

Rumex acetosa (Polygonaceae) with a curious heteromorphic karyotype

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Yoshikane Iwatsubo: *Rumex acetosa* (Polygonaceae) with a curious heteromorphic karyotype

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Rumex acetosa (Polygonaceae) is a well known dioecious perennial plant with sex chromosomes $2n = 14 = 12 + 2X$ in plants with pistillate flowers (female plants) and $2n = 15 = 12 + 1X + 2Y$ in plants with staminate flowers (male plants) (Kihara and Ono 1923a, 1923b, 1925). In plants occurring in Japan, chromosome mutants were documented for the first time by Yamamoto (1935, 1937, 1938), followed by Kurita and Kuroki (1971) and Kuroki (1994). Several forms of chromosome mutants were also identified in *R. acetosa* populations on Skomer Island, off the coast of Wales in England (Wilby and Parker 1988).

In my investigations of chromosome variations of *R. acetosa* growing in various parts of Japan, I have come across many chromosome mutants in various regions throughout the distribution area in Japan. The present report provides documentation of a mutant with a heteromorphic karyotype of *R. acetosa* collected along the roadside in Kurosaki, Kaga City (Ishikawa Prefecture).

Materials and methods

A male plant of *R. acetosa* was cultivated in a plastic pot at the experimental garden of University of Toyama after collecting. An actively growing root tip that had sprouted from this plant was used for the karyotype study. The root tip was pretreated in a 1.9 mM 8-hydroxyquinoline solution at room temperature for one hour, and then kept at 5°C for 15 hours. After being fixed in a mixture of glacial acetic acid and absolute ethyl alcohol (1:3) at room temperature for one hour, the root tip was macerated in 1N hydrochloric acid at 60°C for ten minutes, and then washed in tap water. The root tip was stained and squashed in 1% lacto-propionic orcein. A cell with fully spread metaphase chromosomes was used for the study. Chromosome form was presented according to the nomenclature of Levan et al. (1964).

Results and discussion

Plant investigated herein had 15 chromosomes: an X chromosome, two Y chromosomes and 12 autosomes in somatic cells (Fig. 1); this

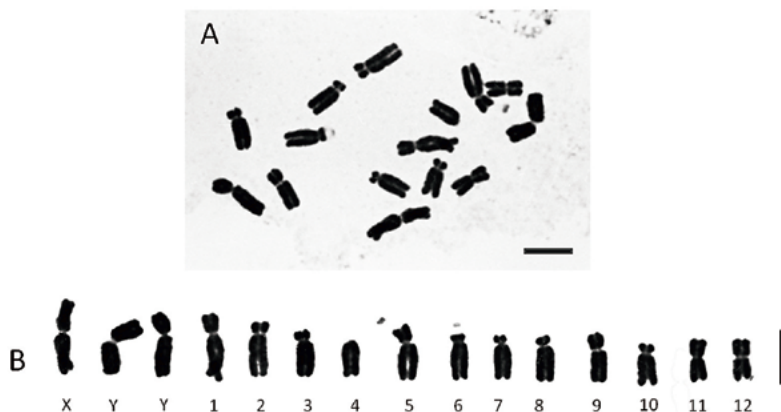


Fig. 1. Somatic metaphase chromosomes (A) and karyogram (B). Bars indicate 5 μ m.

is the same chromosome constitution as a normal male plant of this species. Of the 12 autosomes of this plant, one A5 chromosome (Fig. 1, No. 9) and two A6 chromosomes (Fig. 1, Nos. 11 and 12) had supernumerary segments composed of heterochromatin (Kuroki 1976, 1987, Yonezawa et al. 1978). In plants of *R. acetosa*, the X chromosome has two arms of nearly the same length (3.6 μm and 3.7 μm) (Iwatsubo 2014). However, in the X chromosome of this plant, one arm was 0.7 μm shorter, while the long arm was the same length of that typically observed in *R. acetosa*.

In normal male plants of *R. acetosa*, the two Y chromosomes differ in length (Kihara and Ono 1923a, 1923b); and the longer one, at roughly 6.1 μm in length (Iwatsubo 2014), is denoted as the Y₁ chromosome (Ono 1926), and the shorter one, roughly 5.5 μm in length (Iwatsubo 2014), is denoted as the Y₂ chromosome (Ono 1926). However, the two Y chromosomes of this plant were of similar lengths (5.9 μm and 5.7 μm), and so the Y₁ and Y₂ chromosomes were not discriminated as such. In normal male plants the total length of two Y chromosomes is 11.6 μm ; the total length of the two Y chromosomes of this plant was also revealed as 11.6 μm . It was therefore surmised that either a 0.2 μm part of one arm was translocated

from the Y₁ chromosome to the Y₂ chromosome, or a 0.4 μm part of one arm of the Y₁ chromosome was translocated to the Y₂ chromosome.

In the autosome complement of this plant, the longest autosome (No. 1), one telocentric chromosome (No. 4), and one satellite chromosome (No. 5) had curious forms that differed from those found in normal *R. acetosa*. Compared to the normal karyotype of male plants of *R. acetosa* reported in Iwatsubo (2014), the most likely explanation for the origins of these autosomes is that a 0.7 μm part of one arm of the X chromosome is translocated to the short arm of the No. 1 autosome, and the short arm of the No. 4 autosome is translocated to the short arm of the No. 5 autosome (Fig. 1B, Table 1). In addition to the translocation between the two Y chromosomes, this plant seems to be a chromosome mutant with triple chromosomal translocations.

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Table 1. Chromosome lengths of metaphase chromosomes with a heteromorphic karyotype of male *Rumex acetosa*

Chromosomes	Short arm + Long arm (μm)	Total length (μm)	Arm ratio	Form
X	2.9 + 3.7	6.6	1.3	m
Y	2.9 + 3.0	5.9	1.0	M
Y	1.7 + 4.0	5.7	2.4	sm
A1	1.7 + 4.0	5.7	2.4	sm
A2	1.0 + 4.0	5.0	4.0	st
A3	0.8 + 3.3	4.1	4.1	st
A4	* + 3.3	3.3	∞	T
A5	t-1.4 + 3.5	4.9	2.5	sm
A6	t-0.6 + 3.5	4.1	5.8	st
A7	0.7 + 3.2	3.9	4.6	st
A8	0.7 + 3.2	3.9	4.6	st
A9 (SS5)	1.5 + 2.9	4.6	1.9	sm
A10	0.8 + 2.9	3.7	3.6	st
A11 (SS6)	1.6 + 2.0	3.6	1.3	m
A12 (SS6)	1.5 + 2.0	3.5	1.3	m

Total length and arm ratio do not include satellite.

t: satellite

*: scanty short arm

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- 岩坪美兼：異型対をもつスイバの核型**
- スイバの染色体構造変化個体は、日本では Yamamoto (1935, 1937, 1938), Kurita and Kuroki (1971), Kuroki (1994) により、イギリスでは Wilby and Parker (1988) により報告されている。今回、3カ所で転座が生じたと判断される核型をもつスイバ雄個体が見つかったので報告する。染色体構成は $2n = 15 = 12 + X + YY$ であった。2本のY染色体は長さが等しく、 Y_1 , Y_2 の区別はできなかった。この個体の2本のY染色体の合計長は、通常の雄個体の2本のY染色体の合計長と等しいことから、Y染色体間で転座が生じたと考えられる。X染色体の片腕は $0.7 \mu\text{m}$ 短くなっており、No. 1常染色体の短腕が $0.7 \mu\text{m}$ 長くなっていたことから、X染色体の片腕の一部がNo. 1常染色体の短腕へ転座したものと判断される。No. 4常染色体には長さ $0.8 \mu\text{m}$ の短腕が無く、No. 5常染色体の短腕が $0.8 \mu\text{m}$ 長くなっていたことから転座したものと判断される。このスイバ個体は、このように3カ所で転座が生じたと判断される核型をもっており、このような複数の転座をもつスイバは初めての発見である。
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