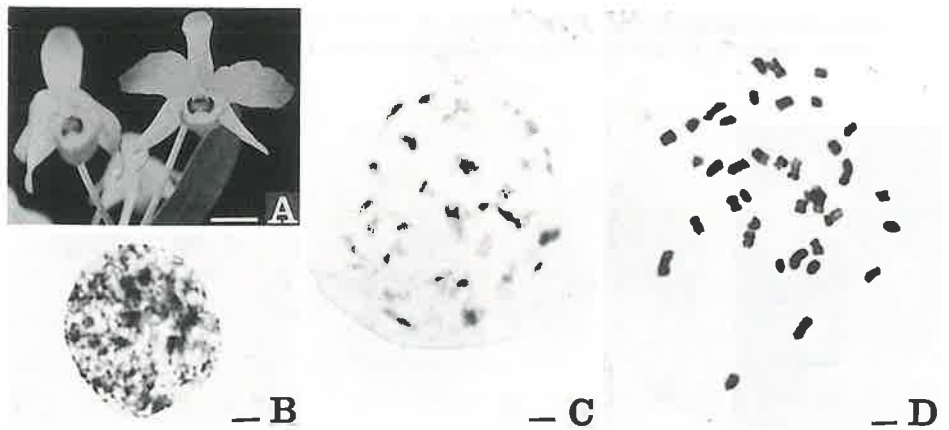

Fig.24. *Dendrobium linawianum*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.1 cm in A and 2.0 μm in B-D.

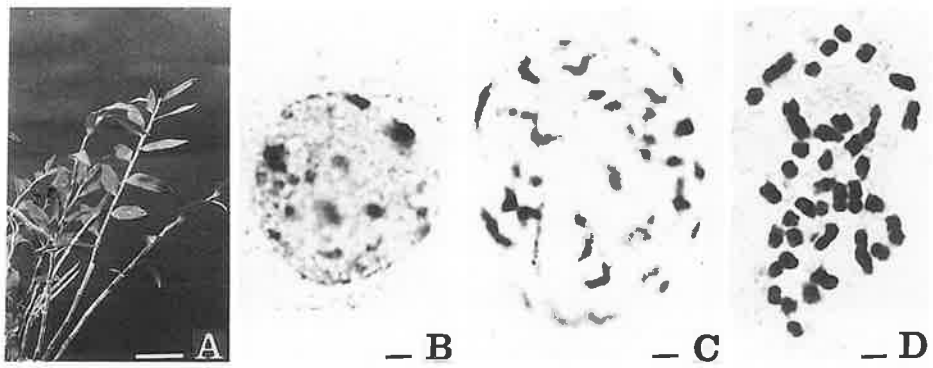

Fig.25. *Dendrobium lohohense*, 2n=38. A, a specimen. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 4.5 cm in A and 2.0 μm in B-D.

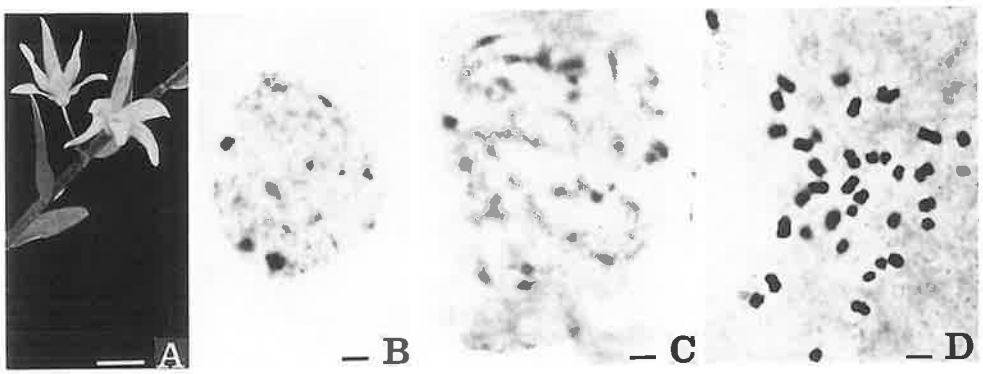

Fig.26. *Dendrobium okinawense*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

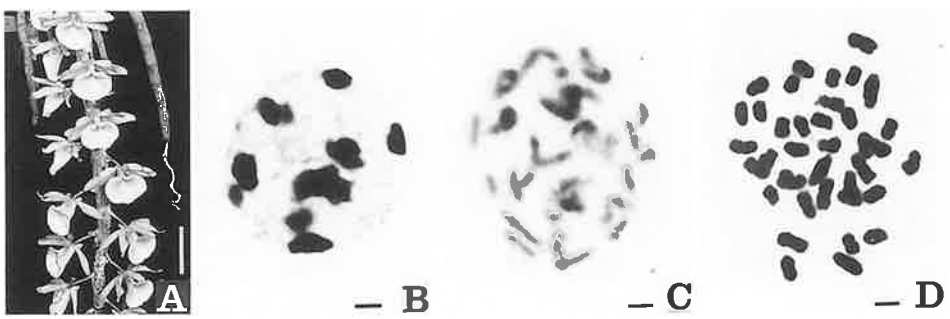

Fig.27. *Dendrobium primulinum* var. *giganteum*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 4.5 cm in A and 2.0 μm in B-D.

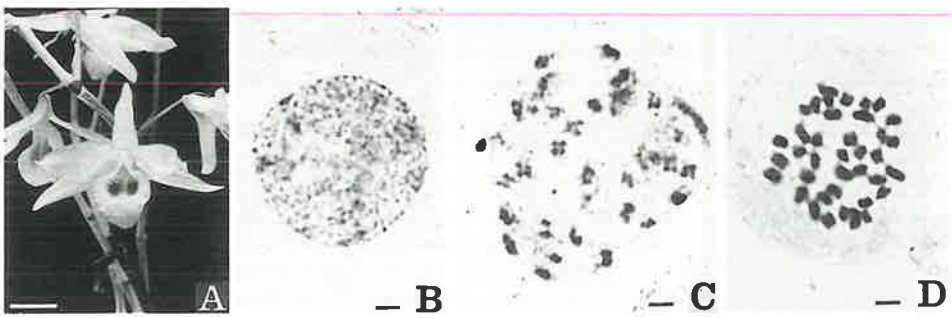

Fig.28. *Dendrobium transparens*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

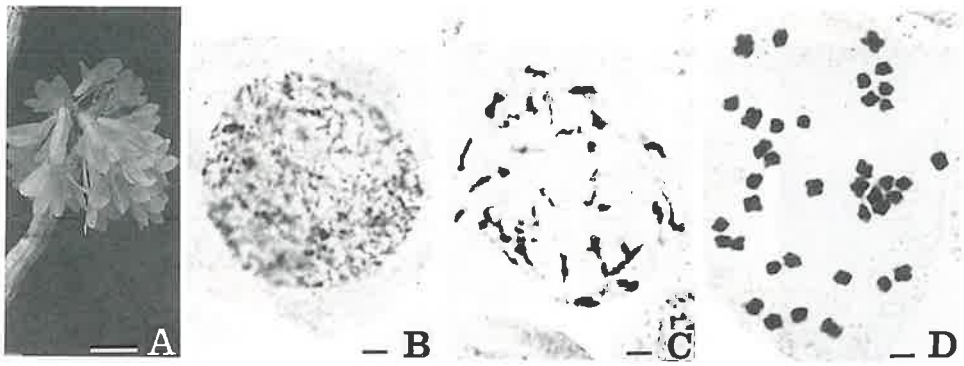

Fig.29. *Dendrobium chrysoglossum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

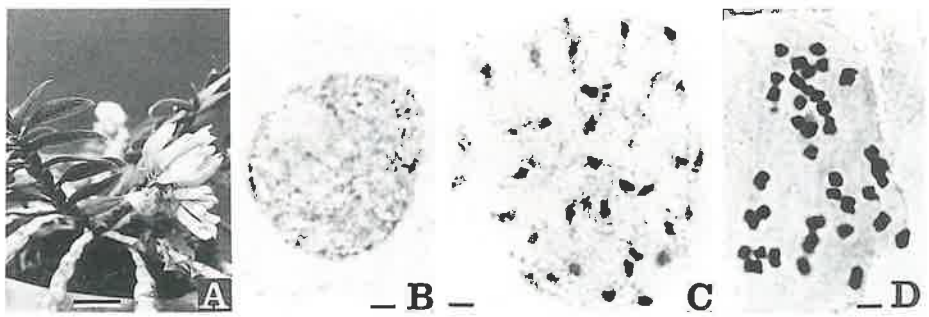

Fig.30. *Dendrobium dichaeioides*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.0 cm in A and 2.0 μm in B-D.

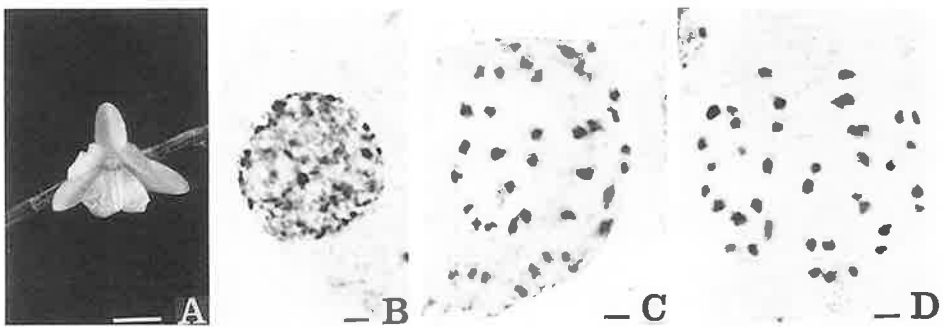

Fig.31. *Dendrobium hughii*, 2n=40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.9 cm in A and 2.0 μm in B-D.

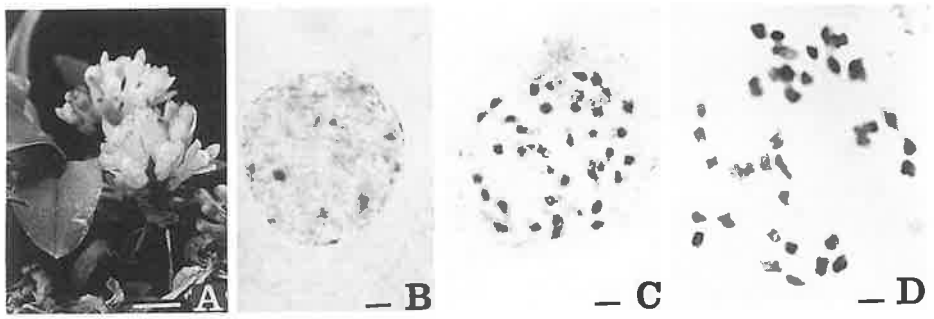

Fig.32. *Dendrobium leucayanum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.8 cm in A and 2.0 μm in B-D.

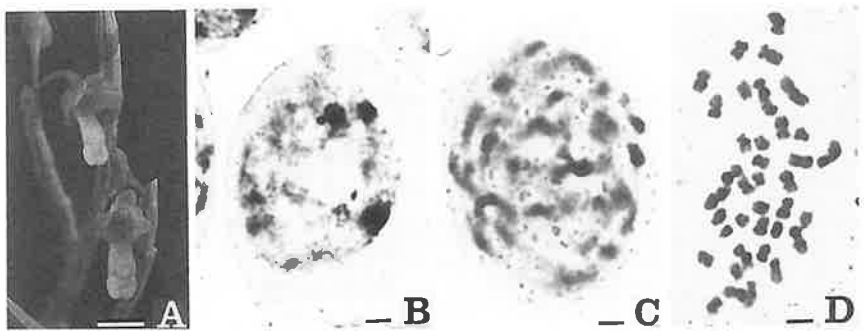

Fig.33. *Dendrobium parcum*, 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.5 cm in A and 2.0 μm in B-D.

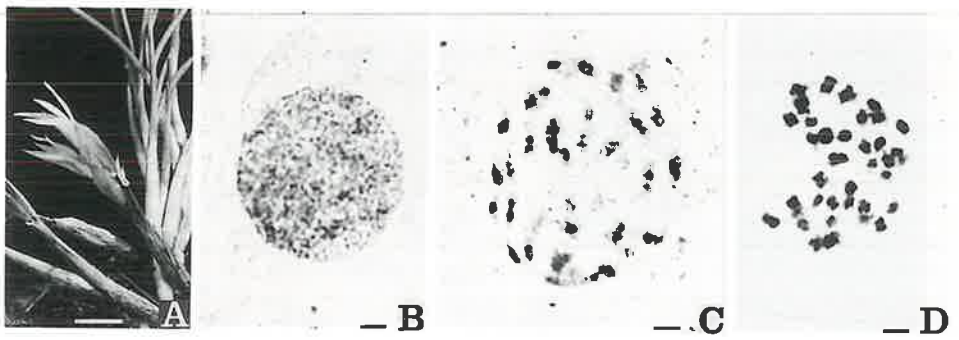

Fig.34. *Dendrobium coerulescens*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.7 cm in A and 2.0 μm in B-D.

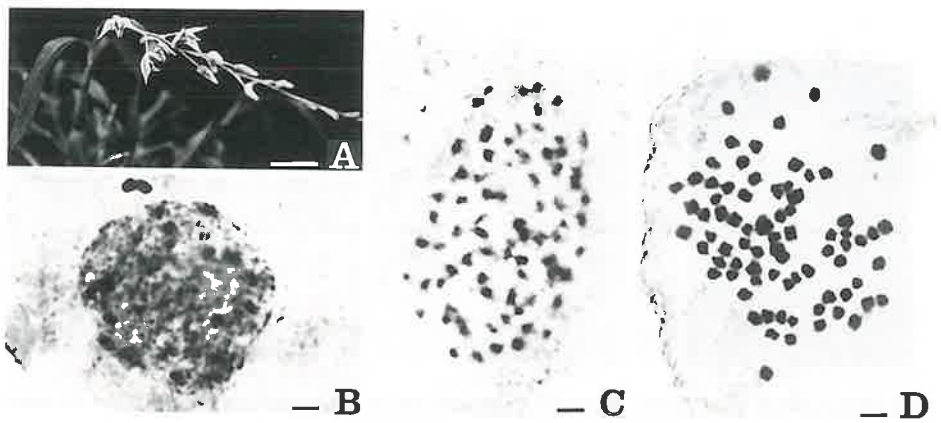

Fig.35. *Dendrobium eriaeflorum*, 2n = 80. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.9 cm in A and 2.0 μm in B-D.

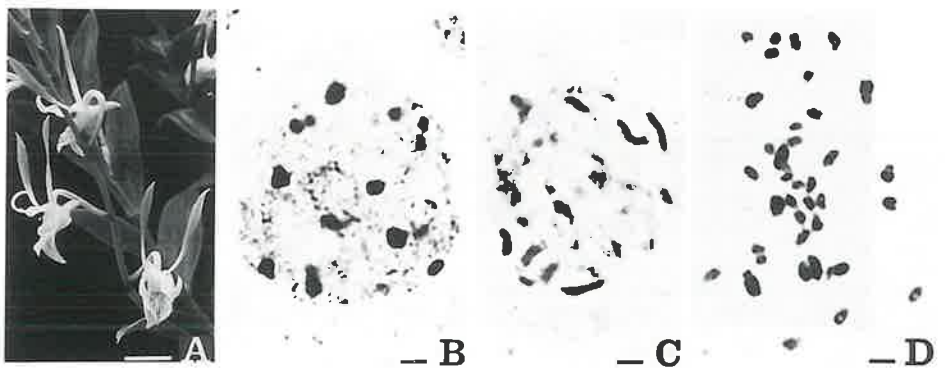

Fig.36. *Dendrobium antennatum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.5 cm in A and 2.0 μm in B-D.

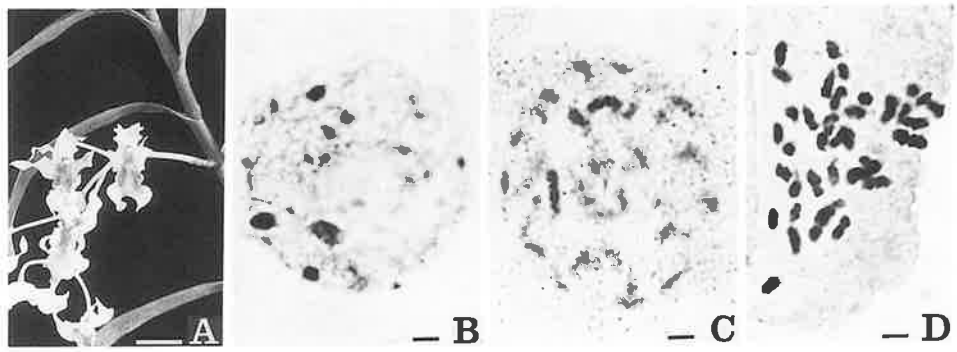

Fig.37. *Dendrobium cincinnatum*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.3 cm in A and 2.0 μm in B-D.

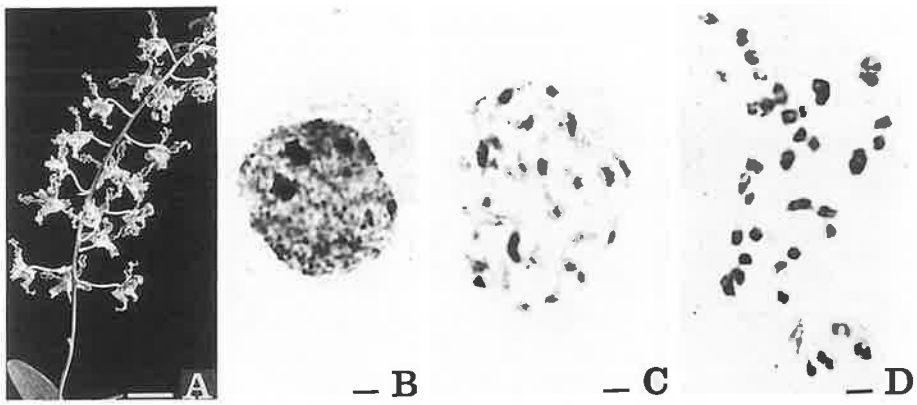

Fig.38. *Dendrobium discolor*, 2n = 38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 4.5 cm in A and 2.0 μm in B-D.

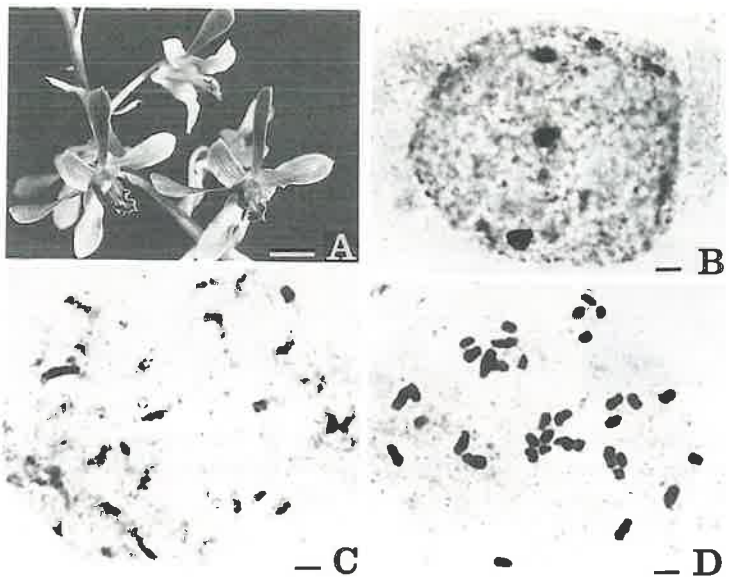

Fig.39. *Dendrobium lineale*, 2n=38. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.0 cm in A and 2.0 μm in B-D.

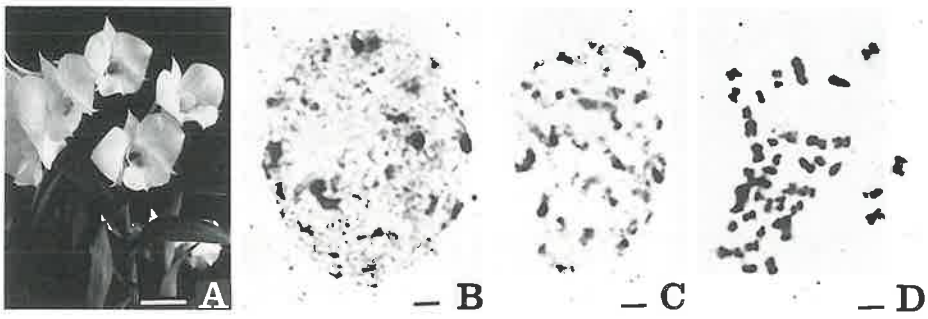

Fig.40. *Dendrobium schuetzei*, 2n=40. A, flowers. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 3.0 cm in A and 2.0 μm in B-D.

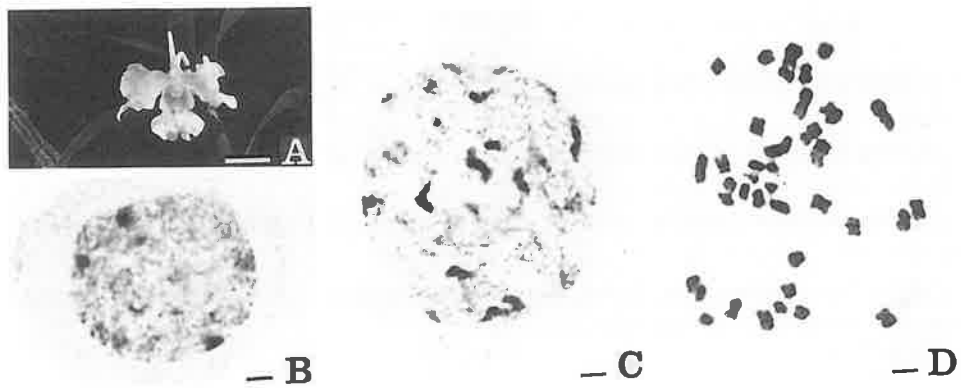

Fig.41. *Dendrobium virgineum*, 2n = 40. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 1.8 cm in A and 2.0 μm in B-D.

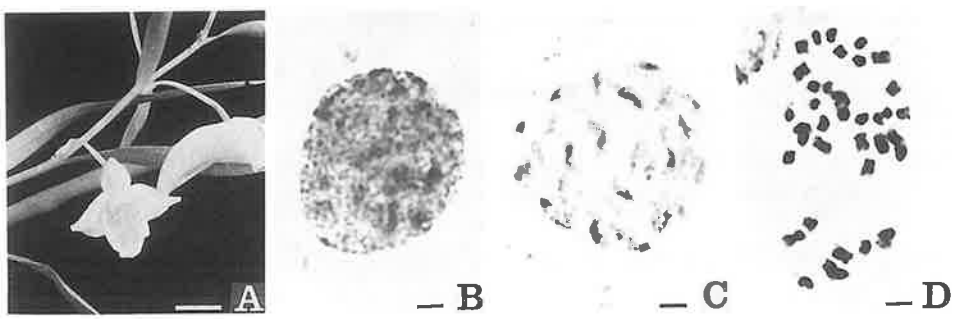

Fig.42. *Dendrobium linearifolium*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.6 cm in A and 2.0 μm in B-D.

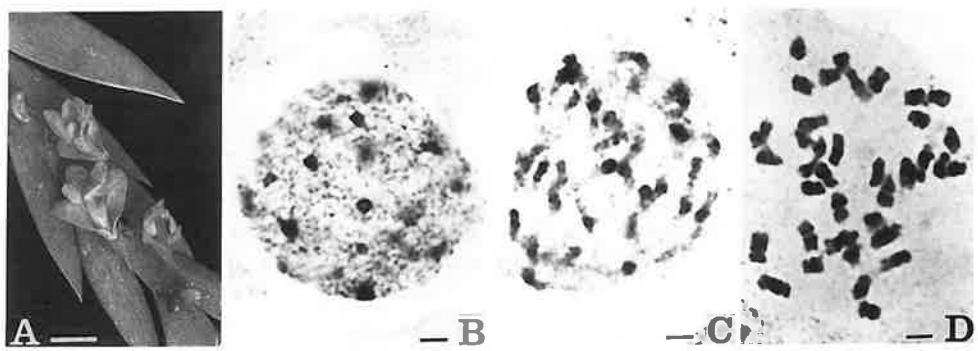

Fig.43. *Dendrobium anceps*, 2n = 38. A, a flower. B, chromosomes at resting stage. C, chromosomes at mitotic prophase. D, chromosomes at mitotic metaphase. Bar indicates 0.6 cm in A and 2.0 μm in B-D.

Summary

1. Chromosome counts were carried out in 43 taxa in 13 sections of the genus *Dendrobium*.
2. Among 43 species in the genus *Dendrobium*, 32 were 2n=38, 7 were 2n=40, one was 2n=57, 2 were 2n=76 and one was 2n=80.
3. The chromosome numbers of the 18 taxa of the genus *Dendrobium* were recorded for the first time and those of 25 taxa were redocumented.
4. The 43 taxa studied were grouped into ten karyomorphological types according to the category proposed in the previous paper.

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