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Cytological Studies of *Carex duvaliana* (Cyperaceae) with Special References to Meiotic Configurations of Intraspecific Aneuploids

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Chromosome numbers and meiotic chromosome configurations of *Carex duvaliana* Franch. et Savat. were determined in 60 plants collected from six localities in the Chugoku Region, Honshu of Japan. Short intraspecific aneuploid series of 2n=74, 76, 77, 78 were found. The 2n=76 plants with regular associations were most common, and heteromorphic quadrivalents, trivalents and univalents were also observed. The high frequency of heteromorphic chain trivalents might indicate that these aneuploids resulted from chromosome fusion or fission.

Introduction

In the genus *Carex*, many interspecific and intraspecific aneuploids have been reported (Heilborn 1924, 1928, 1939; Tanaka 1939, 1948, 1949; Wahl 1940; Davies 1956; Faulkner 1972; Hoshino 1981, 1992; Schmid 1982; Cayouette and Morisset 1985, 1986a, b; and Whitkus 1991). Consecutive chromosome numbers, 2n=12 to 2n=112, were found. Although chromosome numbers were determined in many species, few individuals per population were studied. Particularly, cytological studies on high-chromosome-numbered species were few because the chromosome length of these taxa was below 1.0 μm. More than half of *Carex* species had over 60 chromosomes. Accurate chromosome observations of high-numbered taxa were considered important in understanding the origin of aneuploidy in *Carex*.

Carex duvaliana Franch. et Savat. is common along forest edges and roadsides, and is distributed from Honshu to Shikoku and Kyushu Regions of Japan (Akiyama 1955). Primary cytological studies were conducted by Tanaka (1940, 1948), who reported four intraspecific aneuploids, 2n=75, 76, 77 and 78, in 11 individuals collected from six areas in the Kanto Region on Honshu.

This paper presents the chromosome numbers and the meiotic chromosome configurations of *Carex duvaliana* collected from six localities in the Chugoku Region on Honshu.

Materials and Methods

Materials for chromosome observations conducted on 60 individuals were collected from six localities in Okayama and Hiroshima Prefectures. Cytological observations were made on living materials collected in the field and cultivated in the greenhouse of the Okayama University of Science. Staminate spikes were fixed when they had almost emerged from the leaf sheaths. Chromosome number determinations for each individual were based on counts of at least 30

pollen mother cells. Details on fixation and cytological methods were given in Hoshino (1992). Appendix enumerates voucher specimens 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 60 individuals coming from six different localities, giving four different chromosome numbers: 2n=74, 76, 77 and 78 (Table 1). Three of these numbers were reported by Tanaka (1948), 2n=74 being new for *Carex duvaliana*. Different chromosome numbers were found in the same localities, except in two places where only one individual was studied. Thirty-three plants were 2n=76, 17 were 2n=77, eight were 2n=78, and two were 2n=74.

Table 1 gives the meiotic chromosome configurations. Each individual shows several patterns of meiotic association in metaphase I. The 2n=74 plants had two trivalents and thirty four bivalents (Fig. 1A). Meiotic chromosome configurations of 2n=76 were grouped into three types. The first type, the meiotic division was regular and only bivalent chromosomes were observed. It was the most common, having been found in 24 plants (Fig. 1B). The second type, consisted of trivalents, bivalents and univalents. Although there were several configuration patterns in this type,

Table 1. Meiotic chromosome configurations of *Carex duvaliana*

Chromosome number (2n)	Configuration	No. of plants observed (%*)
Yusu, Mitsu-cho, Okayama Prefecture		
76	2IV +34II	1(2.9)
	IV +36II	(34.3)
	38II	(62.8)
76	IV +36II	1(63.6)
	38II	(36.4)
76	IV +36II	1
76	2III +35II	1(4.2)
	38II	(95.8)
76	38II	7
76	38II	1(95.0)
	37II+2I	(5.0)
77	III +37II	1(95.5)
	III +36II+2I	(4.5)
77	III +37II	2
77	III +37II	1(81.0)
	38II+ I	(19.0)
77	38II+ I	2
78	2III +36II	1
78	III +37II+ I	1(85.2)
	39II	(3.7)
	38II+2I	(11.1)
Nabeyagawa-damu, Mitsu-cho, Okayama Prefecture		
76	38II	2
77	III +37II	1
78	2III +36II	1(73.6)
	III +37II+ I	(18.9)
	39II	(7.5)
78	2III +36II	1
Hara, Okayama-shi, Okayama Prefecture		
74	2III +34II	2
76	2III +35II	1(20.0)
	III +36II+ I	(80.0)
76	2III +35II	1(2.0)
	38II	(98.0)
76	38II	9
77	3III +34II	1(16.7)
	38II+ I	(83.3)
77	2III +35II+ I	1(16.7)
	III +36II+2I	(16.7)
	III +37II	(16.7)
	38II + I	(49.9)
77	38II+ I	1
Futamatase, Bitchu-cho, Okayama Prefecture		
76	38II	1
Aotaki, Yuki-cho, Hiroshima Prefecture		
76	2III +34II+2I	1(25.0)
	38II	(75.0)
76	III +36II+ I	1(3.5)
	38II	(93.0)
	37II+2I	(3.5)
76	38II	5
77	III +37II	1(22.2)
	38II+ I	(77.8)
77	III +37II	5
77	38II+ I	1
78	III +37II+ I	1
78	39II	2
Innoshima Island, Hiroshima Prefecture		
78	2IV +35II	1(37.5)
	IV +37II	(62.5)

*Percentage of configuration types with more than one pattern.

plants with 2n=76=38II were most frequently noted. From one to two trivalent chromosomes were found, and they were all heteromorphic. The third type, consisted of one or two heteromorphic chain quadrivalents were observed. Two plants in this type collected from Yusu, Mitsu-cho, Okayama Prefec-

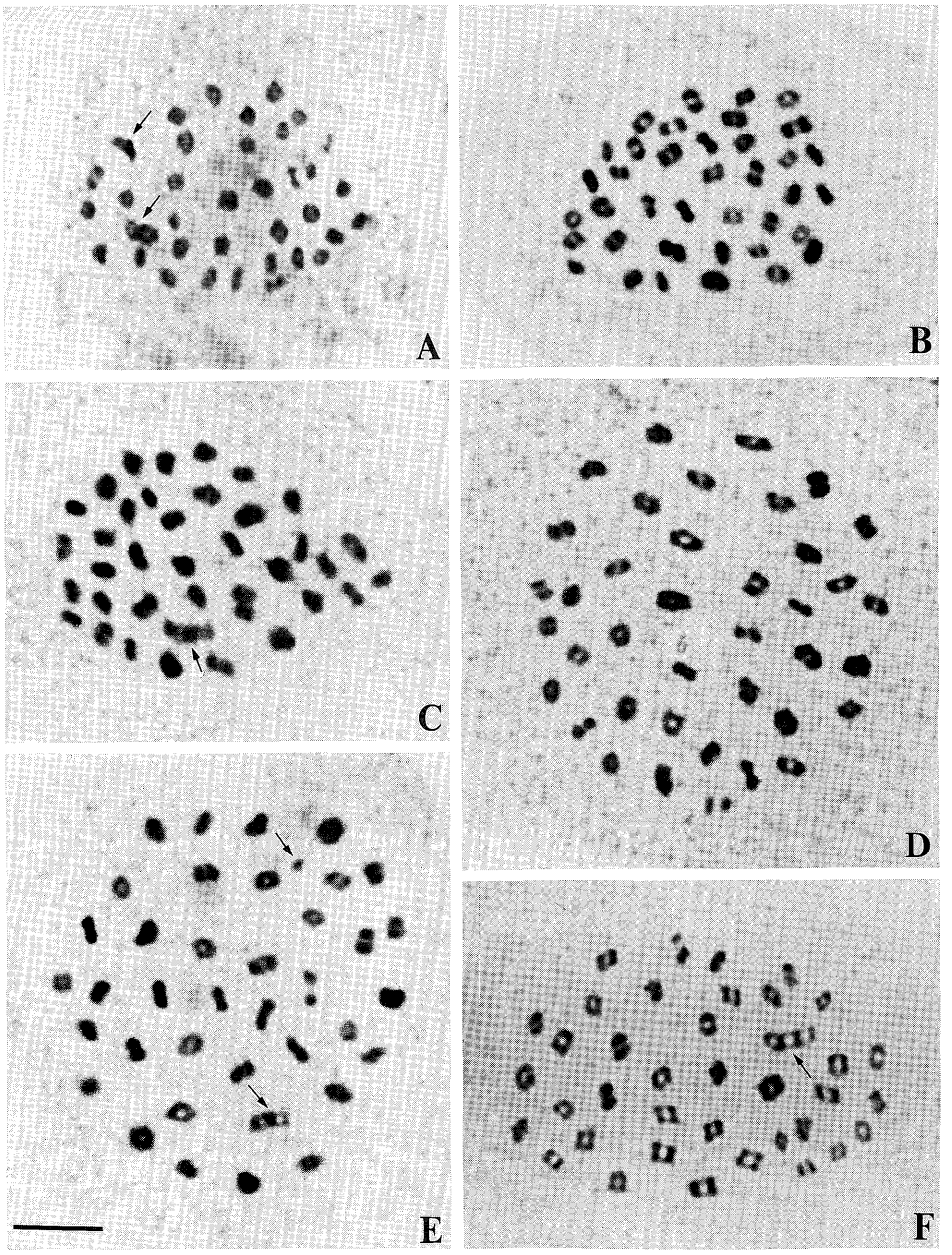

Fig. 1. Meiotic metaphase I chromosomes of *Carex duvaliana*. A: 2n=74 (2III+34II). Arrows indicate the heteromorphic trivalent chromosomes. B: 2n=76 (38II). C: 2n=77 (III+37II). Arrow indicates a trivalent. D: 2n=78 (39II). E: 2n=78 (III+37II+I). Arrows indicate a trivalent and univalent. F: 2n=78 (IV+37II). Arrow indicates a quadrivalent. Bar=5 μm for all figures.

ture, showed several patterns of meiotic configuration. Normal configurations with 38 bivalents were also found. Seventeen plants had 2n=77, and one to three heteromorphic trivalents were found in 13 individuals (Fig. 1C). One or two univalents which were thought to have originated from desynapsis of trivalents or bivalents, were also observed in these aneuploids. Eight plants had 2n=78. Two plants showed 39II (Fig. 1D), and the other six had heteromorphic multivalents or univalent chromosomes (Fig. 1E). Two plants from Innoshima Island, Hiroshima Prefecture, had one or two heteromorphic quadrivalents (Fig. 1F).

From these observations, 2n=76 plants were most common in Okayama and Hiroshima Prefectures and showed normal meiotic association in meiotic metaphase I in over 90 percent of PMC cells. Other three aneuploids, 2n=74, 77, 78, were few and showed disturbed meiosis. Tanaka (1948) reported that these multivalent chromosomes in *Carex duvaliana* originated from chromosome duplication. However, because of the high frequency of heteromorphic chain trivalents observed in this study, these aneuploidy may have resulted from chromosome fusion or fission as demonstrated by Davies (1956), Faulkner (1972), and Cayouette and Morisset (1986a, b). The occurrence of one or two heteromorphic quadrivalents in 2n=76 and 78 plants, suggested that it could have resulted from translocation rather than from chromosome duplication.

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Appendix

Enumeration of voucher specimens

Nabeyagawa-damu, Mitsu-cho (Okayama), 180 m alt., 4167, 4184, 2n=76; 4193, 2n=77; 4173, 4176, 2n=78: Yusu, Mitsu-cho (Okayama), 40 m alt., 1709, 1715, 1723, 1733, 1785, 1791, 4147, 4153, 4158, 4161, 5966, 5971, 2n=76; 1717, 1749, 1775, 4148, 4155, 5968, 2n=77; 1713, 1734, 2n=78: Hara, Okayama-shi (Okayama), 50 m alt., 5939, 5942, 2n=74; 8162, 8163, 4198, 4199, 4203, 4211, 5934, 5941, 5949, 5953, 5956, 2n=76; 8164, 8165, 4213, 2n=77: Futamatase, Bitchu-cho (Okayama), 140 m alt., 5783, 2n=76: Aotaki, Yuki-cho (Hiroshima), 340 m alt., 1965, 1999, 4504, 4505, 5757, 5762, 5765, 2n=76; 8166, 1995, 1998, 4512, 5766, 5778, 5834, 2n=77; 1951, 1983, 4506, 2n=78: Innoshima Island, (Hiroshima), 10 m alt., 8167, 2n=78.

星野卓二，鬼松　文：**ケ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6場所で採集したケスゲ（*Carex duvaliana*）60株の減数分裂第1分裂中期染色体の分析を行った．2n＝74，76，77，78の4種類の種内異数体が観察された．また，同一場所において，異なった染色体を持つ株が混在することがわかった．2n＝76の出現率が最も高く，この異数体では38個のII価染色体を持つ正常な対合型が最も多く観察されたが，IV価，III価やI価も見られた．これら多価染色体が，減数分裂第1分裂中期において全て異型対合をしていることから，本種でみられる種内異数体は染色体の融合または切断などの構造変化により生じたものと考えられる．