Cytogeographical Study of Four Aneuploids of
Carex oxyandra Kudo in Japan

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Chromosome numbers were determined for 342 clones of Carex oxyandra collected from 35 localities in Hokkaido, Honshu, Shikoku and Kyushu, Japan. Four intraspecific aneuploids, \(2n = 18, 20, 24\) and 26, were found. In meiotic division, only bivalent chromosomes were observed in all clones at metaphases I and II, suggesting that the aneuploids are established gamodemes. In the mitotic metaphase chromosomes, trimodal variation in chromosome length was observed. The \(2n = 26\) clones found on Mt. Hiko had two particularly small chromosomes. The cytodemes with higher number of chromosomes are distributed in more southern areas of Japan. Carex oxyandra, therefore, accompanied with chromosome fragmentations, might spread the geographical distribution to the southern parts. The morphological characters of leaves, spikes, scales, perigynia and nuts were similar among the four cytodemes, except for the small leaves on plants from Yaku Island.

Key words: Carex oxyandra — Geographical distribution — Intraspecific aneuploid — Chromosome fragmentation

Carex oxyandra Kudo is distributed from Sakhalin and the Kuril islands to Mt. Yu Shan of Taiwan (Akiyama, 1955). It is widely distributed throughout Japan and is an important species of highlands vegetations. In Sakhalin and the northern parts of Hokkaido, it is found from low to high elevations, but in Honshu, it grows only in mountainous areas above 1,000 m elevation. In Shikoku and Kyushu, it occurs only in the volcanic regions (Akiyama, 1955).

Primary cytological studies of Carex oxyandra were conducted by Tanaka (1948, 1949), who reported two kinds of aneuploids \((2n = 18\) and \(2n = 20\)) from central Honshu. Furthermore, four kinds of aneuploids \((2n = 18, 20, 24, 26)\), collected from central and western Honshu and Shikoku were previously observed (Hoshino, 1981a, b). The mitotic metaphase chromosomes were grouped by size into large, medium, and small. With an increase in chromosome numbers, large chromosomes decreased in number, and small chromosomes increased. Only bivalent chromosomes were observed in these four aneuploids, and there were no irregular divisions in anaphases I and II. These studies indicate that Carex oxyandra may be divided into four cytodemes in Japan.

Tanaka (1948) reported intraspecific aneuploids in about 80 Japanese species of Carex, and Faulkner (1972) observed intraspecific aneuploids in nine species from
northwest Europe. Intraspecific aneuploids were also found in eight species from North America (Cayouette and Morisset, 1985; Cayouette, 1986a, b; Whitkus, 1991). Although there are many kinds of intraspecific aneuploids in Carex, few karyomorphological and geographical studies exist. This paper describes the cytogeographical distribution of C. oxyandra in Japan and shows the relation between cytodemes and morphological characters.

Materials and Methods

Cytological observations were conducted on living plants collected in the field and cultivated in the greenhouse or experimental garden of the Okayama University of Science. When collecting the materials, clones were selected from plants at least 10 m apart. Table 1 gives the localities studied and the chromosome numbers. Appendix 1 enumerates voucher specimens, which are deposited in the Herbarium of the Biological Laboratory of Okayama University of Science (OKAY).

Somatic chromosomes were observed in the meristematic cells of root tips. The root tips were pretreated in a 0.002 M 8-hydroxyquinoline solution for 4 hr at 20°C. Then, they were fixed in a 3 : 1 mixture of absolute ethanol and glacial acetic acid at 5°C for over 1 hr, and stained by a Feulgens nuclear reaction. Following the reaction, they were macerated in a mixture of each 1% of pectinase and cellulase for 1 hr at 30°C. After the maceration, they were stained in 1% aceto-orcein for 10-20 min and then softly squashed.

Meiotic chromosomes were observed in the pollen mother cells. Staminate spikelets were fixed in a 3 : 1 mixture of absolute ethanol and glacial acetic acid at 5°C for over 1 hr. Anthers were then stained in 1% aceto-orcein and softly squashed.

Results

Cytological studies were made on 342 clones collected from 35 localities in Japan. Four kinds of aneuploids (2n = 18, 20, 24, 26) were observed, and the results confirmed the same chromosome numbers reported by Tanaka (1948) and Hoshino (1981a, b).

The mitotic metaphase chromosomes were grouped by size into large (L), medium (M), and small (S). L chromosomes are over 2.0 μm in length, M chromosomes are from 1.5 μm to 2.0 μm, and S chromosomes are below 1.5 μm. The cytodemes with the lowest number of chromosomes, 2n = 18, were found in 120 clones collected from 14 localities in Hokkaido and northern and central Honshu. Mitotic metaphase chromosomes varied in length from 1.0 μm to 2.8 μm, and the karyotype formula was 2n = 18 = 8L + 6M + 4S (Fig. 1A).

The 2n = 20 cytodemes were found in 80 clones collected from 11 localities in central and western Honshu. In Tochigi, Gunma, and Nagano Prefectures, both 2n = 18 and 2n = 20 clones were found. Mitotic metaphase chromosomes of the 2n = 20 clones varied in length from 1.1 μm to 2.6 μm, and the karyotype formula was 2n = 20 = 4L + 10M + 6S (Fig. 1B). Carex oxyandra had never been collected in the Chugo-