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Meiotic Chromosome Configurations of Intraspecific Aneuploids of *Carex sikokiana* (Cyperaceae) in Japan

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Chromosome number and meiotic chromosome configurations of *Carex sikokiana* Fr. et Sav. were determined for 103 plants collected from seven localities in the Chugoku District, Honshu, Japan. Consecutive new chromosome numbers, 2n = 68, 69, 70 and 71, were found. 2n = 68 was found in 59 plants, making it the most common, and 38 plants showed 2n = 69. Heteromorphic chain trivalents with large, medium and small chromosomes, were observed in 52 plants. Our observations in *Carex sikokiana* indicated that the four intraspecific aneuploids originated from trivalent chromosomes which were produced by fusion and/or fission.

Introduction

Carex sikokiana Fr. et Sav. is common in forest floors, and is distributed from western Honshu to the Shikoku and Kyushu Regions (Akiyama 1955). Primary cytological studies of this species were conducted by Tanaka (1948), who reported 2n = 60 in two individuals collected from the Kanto District.

Although many intraspecific aneuploids were reported in *Carex* by Tanaka (1939, 1948, 1949), Wahl (1940), Davies (1956), Faulkner (1972), Schmid (1982), Cayouette and Morisset (1985, 1986a, 1986b), and Whitkus (1991), few individuals per population were studied in *Carex*. Particularly, cytological studies on high-chromosome numbered species were few because the chromosome length of these taxa was below 1.0 μm. Hoshino et al. (1994) reported short intraspecific aneuploid series of 2n = 74, 76, 77 and 78, in *Carex duvaliana* Fr. et Sav., and mentioned that accurate chromosome observations of high-numbered taxa were considered important in understanding the origin of aneuploidy in *Carex*.

This paper reports the chromosome numbers and meiotic chromosome configurations of *Carex sikokiana* collected from seven localities in the Chugoku District, Honshu, Japan.

Materials and Methods

Materials for observation of chromosomes conducted on 103 individuals were collected from seven localities in Hyogo, Okayama, and Hiroshima Prefectures in western Honshu, Japan. When collecting materials, each individual was selected from plants at least three meters apart. Cytological observations were carried out on living materials collected in the field and cultivated in the experimental garden of the Okayama University of Science. Meiotic metaphase chromosomes were observed in the pollen mother cells (PMC's) of young male spikes. Chromosome number determination for each individual was based on counts of at least thirty PMC's. Details on fixation and cytological methods were given in Hoshino (1992). The Appendix enumerates voucher specimens, which

are deposited in the Herbarium of the Biological Laboratory of Okayama University of Science (OKAY).

Results and Discussion

Chromosome counts at meiotic metaphase I were made on 103 individuals, giving consecutive chromosome numbers from 2n = 68 to 2n = 71. Tanaka (1948) reported 2n = 60 in two individuals collected from the Kanto District of central Honshu. The four chromosome numbers determined in this study are reported for the first time for *Carex sikokiana*. Different chromosome numbers were found within populations of Yusu, Sowadani and Aotaki; however plants within populations from four locations had the same chromosome numbers.

Table 1 shows the meiotic configurations of six aneuploids. Fifty-nine plants collected from six areas, showed 2n = 68, as the most common. Regular configurations with 34 bivalents were observed in 46

Table 1. Meiotic chromosome configurations of *Carex sikokiana*

Chromosome number (2n)	Configuration	No. of plants observed (%*)
Yusu, Mitsu-cho, Okayama Prefecture		
68	34II	21
68	34II	1 (95.2)
	33II+2I	(4.8)
69	2III+ 31II+ I	1 (3.3)
	III+ 33II	(76.7)
	34II+ I	(20.0)
69	III+ 33II	7
69	III+ 33II	12 (86.4)
	34II+ I	(13.6)
70	2III+ 32II	1 (63.3)
	III+ 33II+ I	(10.0)
	35II	(26.7)
71	III+ 34II	2 (90.0)
	35II+ I	(10.0)
Sowadani, Kayou-cho, Okayama Prefecture		
68	III+ 32II+ I	1 (6.7)
	34II	(86.6)
	33II+2I	(6.7)
68	34II	7
68	34II	1 (90.0)
	33II+2I	(10.0)
69	III+ 32II+2I	1 (86.7)
	III+ 33II	(3.3)
	34II+ I	(10.0)
69	III+ 33II	2
69	III+ 33II	10 (85.0)
	34II+ I	(15.0)
70	2III+ 32II	1 (56.7)
	III+ 33II+ I	(10.0)
	35II	(33.3)
Shimomura, Takahashi-shi, Okayama Prefecture		
69	III+ 32II+2I	1 (3.3)
	III+ 33II	(93.4)
	34II+ I	(3.3)
69	III+ 33II	1
69	III+ 33II	3 (94.0)
	34II+ I	(6.0)
Mumyodani, Tetta-cho, Okayama Prefecture		
68	2III+ 31II	1 (3.3)
	34II	(96.7)
68	34II	1
Yokogawa, Aida-cho, Okayama Prefecture		
68	2III+ 31II	1 (3.3)
	34II	(96.7)
68	34II	1
68	34II	1 (96.7)
	33II+2I	(3.3)
Obiyama, Kouzuki-cho, Hyogo Prefecture		
68	34II	9
68	34II	2 (95.0)
	33II+2I	(5.0)
Aotaki, Yuki-cho, Hiroshima Prefecture		
68	IV+ 32II	1 (53.4)
	III+ 32II+ I	(3.3)
	34II	(43.3)
68	2III+ 31II	1 (13.3)
	III+ 32II+ I	(13.3)
	34II	(70.0)
	33II+ I	(3.4)
68	2III+ 31II	1 (93.3)
	III+ 32II+ I	(6.7)
68	III+ 32II+ I	1 (13.3)
	34II	(83.4)
	33II+2I	(3.3)
68	III+ 32II+ I	1 (53.3)
	34II	(46.7)
68	34II	7
70	2III+ 32II	1 (40.0)
	III+ 33II+ I	(53.4)
	35II	(3.3)
	33II+4I	(3.3)
70	2III+ 32II	1 (80.0)
	35II	(20.0)

*Percentage of configuration types with more than one pattern.

individuals at meiotic metaphase I (Fig. 1A). Irregular configurations were also found in 13 plants that had several configuration types. One or two heteromorphic chain trivalents with large, medium and small chromosomes, and univalents were observed. One heteromorphic quadrivalent was observed in only one plant from Aotaki, Hiroshima Prefecture. The 2n = 69 and 71 were found in 38 and two individuals, respectively, and heteromorphic trivalents, or univalents were observed in each cell (Figs. 1-B, D). Four plants showed that 2n = 70 had trivalents or univalents in each individual (Fig. 1C), and regular association with 35 bivalents was also observed.

Tanaka (1948) reported homomorphic quadrivalents and trivalents with hetero- and homomorphic associations, in one individual out of two with 2n = 60. However in this study, chain trivalents were most common and heteromorphic with large, medium and small chromosomes. The quadrivalents found in one individual, also showed heteromorphic chain associations. This quadrivalent is thought to have originated from translocation rather than from chromosome duplication. One or two univalents were observed in almost all cells with trivalents, and are thought to have originated by the desynapsis of trivalent or bivalent chromosomes. In this study, 2n = 60 was not found. There is a possibility to find plants with lower chromosome numbers as reported by Tanaka (1948), because our observations were carried out only the populations of the Chugoku District.

Hoshino (1980, 1981, 1992) reported intraspecific aneuploids in *Carex oxyandra* and *C. conica*, which showed few chromosome variations within populations and were speciated in cytogenetically stable cytodemes. However *Carex sikokiana* is considered, cytologically, to be a highly variable species,

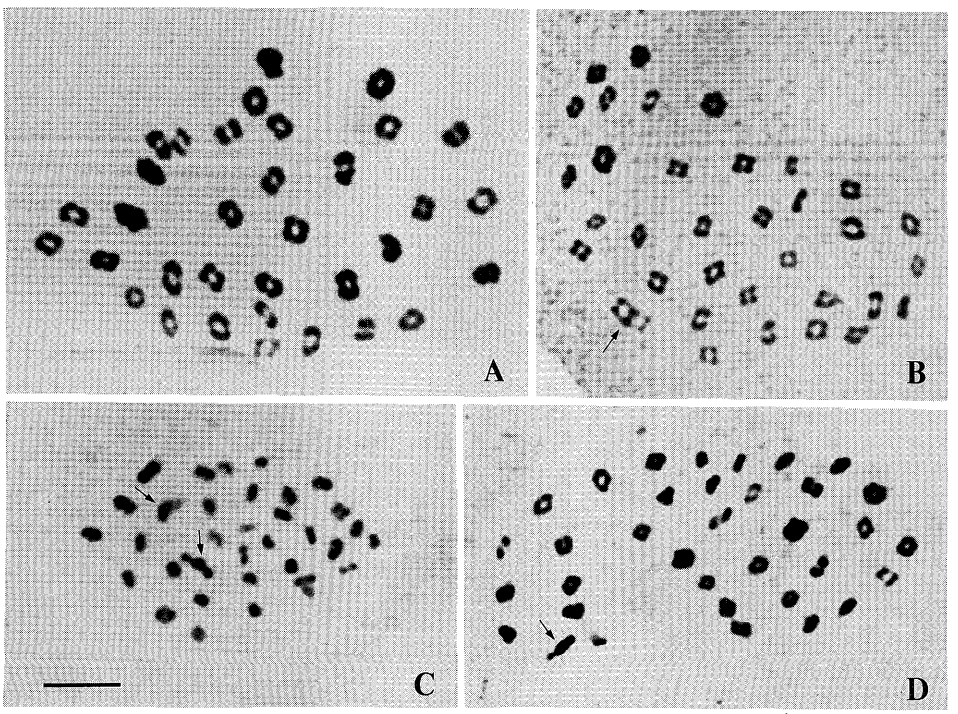

Fig. 1. Meiotic metaphase I chromosomes of *Carex sikokiana*. A: 2n = 68 = 34II. B: 2n = 69 = III + 33II. C: 2n = 70 = 2III + 32II. D: 2n = 71 = III + 34II. Arrows indicate trivalent chromosomes. Bar = 5 μm for all figures.

the same as *C. duvaliana* reported by Hoshino and Onimatsu (1994).

Davies (1956) and Faulkner (1972) suggested that the aneuploidy in the genus *Carex*, is mainly structural, rather than quantitative, and almost certainly occurs from fusion and/or fission, as facilitated by the unlocalized centromeres. Schmid (1982), Cayouette and Morisset (1986a, 1986b), and Whitkus (1991) proposed two forms of aneuploidy in this genus. The first is quantitative aneuploidy, originating from duplication or deletion of whole chromosomes. The second is qualitative aneuploidy, caused by fission or fusion of chromosomes. Fusion of two chromosomes could have given rise to hypoploid cytotypes whereas fission of one chromosome to hyperploid cytotypes.

Our observation of *Carex sikokiana* suggested that the high percentage of heteromorphic trivalents found in the consecutive series from 2n = 68 to 2n = 71 probably originated from chromosome fission and/or fusion.

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Appendix. Enumeration of voucher specimens

Obiyama, Kouzuki-cho (Hyogo), 130 m alt., 4568, 4571–4575, 4577, 4578, 4580, 4581, 4583, 2n = 68: Yokogawa, Aida-cho (Okayama), 160 m alt., 4560, 4561, 4563, 2n = 68: Yusu, Mitsu-cho (Okayama), 40 m alt., 1717, 1721, 1726, 1755, 1782, 2043, 2049, 2055, 2070, 2071, 2079–2081, 2103, 2105, 2113, 2119–2121, 4240, 4244, 2n = 68; 1746, 1759, 2050, 2084, 2094, 4127, 4128, 4130, 4133, 4136, 4141, 4220, 4227–4231, 4236, 4238, 4242, 2n = 69; 4129, 2n = 70; 4143, 4233, 2n = 71: Sowadani, Kayou-cho (Okayama), 240 m alt., 1903, 1919, 1920, 4249, 4252, 4263, 4275. 4283, 4285. 2n = 68; 1997, 4250, 4253, 4254, 4256, 4261, 4269, 4271, 4276, 4277, 4279, 4286, 4288, 2n = 69; 4251, 2n = 70: Shimomura, Takahashi-shi (Okayama), 200 m alt., 4395–4397, 4400, 4401, 2n = 69: Mumyodani, Tetta-cho (Okayama), 290 m alt., 4411, 4424, 2n = 68: Aotaki, Yuki-cho (Hiroshima), 420 m alt., 4517, 4528, 1935, 1941, 1953, 1954, 1961, 1978, 4518, 4519, 4529, 4531, 4533, 4544, 2n = 68; 4521, 4532, 2n = 70.

星野卓二，林　晋，鬼松　文：**ベニイトスゲの種内異数体における染色体の対合分析**

本邦の中国地方の7カ所で採集したベニイトスゲ（***Carex sikokiana***）103株の染色体数の算定と減数分裂第1中期染色体の対合分析を行った．その結果，2n＝68，69，70，71の4種類の種内異数体が観察された．2n＝68が59株でみられ，出現率が最も高く，ついで2n＝69が38株で観察された．多価染色体はⅣ価とⅢ価が見られた．Ⅳ価染色体は1株で見られたのみで，他はすべて，大型，

中型，小型染色体からなる異型Ⅲ価染色体であった．この異型Ⅲ価染色体は全体の約半数の株でみられた．これらのことから，ベニイトスゲにおける連続した種内異数性の成因としては，主に染色体の融合や切断などの構造変異により生じたⅢ価染色体の不等分離が考えられる．