CHROMOSOME NUMBERS OF SARCANTHINE ORCHID SPECIES OF THAILAND[1]

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and

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Sarcanthine orchids constitute a large and diverse taxonomic group of predominantly Old World monopodial orchids. ***Dressler*** and ***Dodson*** (1960) have listed 106 separate genera in the subtribe *Sarcanthinae* of the tribe *Epidendreae* based primarily on ***Schlecthter***'s classification, but some of these may not merit recognition. Thailand abounds in species of this group, many of which are well known among orchidists because of their desirable horticultural characteristics.

The role of cytology in aiding breeding programs as well as in clarifying taxonomic relationships in orchids is generally recognized. According to ***Tanaka*** and ***Kamemoto***'s recent tabulations (1963; *In press*), chromosome numbers for 55 species distributed among 15 genera of the *Sarcanthinae* have been reported to date by various workers. These counts, however, represent only a small fraction of the known species of this group. Species are the basic building blocks for improved advanced generation hybrids. Since cytological data on many of the horticulturally desirable species of Thailand are lacking, an investigation on the cytogenetics of orchids of Thailand was initiated at Kasetsart University in the Fall of 1962. The present paper reports the finding on the chromosome numbers of species of the sarcanthine or *Vanda* alliance.

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Materials and Methods

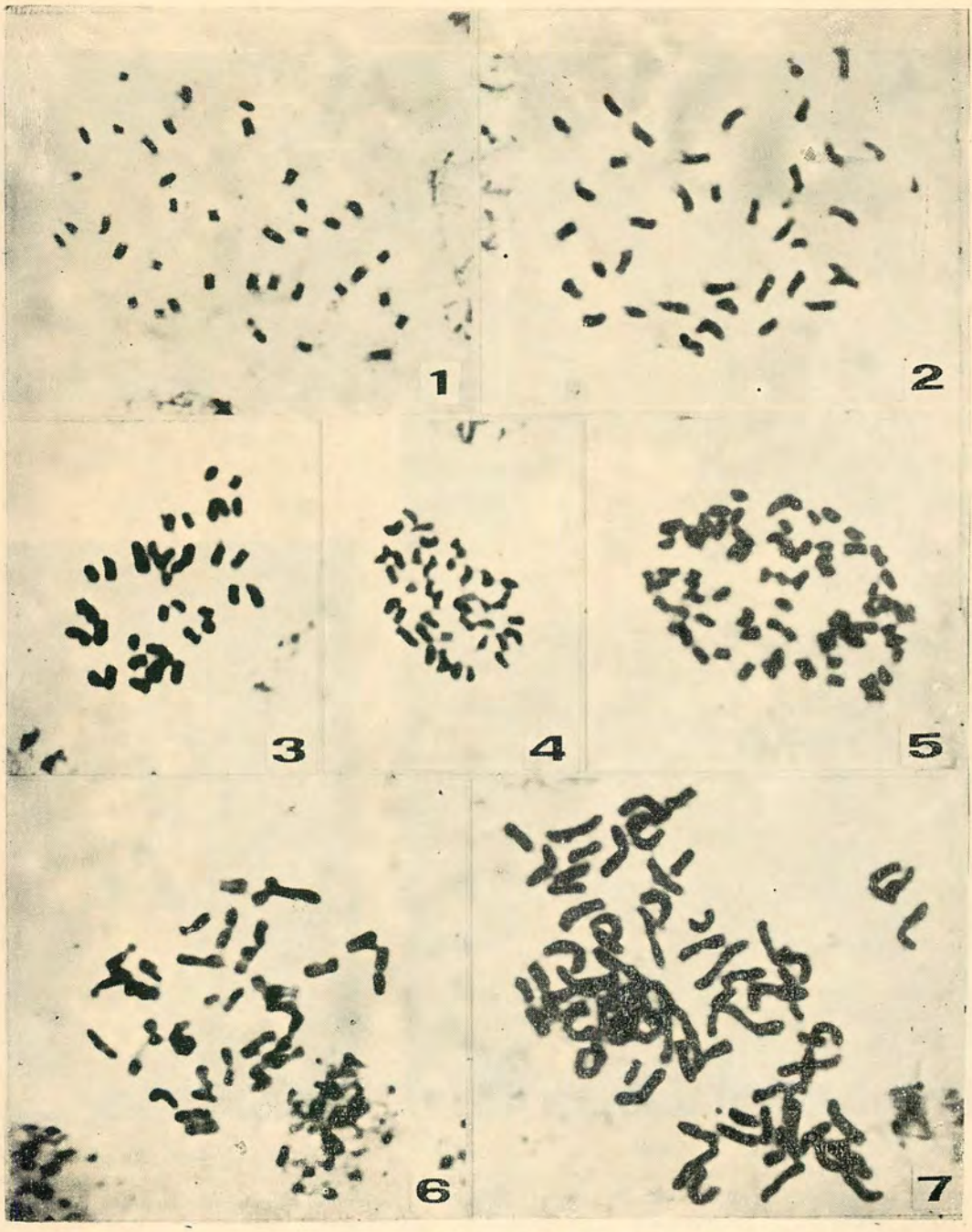
All plants investigated had been collected from their native habitats in Thailand. Individual plants were labelled for reference, and whenever possible, photographs in both color and black and white were taken for documentation. To verify taxonomic identities, ***Holttum***'s (1953) "Flora of Malaya, Vol. 1, Orchids" and ***Seidenfaden*** and ***Smittinand***'s (1963) "The Orchids of Thailand" were consulted. Also plants were often taken directly to Mr. ***Tem Smitinand*** of the Royal Forest Department, Bangkhen, Bangkok, for identification. The writers are greatly indebted to him for his generous support throughout the course of study.

The cytological method employed was essentially that described earlier by ***Shindo*** and ***Kamemoto*** (1963a). Active root were severed and placed in 0.002M hydroxyquinoline for 5 to 6 hours and then transfered in 1 : 1 : 2 mixture of chloroform, 95% ethyl alcohol and glacial acetic acid. The following morning they were hydrolyzed in 1 : 1 mixture of 95% ethyl alcohol and concentrated hydrochloric acid for 5 minutes, moved to 45% acetic acid for about 30 minutes, and finally squashed and stained in 1% acetoorcein. Photomicrographs were taken of selected plates.

Observations

Table 1 lists the chromosome numbers of 47 species belonging to 20 genera, 36 species and 11 genera of which have not been reported previously. The great majority of species showed 2n = 38 chromosomes (Fig. 1-4, 6), and no aneuploids were observed. Three species, *Aerides odoratum, Doritis pulcherrima* and *Vanda denisoniana* were represented by both diploid and tetraploid varieties or forms. *Aerides odoratum* var. *immaculatum,* (Fig. 9) which comes from north and northeast Thailand, was determined to tetraploid, while the type species (Fig. 8) distributed in west and peninsular Thailand was diploid. The tetraploid variety is characterized by more erect stems and inflorescenses than those of the diploid.

Doritis pulcherrima var. *buyssoniana* which originates from Ubol region in northeast Thailand was confirmed to be tetraploid (Fig. 7). It appears to have a limited distribution in Thailand, whereas the



Figs. 1-7. Somatic chromosomes of some sarcanthine species. X2,000. Fig.1, *Phalaenopsis cornu-cervi*, 2n = 38. Fig. 2, *Rhynchostylis gigantea*, 2n = 38. Fig. 3, *Sarcanthus carinatus*, 2n = 38. Fig. 4, *Renanthera coccinea*, 2n = 38. Fig. 5, *Vanda denisoniana* (brown), 2n = 76. Fig. 6, *Doritis pulcherrima*, 2n=38. Fig. 7, *Doritis pulcherrima*, var. *buyssoniana*, 2n = 76.

Figs. 8-12 Diploid and tetraploid species and varieties. Fig. 8, Diploid *Aerides odoratum*, about 3/8 natural size. Fig. 9, Tetraploid *A. odoratum* var. *immaculatum*, about 2/3 natural size. Fig. 10, Diploid *Vanda denisoniana* (greenish yellow), natural size. Fig. 11, Tetraploid *V. denisoniana* (brown), about 3/4 nalural size. Fig. 12, Diploid *Doritis pulcherrima* on left, tetraploid *D. pulcherrima*, var. *buyssoniana* on right, about 1/2 natural size.

diploid *D. pulcherrima* is more wide-spread. The tetraploids display typical "gigas" characteristics with flowers nearly double the size of those of diploids (Fig. 12).

The white to green to yellow flower type of *Vanda denisoniana* (Fig. 10) was diploid, while the brownish type was predominantly tetraploid (Fig. 5, 11). Flower as well as vegetative characteristics of the two types appear to vary considerably. A more detailed study might reveal significant cytotaxonomic relationships.

Some differences in size of chromosomes of species complements were evident. *Doritis pulcherrima* and its botanical variety, *buyssoniana,* possessed conspicuously larger chromosomes than the rest of the sarcanthine species examined including the relatively closely allied species of *Phalaenopsis* (Fig. 6, 7). Within the genus *Ascocentrum, A. micranthum* possesed much larger chromosomes than the other species of this group. Also, the chromosomes of *Vandopsis lissochiloides* appeared to be slightly larger than those of most species. A critical karyotype analysis should reveal fine differences as demonstrated in an earlier work by ***Shindo*** and ***Kamemoto*** (1963a; 1963c.).

Discussion

The present study brings the total of species and genera of the *Sarcanthinae* examined cytologically to 91 and 26, respectively. The diploid number, 2n = 38, predominates. Earlier workers have also reported 2n=36 and 40 for some species (***Tanaka*** and ***Kamemoto,*** 1963), but these counts arequestion able because of the inadequacies of early techniques. Aneuploids have not been encountered in Thailand and Southeast Asian species, although *Dendrophylax funalis,* a West Indian species, and *Aerangis biloba,* an African member, have 42 and 50 chromosomes, respectively (***Shindo*** and ***Kamemoto,*** 1963b).

Polyploidy has been disclosed in 6 species. *Aerides odoratum, Doritis pulcherrima* and *Vanda denisoniana* have both diploid and tetraploid varieties or forms. Two species, *Vanda tricuspidata* and *V. concolor,* are tetraploid (***Storey,*** 1952), while one, *V. spathulata* is hexaploid (***Storey*** *et. al.* 1963). Both diploidy and hexaploidy have

been reported for *Renanthera coccinea* (***Kamemoto*** and ***Shindo***, 1962), but whether the hexaploid form is a horticultural variant or a naturally occuring race has not been clarified. All plants sampled within Thailand revealed their diploid nature, whereas those generally cultivated in Hawaii and Singapore were found to be hexaploid.

For a few species a polyploid individual has been recorded along with the typical diploid, but such polyploid plants must be considered horticultural variants and not truly representative of the species.

The knowledge of existing polyloids at the species level is of considerable significance in breeding. In crosses involving polyploids and diploids, one might expect a strong influence of the polyploid parent in the offspring. The tetraploid *V. concolor* has shown such influence (***Storey***, 1952), and the hexaploid *V. spathulata* has exerted almost complete dominance in flower size and color (***Storey et. al.*** 1963).

Where diploid and tetraploid forms occur within a species, it may be rewarding to perform crosses between them to produce triploids, for in most groups of orchids triploids have exhibited vigorous growth, floriferousness and other desirable qualities.

The tetraploids should be of particular value in intergeneric hybridization. While hybrid sterility is a common feature among diploid intergeneric hybrids, tetraploid hybrids involving two tetraploid species may be fertile. Such tetraploid intergeneric hybrids may possibly circumvent the sterility barrier of intergeneric hybrids and open new avenues for producing multiple species combinations.

The hexaploid *Renanthera coccinea* intercrossed with its diploid counterpart should give rise to presumably fertile tetraploid offspring which could subsequently be employed effectively in a breeding program.

Summary

Chromosome numbers of 47 species of Thailand belonging to 20 genera of the subtribe *Sarcanthinae* were investigated. Counts for 36 species and 11 genera were reported for the first time. The majority of species had 2n=38 chromosomes. Both diploid and

tetraploid varieties or forms were observed for *Aerides odoratum*, *Doritis pulcherrima*, and *Vanda denisoniana*. The significance of polyploidy at the species level on the breeding of orchids was briefly discussed.

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TABLE 1.

Chromosome numbers of sarcanthine orchid species of Thailand.

Species	Plant Reference	2n
Acampe longifolia Ldl.	K21	38
A. ochracea Hochr.	K216-3	38
A. papillosum Ldl.		38
Aerides crassifolium Par. & Rchb. f.	HCH91	38
A. falcatum Ldl.	HCH26	38
	HCH42	38
	HCH48	38
	RS202	38
A. fieldingii Lodd.	HCH105	38
	HCH155	38
	K26	38
A. flabellatum Rolfe	HCH16	38
	HCH18	38
A. houllettianum Rchb. f.		38
A. mitratum Rchb. f.	K191	38
	RS210	38
	RS211	38
A. odoratum Lour.	K158	38
	K166	38
	K173	38
A. odoratum var. *immaculatum* Guill.	HCH129	76
	K70-3	76
	K149-1	76
	RS250	76
	RS2004	76
Ascocentrum ampullaceum (Roxb.) Schltr.		38
A. curvifolium (Ldl.) Schltr.		38
A. micranthum (Ldl.) Holtt.	K31	38
A. miniatum (Ldl.) Schltr.		38
Camarotis apiculata Rchb. f.	RS2003	38
Chiloschista luniferus (Rchb. f.) J.J.S.	K180-1	38
	K180-2	38
Diploprora championi (Ldl.) Hk. f.	K29	38
Doritis pulcherrima Ldl.	HP145	38
D. pulcherrima var. *buyssoniana*		76
Gastrochilus calceolaris Don	K25	38
Pelatantheria ctenoglossa Ridl.		38
Phalaenopsis cornu-cervi (Breda) Bl. & Rchb. f.		38

Species	Plant Reference	2n
Phalaenopsis decumbens (Griff.) Holtt.	K47-1	38
	K47-2	38
Pomatocalpa spicatum Breda	K170-1	38
Renanthera coccinea Lour.	K178-1	38
	K178-2	38
	RS	38
	RS	38
Rhynchostylis coelestis Rchb. f.	HP2	38
	HP3	38
	HP5	38
	HP9	38
R. gigantea (Ldl.) Ridl.		38
R. gigantea var. *illustre*		38
R. retusa Blume		38
Robiquetia paniculata (Ldl.) J.J.S.	K204	38
R. spathulata (Bl.) J.J.S.	HK136	38
	K113	38
Sarcanthus appendiculatus Hk. f.	HCH118	38
S. carinatus Rolfe	RS110	38
S. flagelliformis Rolfe ex Downie	RS106	38
S. kunstleri King & Pantl.		38
S. subulatus (Bl.) Rchb. f.		38
S. termissus Rchb. f.		38
Staurochilus (Trichoglottis) dawsonianus (Rchb. f.) Schltr.	HCH92	38
S. fasciatus (Rchb. f.) Ridl.		38
Thrixpermum acuminatissimum (Bl.) Rchb. f.	K200	38
Th. arachnites (Bl.) Rchb. f.	K23	38
Vanda coerulea Griff.		38
V. coerulescens Griff.	S1	38
V. denisoniana Bens. & Rchb. f. (green to yellow)	14 plants	38
V. denisoniana Bens. & Rchb. f. (brown)	10 plants	76
	4 plants	38
V. laotica Guill.		38
V. teres Ldl.		38
Vandopsis gigantea (Ldl.) Pfitz.		38
V. lissochiloides Pfitz.		38
V. (Vanda) parishii (Veitch & Rchb. f.) Schltr.		38