CHROMOSOME NUMBERS OF SOME TROPICAL RHODODENDRONS (SECTION *VIREYA*)

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Chromosome counts for 27 species plus one intersubsectional hybrid are presented from all seven subsections of section *Vireya* in the genus *Rhododendron*. Twenty-three are new, and five confirm previously published counts. The plants originate from a wide geographical and altitudinal range; all have a uniform somatic number of 2n = 26.

Keywords. Chromosomes, rhododendrons, tropical, Vireya.

INTRODUCTION

Rhododendron L. (*Ericaceae*) section *Vireya* (Blume) Copel.f. is the largest section in the genus, being a group of 303 species (Argent *et al.*, 1996), distributed from the Himalayas and South China through the South-East Asian archipelago to the Solomon Islands and the northern parts of Australia. There is considerable morphological diversity in the section, and seven subsections have been described based on floral and scale characters (Sleumer, 1966). Current taxonomic studies have indicated that floral characters are highly plastic and subject to considerable selection pressures because of their role in pollination biology (Stevens, 1976; Argent *et al.*, 1988). Other characters such as floral bracts and fruits have been sought, and these have indicated that the current infra-sectional classification is in need of revision (Argent, 1989). Despite the high level of morphological diversity there is considerable hybridization reported in Vireya rhododendrons (Rouse & Williams, 1989; Williams & Rouse, 1997) suggesting that genetic divergence in terms of reproductive barriers between species and as well as between subsections is low.

Chromosome numbers for many species of *Rhododendron* were initially investigated nearly 70 years ago, and relatively recently the most extensive survey was that of Janaki Ammal *et al.* (1950). This author also summarized the information on polyploidy in relation to geographical and altitudinal distribution and classification of the genus (Janaki Ammal, 1950). These studies, which sampled 368 taxa, indicated that polyploids occurred frequently among lepidote (scaly-sleaved) rhododendrons, but not among the elepidotes (those without scales). Polyploid species were found in a relatively restricted area of the Sino-Himalayan region, whereas diploids (2n = 26) were far more widely distributed over the full geographic range of sect. *Rhododendron*. Only two species among these non-Vireya rhododendrons were reported to have n = 12 (i.e. 2n = 24), namely, *R. wallichii* Hook.f. (as *R. campanulatum* var. *wallichii* Hook.f.) and *R. grande* Wight (Mehra, 1976). These two species

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are not closely related, and it is a surprise to find that they share a common, deviant chromosome number (Chamberlain, pers. comm.). Clearly, confirmation of these counts is highly desirable.

Four species in sect. *Vireya* were counted by Janaki Ammal *et al.* (1950) and all were diploid (2n = 26). The most significant previous investigation of the cytology of tropical Rhododendrons, all belonging to sect. *Vireya*, was that of Jones & Brighton (1972) who reported 33 counts. They found 32 diploids (2n = 26) and one individual with 2n = 30, presumed to be an aneuploid. Although several subsections were included in this study the geographical range of the section represented was rather limited, as the majority of individuals counted were from New Guinea. In addition, 12 of the counts, including the aneuploid, were of unnamed individuals, and there is doubt as to the accuracy of names of some of the others. We know of no further recent chromosome counts reported for Vireya rhododendrons in the literature. It was decided to further investigate whether or not polyploidy or some other cytological variation occurs in this section.

MATERIALS AND METHODS

The Royal Botanic Garden Edinburgh (RBGE) has an unrivalled living collection of half the Rhododendron species from section *Vireya,* representing all subsections and a very wide altitudinal (500–2500m) and geographic range (Fig. 1). This collection provided the opportunity to sample further in the section using reliably named living material of known provenance.

Roots were taken from cuttings and pretreated for five hours in 0.002M 8-hydroxyquinoline (OQ) kept in the dark at 20°C. Roots were then fixed in 3 : 1 absolute alcohol : glacial acetic acid and stored at 4°C until needed. Prior to squashing fixed material was softened in a 50 : 50 mixture of 4% pectinase and 4% cellulase for 30min at 37°C. Root tips were then dissected in 45% acetic acid and squashed in lacto-propionic orcein. All observations were made using phase contrast microscopy. This protocol was found to be reliable for all the material examined but some experimentation during later stages of this study was made using a saturated solution of oryzalin as a pretreatment for five hours at 20°C in the dark. This was found to be an effective pretreatment although the chromosomes tended to be more contracted and clustered than those treated with OQ.

Vouchers for all examined species are lodged in the herbarium of the RBGE (E).

RESULTS AND DISCUSSION

Counts were made of 28 accessions representing 27 species and one intersubsectional hybrid (*R. caliginis* Kores × *vitis-idaea* Sleumer). The results and accesssions details are presented in Table 1 and photographs in Fig. 2a–h. All the accessions examined had a count of 2n = 26. In a number of cases karyological details were clear enough to indicate that the chromosomes were mostly metacentric to submetacentric, and

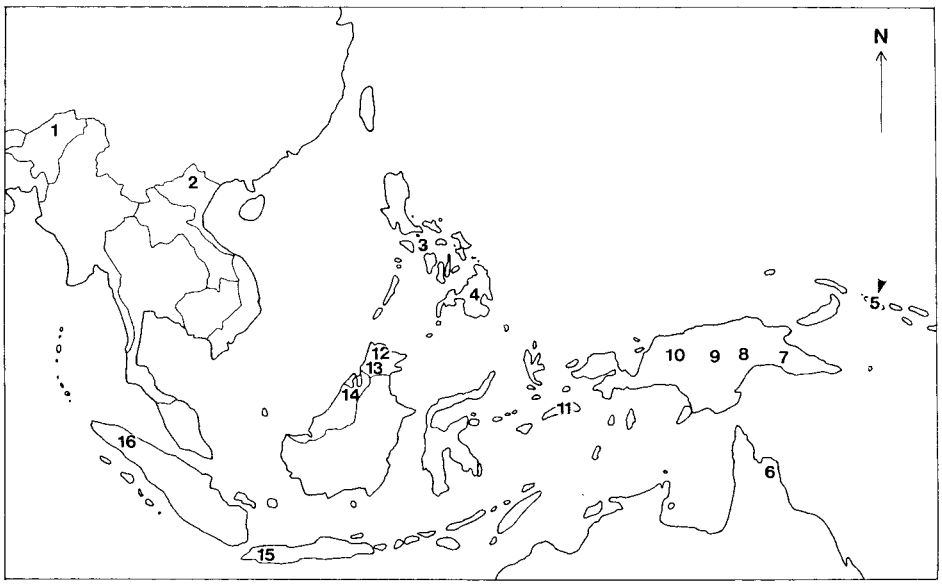

FIG. 1. Sites from which selected species used in this study were collected showing the geographical range: 1, *Rhododendron santapaui*; 2, *R. rushforthii*; 3, *R. quadrasianum*; 4, *R. apoanum*, *R. bagobonum*; 5, *R. loranthiflorum*; 6, *R. lochiae*; 7, *R. dianthosumum*; 8, *R. anagalliflorum*; 9, *R. phaeochitum*; 10, *R. inundatum*; 11, *R. ruttenii*; 12, *R. himantodes*, *R. praetervisum*, *R.cuneifolium*; 13, *R. orbiculatum*, *R. stapfianum*; 14, *R. pneumonanthum*, *R. himantodes*; 15, *R. album*; 16, *R. vanderbiltianum.*

one pair of satellited chromosomes was often present (e.g. Fig. 2f&h). Some variation was observed in chromosome size between species, but this needs confirmation based on a more specific study.

Among the four species of section *Vireya* surveyed by Janaki Ammal *et al.* (1950) was included *R. lochiae* (as *R. lochae*), whose number of 2n = 26 is confirmed in the present study and also by Jones & Brighton (1972). This species is found in Australia, one of the geographical extremes of the section. The counts made by Jones & Brighton (1972) on four other species, namely, *R.? beyerinckianum, R.? aequabile, R. orbiculatum* and *R. commonae* were also concordant with our observations on different accessions of the same taxa, although we have not been able to trace voucher specimens to check their taxonomic identity.

These results show that chromosomal diversity in *Rhododendron* sect. *Vireya* is low even across a wide geographical and taxonomic sample and support the hypothesis that high morphological diversity in the group is not reflected in much cytological diversity, at least not at the gross chromosomal level. Chromosome counts now available for about 60 taxa are almost uniformly 2n = 26. To date, only one case of an aneuploid number of 2n = 30 has been reported (Jones & Brighton, 1972). There is as yet no evidence of polyploidy in sect. *Vireya*, in contrast to sect. *Rhododendron* where polyploidy occurs among one third of cytologically examined lepidote species,

TABLE 1. Chromosome numbers of *Rhododendron* (section *Vireya*)

Name	Origin	Acc. no.	2n	Fig.
Subsect. *Albovireya* Sleumer				
R. aequabile J.J. Sm.	Indonesia, Sumatra, Mt Singalang, alt. 2896m, 18 xii 1974, *Valder*	19750002	26	2a
R. album Blume	Indonesia, Java, Gunung Salak, alt. 1500m, *Argent*	19882540	26	
Subsect. *Malayovireya* Sleumer				
R. apoanum Stein	Philippines, Mindanao, Cotabato, Mt Apo, alt. 2200m, iii 1992, *Argent* A6	19922797	26	
R. himantodes Sleumer	Malaysia, Sarawak, Mulu, Tamashoo, 1200m, *Argent*	19781723	26	
Subsect. *Phaeovireya* Sleumer				
R. beyerinckianum Koord.	Papua New Guinea, *Stonor* 7	19490413	26	2b
R. dianthosmum Sleumer	Papua New Guinea, Morobe District, Wau Subdistrict, Bulldog Road, alt. 2700m, 12 xii 1974, *Kores*	19750104	26	2c
R. phaeochitum F. Muell.	Papua New Guinea, above Telefomin, alt. 1700m, 30 xii 1964, *Herklots* 5	19650269	26	
Phaeovireya × *Vireya*				
R. caliginis Kores × *vitis-idaea* Sleumer	Papua New Guinea, alt. 2500m.	19902941	26	
Subsect. *Pseudovireya* (Clarke) Sleumer				
R. cuneifolium Stapf.	Malaysia, Sabah, Mt Tambuyukon, alt. 1000m, 10 x 1995, *Argent & Smith* 285	19952781	ca. 26	
R. quadrasianum Vidal	Philippines, Romblon, Sibuyan Island, alt. 500–1500m, viii 1989, *Argent* 3	19902338	26	
R. rushforthii Argent & D.F. Chamb.	Vietnam, Lào Cai Province, Sapa, alt. 1829m, *Rushforth* 2357	19933195	26	
R. santapaui Sastry *et al.*	India, Subansiri Division, North East Frontier Agency, 1965, alt. 1550m, *Cox & Hutchison* 459	19830996	26	
R. vanderbiltianum Merr.	Indonesia, Sumatra, Gunung Kemiri, 1997, alt. 2000m, *Binney*	19982483	26	2d
Subsect. *Siphonovireya* Sleumer				
R. herzogii Warb.	Papua New Guinea, *Searle* 4	19741762	26	

TABLE 1. Continued

R. inundatum Sleumer	Indonesia, Irian Jaya, trail from Pabilylo to Wamena, alt. 2500m, 31 x 1992, *Mitchell & Smith* 211	19930977	26	
Subsect. *Solenovireya* Copel. f.				
R. loranthiflorum Sleumer	Solomon Islands, Bougainville Island, Aropa, Lake Lolom, alt. 1520m, 1964, *Craven*	19830533	26	
R. orbiculatum Ridl.	Malaysia, Sabah, Gunong Lumarku, alt. 914m, ii 1980. *Argent*	19801407	26	2e
R. pneumonanthum Sleumer	Malaysia, Sarawak. *Adams*	19902993	26	
R. ruttenii J.J. Sm.	Indonesia, Seram, Manusela National Park, N side of Gunong Binaia, alt. 2500m, ix 1987, *Argent* 87/32	19880574	26	
R. stapfianum Hemsl. ex Prain	Malaysia, Sabah, Gunong Lotung, alt. 1500m, Argent	19821522	ca. 26	
R. tuba Sleumer	Papua New Guinea, Mt Maneao, vii 1974, *Weeks & Cruttwell* ANRS 150	19830538	26	
Subsect. *Vireya* Copel.f.				
R. anagalliflorum Wernham	Papua New Guinea, West Highlands District, 2 miles E of Bang on old road to Hagen, 1972, alt. 1600m, *Searle & Stanton*	19821953	26	
R. bagobonum Copel.f.	Philippines, Mindanao, Cotabato, Mt Apo, iii 1992, alt. 2200m, *Argent* A44	19922741	26	2f
R. commonae Foerster	Papua New Guinea, Kain Swamp, alt. 2500m	19832058	26	2g
R. crassifolium Stapf.	Malaysia, Sabah, Kimanis Road, alt. 1219m, ii 1980, *Argent*	19801206	26	
R. lochiae F. Muell.	Australia, Queensland, Mt Finnegan, alt. 1100m, *Warren*	19951543	26	2h
R. praetervisum Sleumer	Malaysia, Sipitang District, Mt Kinabalu, alt. 2438m, 1963, *Giles & Woolliams*	19790954	26	
R. wrightianum Koord. var. *cyclopense* J.J. Sm.	Papua New Guinea, Mt Cyclops, alt. 1640m, *Sleumer*	19670477	26	

the degree of polyploidy ranging from triploids ($2n = 39$) to dodecaploids ($2n = 156$) (Janaki Ammal, 1950). Enormous species diversification has clearly occurred at the diploid level, as is the case among elepidote species of sect. *Rhododendron*, which are also all diploid as far as is known.

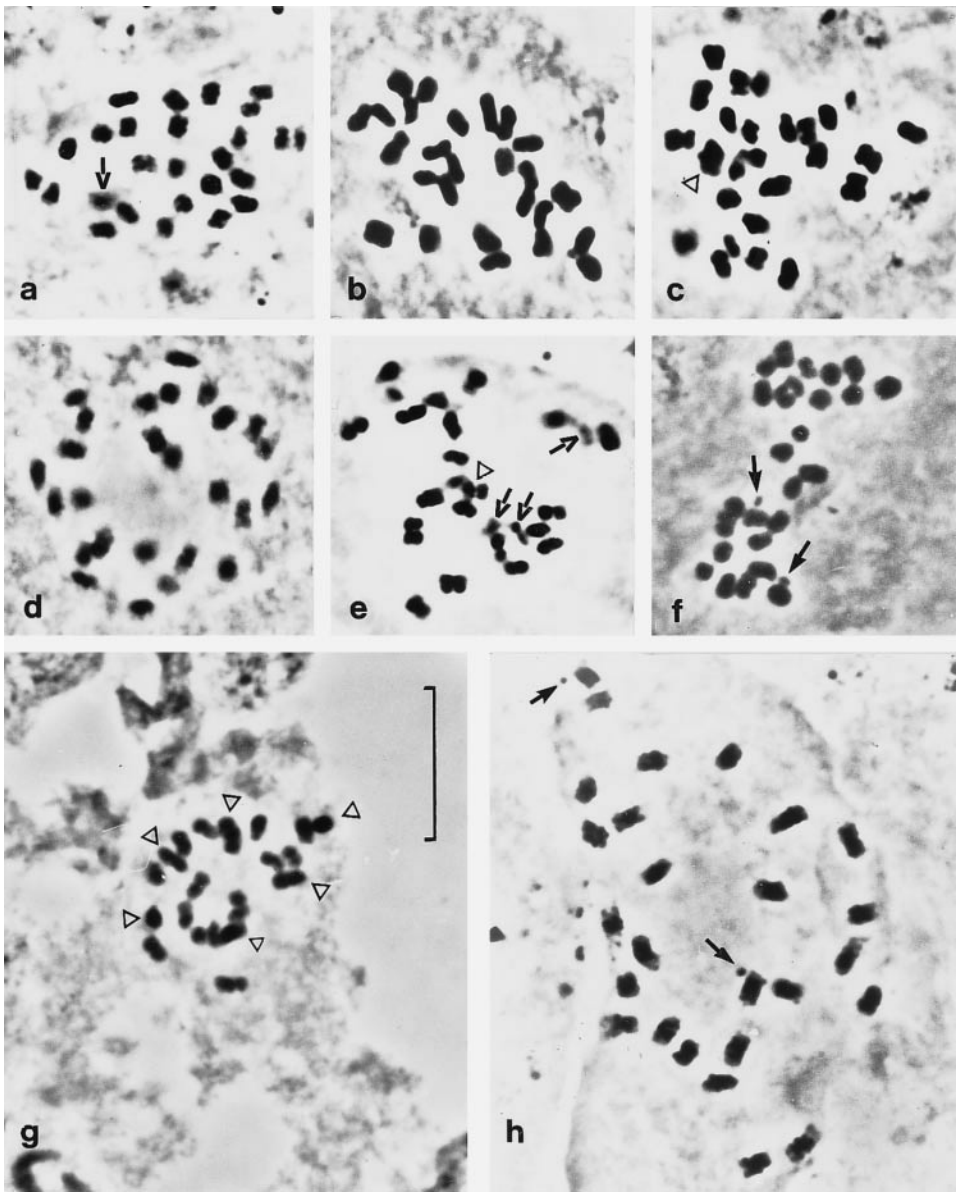

FIG. 2. Somatic chromosomes of *Rhododendron* sect. *Vireya*, all 2n = 26, in root tips after oxyquinoline pretreatment, except for e: a, *R. aequabile*, out-of-focus chromosome arrowed; b, *R. beyerinckianum*, note close association of chromosomes in twos; c, *R. dianthosmum*, open arrowhead indicates overlapping chromosomes; d, *R. vanderbiltianum,* prometaphase; note close association of certain chromosomes; e, *R. orbiculatum*, metaphase from oryzalin pretreated root tip, open arrow head indicates overlapping chromosomes, other arrows, out-of-focus chromosomes; f, *R. bagobonum*, note satellites indicated by arrows; g, *R. commonae*, metaphase with many overlapping and closely associated chromosomes (open arrow-heads); h, *R. lochiae*, prometaphase, note tiny satellites (arrowed). Scale bar = 10mμ in g, approximately × 2000, applicable to all figures.

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