

Yoshikane Iwatsubo, Takeshi Orikawa and Hidenari Himi: Chromosome constitutions of *Rumex acetosa* with hermaphrodite and staminate flowers

Rumex acetosa L. (Polygonaceae) is a dioecious plant with sex chromosomes (Kiraha and Ono 1923a, 1923b): those with pistillate flowers (female plants) have 14 chromosomes comprising two X chromosomes and 12 autosomes expressed as a karyotype formulae of $2n = 14 = 12A+XX$. Meanwhile, those with staminate flowers (male plants) have 15 chromosomes comprising one X chromosome, two Y chromosomes distinguishable by length (longer and shorter chromosomes denoted as Y_1 and Y_2 , respectively), and 12 autosomes expressed as a karyotype formulae of $2n = 15 = 12A+X+Y_1Y_2$. In the wild, however, a few plants have both hermaphrodite and staminate flowers, and a small number of the hermaphrodite flowers produce fruits with mature seeds (Fig. 1). This paper reports on the variation in chromosome constitutions of *R. acetosa* plants with both hermaphrodite and staminate flowers.



Fig. 1. Male (top) and hermaphrodite (lower) flowers of a plant of *Rumex acetosa* with $2n = 22 = 18 + XX + Y_1Y_2$.

Materials and methods

In total, 32 individuals of *R. acetosa* with both staminate and hermaphrodite flowers grown on the bank along the Joganji River (Mukaishinjomachi, Toyama City, Toyama Prefecture, central Japan) were collected. Plants were maintained in an experimental garden at the Faculty of Science, University of Toyama. Cultivation was continued until the plants flowered the following year and we confirmed that they had both hermaphrodite and staminate flowers.

Chromosome constitutions were determined using meristem cells of root tips. Newly formed root tips collected from potted plants were pretreated in 2 mM 8-hydroxyquinoline at room temperature (ca. 25°C) for 1 h, and then incubated at ca. 5°C for 15 h. Following this, each of the root tips was fixed with a mixture of glacial acetic acid and ethyl alcohol (1:3) for 1 h, soaked in 1N HCl at room temperature for a few hours, macerated in 1N HCl at 60°C for 10 minutes, washed in tap water, and stained in a drop of 1.5% lacto-propionic orcein on a slide glass. A common squash technique was used for preparation.

Results and Discussion

All 32 individuals of *R. acetosa* we examined were equally triploid plants with 22 chromosomes. Chromosome constitution for all plants was uniformly represented as $2n = 22 = 18+XX+Y_1Y_2$ (Fig. 2, Table 1).

The karyotype of normal *R. acetosa* from the Toyama prefectural area is known to be polymorphic in the autosome complements for the absence and existence of a supernumerary segment (SS) in A5 and A6 chromosomes (Iwatsubo 2014). These triploid plants were also polymorphic in the number of A5 and A6 chromosomes with SS (SS5 and SS6, respectively). As shown in Table 1, the number of SS5 chromosomes ranged from 0 to 2 and the number of SS6 chromosomes from 0 to 3 in the plants examined, and 20.8% of A5 chromosome and 51.0% of A6 chromosome had a SS in the triploid plants examined.

In normal diploid *R. acetosa* occurred in Toyama Prefecture, the mean frequency of SS5 chromosome is 24.5% and that of SS6 is 47.7% (Iwatsubo 2014). The frequencies of SS5 chromosome in A5 chromosomes and SS6 chromosome in A6 chromosomes were similar between normal diploid plants and triploid plants with $2n = 22 = 18 + XX + Y_1Y_2$.

Typically, triploid *R. acetosa* exhibits chromosome constitutions of either $2n = 21 = 18+3X$ (Ono and Shimotomai 1928; Ono 1928, 1930, 1932; Ono 1935; Kuroki 1976; Iwatsubo 2014) or $2n = 22 = 18+2X+Y_1Y_2$ (Ono and Shimotomai 1928; Ono 1928, 1930, 1932; Kihara and Yamamoto 1931; Takenaka 1931; Kuroki and Kurita 1970, 1971; Kurita and Kuroki 1972; Kuroki 1976; Iwatsubo 2014). The former triploid plant is known to have female flowers, while the latter has both staminate and hermaphrodite flowers (Ono and Shimotomai 1928; Ono 1928, 1930, 1932, 1935; Kihara and Yamamoto 1931; Takenaka 1931; Ono 1935; Kuroki and Kurita 1970, 1971; Kurita and Kuroki 1972; Kuroki 1976). The examined plants with both hermaphrodite and staminate flowers all showed chromosomal constitutions of $2n = 22 = 18+2X+Y_1Y_2$, consistent with earlier reports. This study indicates that the supernumerary segment of A5 and A6 chromosomes does not affect sexual expression also in triploid *R. acetosa*, as known the numbers of A5 and A6 chromosomes with a supernumerary segment does not affect sexual expression in diploid *R. acetosa* (Iwatsubo 2014).

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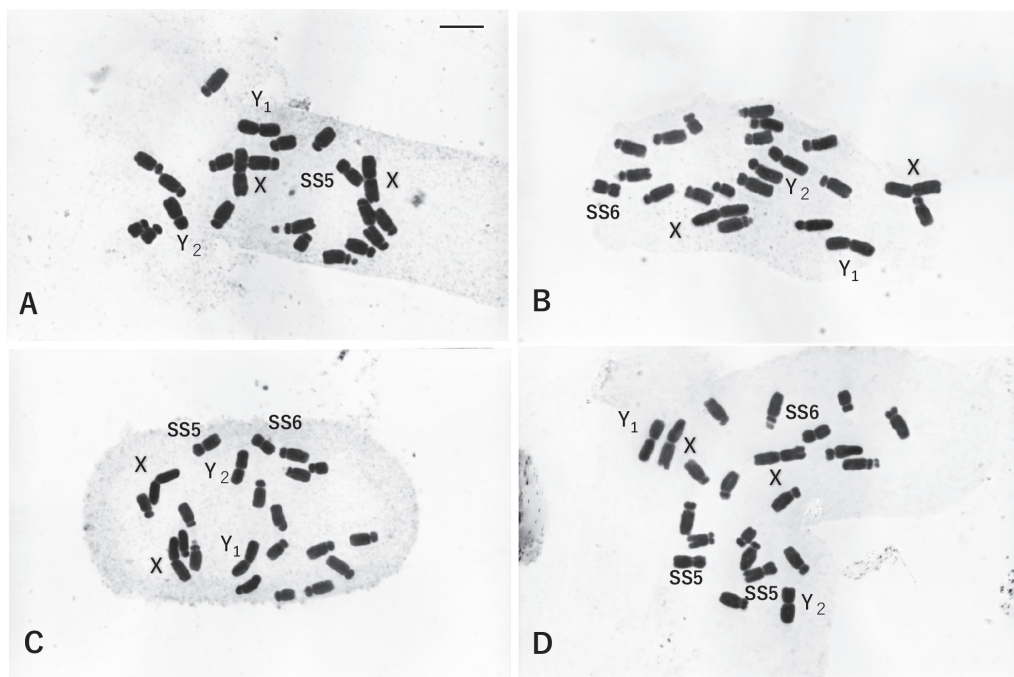


Fig. 2. Four forms of somatic metaphase chromosomes of *Rumex acetosa* with $2n = 22 = 18 + XX + Y_1Y_2$. A: one SS5, B: one SS6, C: one SS5 and one SS6, D: two SS5 and one SS6. Bar = 5 μ m.

岩坪美兼・折川武司・氷見栄成：両性花と雄花がともに咲くスイバ *Rumex acetosa* の染色体構成

雌雄異株のスイバには両全花が咲き、一部の両全花には果実が稔る個体が時々存在する。富山県の中央部を流れる常願寺川沿いで集めた両全花が咲き果実が稔っていた32株について染色体を調べたところ、すべて $2n = 22 = 18+2X+ Y_1Y_2$ の三倍体であった。富山県内の二倍体スイバでは第5常染色体 (A5) と第6染色体 (A6) に過剰分節 (SS) が存在する染色体と存在しない染色体の2型が知られているが、観察した三倍体スイバの第5常染色体の20.8% および第6常染色体の51.0% に過剰分節 (SS) が存在しており、富山県内の二倍体スイバの平均 24.5% および47.7% (Iwatusbo 2014) とほぼ近い割合であった。

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