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Chromosome number of myoga ginger (*Zingiber mioga*: Zingiberaceae) in Korea

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ABSTRACT: The chromosome number of myoga ginger (*Zingiber mioga* (Thunb.) Roscoe: Zingiberaceae) has been reported as $2n = 22$ for Chinese plants and $2n = 55$ for Japanese plants. We checked the chromosome number of *Z. mioga* in plants collected in Jeollabuk-do and Jeollanam-do, Korea, and counted $2n = 44$, the first report of this number for the species. As the basic chromosome number of *Z. mioga* is thought to be $x = 11$, *Z. mioga* plants in China, Korea, and Japan appear to be diploids, tetraploids, and pentaploids, respectively. In finding the tetraploid race of *Z. mioga* in Korea, we can hypothesize that the pentaploid race in Japan is derived through the fertilization of reduced gametes of the diploid race and unreduced gametes of the tetraploid race.

Keywords: chromosome number, edible plant, Korea, myoga ginger, tetraploid, *Zingiber mioga*, Zingiberaceae

Myoga ginger (*Zingiber mioga* (Thunb.) Roscoe: Zingiberaceae) is a perennial herb, native to tropical Asia (Makino et al., 1961). It is cultivated for its edible flowers (inflorescences) in Japan and edible and medicinal use in China (Wu and Larsen, 2000; Ohba 2016). In Korea, however, it is only occasionally cultivated, and naturalized, mainly on the southern peninsula and on Jeju Island (Lee, 1996, 2006; Jung et al., 2016; Korea National Arboretum, 2016; Kim and Kil, 2016).

The chromosome number of *Z. mioga* has been reported to be $2n = 55$ in Japanese plants (Morinaga et al., 1929; Takenaka, 1932; Sato, 1960; Suzuka and Mitsuoka, 1968) while $2n = 22$ has been reported for the species in China (Chen et al., 1982). As the basic chromosome number of *Z. mioga* may be $x = 11$, the plants in Japan are pentaploids, while those in China are diploids. We were therefore intrigued to know the ploidy level of *Z. mioga* in Korea, an area between the diploid and pentaploid races.

Materials and Methods

We collected plants of *Z. mioga* at two localities in Korea and transplanted them to the nurseries of the Korea Research Institute of Bioscience & Biotechnology (Daejeon, Korea) and to the University of Tokyo (Tokyo, Japan) to be used for cytological investigation (Table 1).

Root tips were pretreated with a 2 mM 8-hydroxyquinoline solution at 20°C for 1 h and consequently at 4°C for 15 h before being fixed with Newcomer's fluid (see Sharma and Sharma, 1980). Fixed root tips were macerated in 1 N HCl for 10 min at 60°C. After washing with distilled water, they were stained with 2% lacto-propionic orcein. Slide preparations were made by the conventional squash method.

Results and Discussion

The chromosomes of *Z. mioga* in Korea were counted as

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Table 1. List of voucher specimens for this study.

Locality	Collection no. (Herbarium)
Korea. Jeollabuk-do, Jeonju-si, Haksan Mt.	*B.-M. Nam 200926ZM01* (KRIB)
Korea. Jeollanam-do, Muan-gun, Mongtan-myeon, Dalsan-ri, Beopcheon-sa Temple	*H. Ikeda 18101801* (TI)

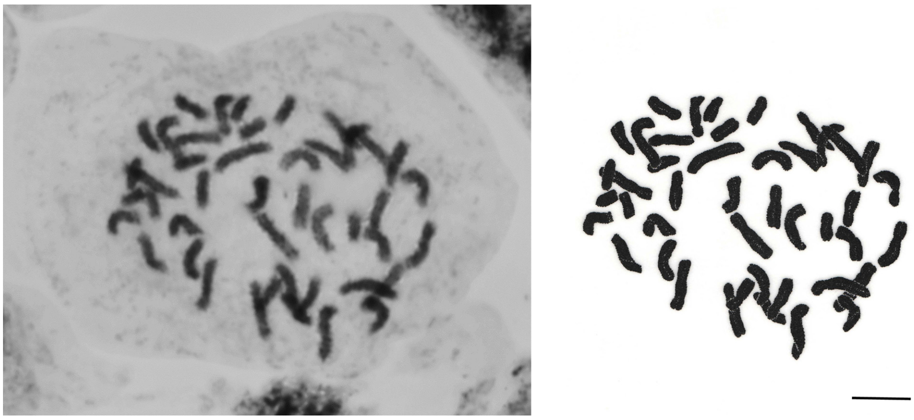

Fig. 1. Photomicrograph (left) and drawing (right) of somatic chromosomes of *Zingiber mioga* from Korea (2*n* = 44). Scale bar = 5 μm.

2*n* = 44 (Fig. 1). Counts of 2*n* = 22 (Chen et al., 1982) and 2*n* = 55 (Morinaga et al., 1929; Takenaka, 1932; Sato 1960; Suzuka and Mitsuoka, 1968) have been reported for *Z mioga*. The report of 2*n* = 44 is therefore the first for this species. As the basic chromosome number of *Z. mioga* is thought to be *x* = 11, 2*n* = 44 for *Z. mioga* in Korea may be a tetraploid.

Polyploidization plays an important role in the diversification of plants (Grant, 1981; Soltis and Soltis, 2009; Soltis et al., 2009), and also impacts crop domestication and establishment of important agronomic traits (Hancock, 2005; Renny-Byfield and Wendel, 2014; Zhang et al., 2019). Therefore, *Z. mioga* is thought to have been improved through polyploidization from the diploid race in China to a pentaploid race in Japan. It has been difficult, however, to explain the process of establishment of pentaploids directly from diploids, since additional steps are needed in the polyploidization process. In finding the tetraploid race of *Z. mioga* in Korea, we can hypothesize that the pentaploid race is derived through fertilization of reduced gametes of the diploid race and unreduced gametes of the tetraploid race. Although it is just a hypothesis, we may be able to clarify the process of the establishment of the pentaploid race of *Z. mioga* through further cytological and molecular investigations of these cytotypes.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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