

Chromosome Numbers of *Woodsia kitadakensis* and *W. subcordata* (Woodsiaceae)

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キタダケデンダとヒメデンダ（イワデンダ科）の染色体数

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The somatic and meiotic chromosome numbers of *Woodsia kitadakensis* and *W. subcordata* s.str. were determined. Both forms showed $2n = 164$ in the somatic metaphase and 82_{II} at the diakinesis or metaphase I of the meiosis. They were regarded as sexual tetraploids. Cytologically, *Woodsia kitadakensis* is not distinguishable from *W. subcordata* with reference to chromosome numbers.

Introduction

Woodsia kitadakensis Ohwi and *W. subcordata* Turcz. are small ferns grown on cliffs in mountains, and are distributed throughout northeastern Asia; Manchuria, Mongolia, Korea, Siberia and Japan (Tagawa 1937, Brown 1964). In Japan they are very rare and have been known only at a few places (Kurata and Nakaike 1985). There were some taxonomic confusions in these taxa: some taxonomists distinguished them as different species (Tagawa 1937, 1959) or varieties (Mitsuta 1979). But many others treated *W. kitadakensis* conspecific with *W. subcordata* and their treatment gains general acceptance at present (Kurata 1954, Ohwi 1957, Nakaike 1975, Serizawa 1982, Iwatsuki 1992).

Less attention has been paid to the cytology of them. Brown (1964) and Serizawa (1982) assumed

that *Woodsia subcordata* had allopolyploid origins, but they did not give any cytological evidence for their hypothesis. Ma (1985) determined the approximate meiotic chromosome number of Chinese *W. subcordata* as $n = ca. 80$. However, to date, the exact chromosome number has not been decided and no data have been published on the somatic and meiotic chromosomes of Japanese *W. kitadakensis* and *W. subcordata* s. str. This report presents the chromosome numbers of both forms and to examine the cytological possibility of distinction of them.

Materials and Methods

A single plant of *Woodsia kitadakensis* was collected by Dr. S. Serizawa at Mt. Kitadake, Yamanashi Prefecture on July 2, 1984, and two plants of *W. subcordata* s. str. were collected by

myself at Mt. Teine, Hokkaido Prefecture on July 31, 1981. They were cultivated in pots at the Botanical Institute, Faculty of Science, Hiroshima University.

For the observation of the somatic chromosomes, root tips were pretreated with 0.002M 8-hydroxyquinoline solution for four hours at room temperature. After fixation in 45% acetic acid for 20 minutes, the root tips were hydrolyzed in 60°C 1N HCl for 20 seconds. Then, they were stained with 2% aceto-orcein and squashed.

For the meiotic chromosomes, young fertile pinna was fixed in a solution of ethanol alcohol : acetic acid = 3 : 1 overnight in a refrigerator in May, 1984 and 1985. After staining with 2% aceto-orcein, the usual squash method was applied.

Voucher specimens (*W. kitadakensis* = Takamiya 3061; *W. subcordata* s. str. = Takamiya 1553 and 1554) were deposited in the herbarium of Kumamoto University (KUMA).

Results and Discussion

The somatic metaphase chromosomes of *Woodsia kitadakensis* were found to be $2n=164$ (Fig. 1). The meiosis was normal and at diakinesis 82 bivalents were observed constantly (Fig. 3). Thus, this species should be a sexual tetraploid with a basic chromosome number $x=41$.

In the two plants of *Woodsia subcordata* s. str., the somatic chromosome number was found to be $2n=164$ (Fig. 2), 82 bivalents occurred regularly at metaphase I (Fig. 4), and there was no irregularity throughout meiosis. This species should, therefore, be a sexual tetraploid.

Momose (1967) described that the prothallus of *Woodsia kitadakensis* was hermaphrodite bearing both antheridia and archegonia, and Ma and Wang (1986) found the same evidence in Chinese *W. subcordata*. Their observations sup-

port the sexual reproduction of both forms.

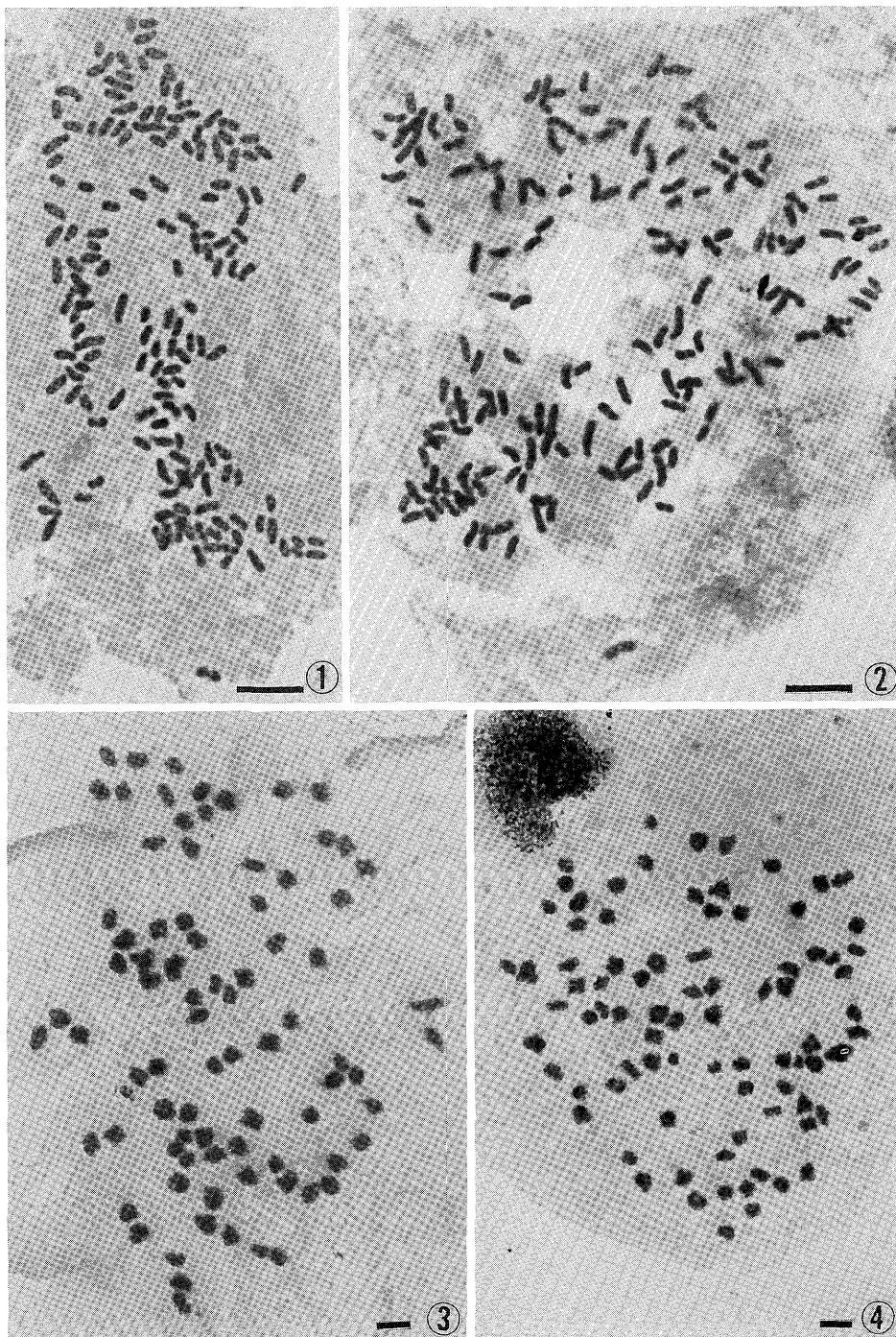
The present results coincide with Ma's (1985) approximate count of $n \approx 80$, except for his description of irregularities in the meiosis. *Woodsia kitadakensis* is not cytologically distinguishable from *W. subcordata* with reference to chromosome numbers.

Several basic chromosome numbers, $x=33, 37, 38, 39,$ and 41 , have been reported in the genus *Woodsia*, with plants where $x=41$ being the most widespread in this genus (Ma 1985). *W. kitadakensis* and *W. subcordata* are also included in the $x=41$ group.

Based on several morphological evidences, Brown (1964) concluded that *Woodsia subcordata* s.l. is a highly polymorphic species and should thus be a fertile allopolyploid originating from the hybrid between *W. ilvensis* R. Br. and *W. polystichoides* Eat. Serizawa (1982) supported Brown's view, and considered it impossible to distinguish *W. kitadakensis* from *W. subcordata* s. str. as the former was a local type of polymorphic *W. subcordata* s.l.

Although single chromosome number of $n=41$ and $2n=82$ have been reported in *Woodsia polystichoides* from many sources (Ma 1985), two different chromosome numbers, $n=39$ and $n=41$, have been reported in *W. ilvensis*. Concerning these two chromosome numbers, Ma (1985) mentioned that it was not certain whether some of the counts were wrong or there really were two cytotypes within this species.

Ma (1985) and Ma and Wang (1986) considered that *Woodsia subcordata* with $n \approx 80$ might be an allotetraploid derived from *W. ilvensis* with $n=39$ and *W. polystichoides* with $n=41$. The present results with somatic and meiotic chromosome numbers of $2n=164=82_{II}$ in *W. subcordata* s.l. do not contradict the hypothesis of allotetraploid origin of this species. However, we need



Figs. 1–4. Photomicrographs of somatic metaphase chromosomes (Figs. 1 and 2, $2n=164$) and meiotic chromosomes (Figs. 3 and 4, $2n=164=82_{II}$) of *Woodsia kitadakensis* (Figs. 1 and 3; Takamiya 3061) and *W. subcordata* (Figs. 2 and 4; Takamiya 1553). Scale bars represent $5\ \mu\text{m}$.

to alternate the chromosome number of *W. ilvensis* from $n=39$ to $n=41$.

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要 旨

山梨県北岳産のキタダケデンダ (*Woodsia kitadakensis*) と、北海道手稲山産のヒメデンダ (*W. subcordata*) の染色体数を決定した。両種とも、体細胞分裂中期では 164 個の染色体が、減数第一分裂の移動期または中期では 82 個の二価染色体が観察され、 $2n=164=82_{II}$ であり、共に有性生殖四倍体であることがわかった。両者の分類学的区別は微妙であり、多くの分類学者はキタダケデンダを独立種ではなくヒメデンダの異名としているが、染色体数の上からも両種は区別できなかった。