Ophiopogon japonicus (L.f.) Ker Gawl. (Asparagaceae), indigenous to China, Taiwan, Korea, and Japan is a perennial evergreen plant cultivated for medicinal use or as an ornamental garden plant in Japan. Reported chromosome numbers for this species include 2n = 36 (Satô 1942), 67 (Nagamatsu and Noda 1971), 68 (Nagamatsu and Noda 1971; Liang et al. 1998), 70 (Yamashita and Tamura 2001) and 72 chromosomes (Satô 1942; Inuma 1949; Sharma and Chaudhuri 1964; Hasegawa 1968; Hsu 1971; Yang et al. 1990; Yamashita and Tamura 2001). The basic chromosome number for this genus is believed to be x = 18 (Darlington and Wylie 1955). Of the five somatic chromosome numbers reported in this taxon, the chromosome count 2n = 36 was reported only once from a cultivated plant in the Nikko Botanical Garden in Japan. This plant is inferred to be a diploid plant. Those with 2n = 67, 68 and 70 chromosomes are all considered hypo-tetraploid plants, and that with 2n = 72 chromosomes is considered tetraploid.

The present study aimed to clarify which of the five chromosome forms found in O. japonicus are cultivated in Toyama Prefecture, located on the Japan Sea side of central Honshu, Japan.

Materials and methods

We used 82 cultivated ornamental plants of O. japonicus collected widely from temples, shrines, public parks and private houses in Toyama Prefecture (Table 1). Following collection, each plant was grown in a plastic pot at the experimental garden of the University of Toyama. Chromosome counts were examined in meristematic cells of the root tips with fully spread metaphase chromosomes.

Newly-formed root tips collected from potted plants were pretreated in 2.1mM 8-hydroxyquinoline solution at room temperature (about 25°C) for 1 to 1.5 h. and then kept at ca. 5°C for 15 h. These root tips were fixed in a mixture of glacial acetic acid and absolute ethyl alcohol (1:3) at room temperature for 1 h, macerated in 1N hydrochloric acid at 60°C for 10 minutes, and then washed in tap water. Root tip meristems were stained in a drop of 1.5% lacto-propionic orcein on a glass slide, and prepared using a common squash technique. Voucher specimens of the plants examined have been deposited in the Toyama Science Museum (TOYA).

Results and discussion

The O. japonicus examined in the present study showed chromosome numbers of 2n = 67 and 68 chromosomes (Table 1). Of the 82 plants collected from 26 sites in Toyama Prefecture, 77 plants (94%) had 2n = 68 chromosomes (Fig. 1A) and 5 plants (6%) from 3 sites had 2n = 67 chromosomes (Fig. 1B). This study showed that two chromosome forms of O. japonicus were cultivated in the studied area.

Nagamatsu and Noda (1971) reported that cultivated O. japonicus collected from the Tokyo metropolitan area and Kanagawa, Gifu,
Table 1. Chromosome numbers and collection sites of cultivated *Ophiopogon japonicus* in Toyama Prefecture

<table>
<thead>
<tr>
<th>Chromosome number</th>
<th>Cultivated place</th>
<th>No. of individuals examined</th>
<th>Collection locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>2n = 67</td>
<td>Temple / Shrine</td>
<td>3</td>
<td>Inami, Nanto City</td>
</tr>
<tr>
<td></td>
<td>Public garden</td>
<td>1</td>
<td>Kanayamachi, Takaoka City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>Kamikoizumi, Namerikawa City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Bakurohouhonmachi, Takaoka City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>Kanayamachi, Takaoka City</td>
</tr>
<tr>
<td></td>
<td>Private house</td>
<td>1</td>
<td>Miyukimachi, Takaoka City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Toide, Takaoka City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9</td>
<td>Daimon, Imizu City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>Taikouyama, Imizu City</td>
</tr>
<tr>
<td>2n = 68</td>
<td></td>
<td>5</td>
<td>Inami, Nanto City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>Fukuno, Nanto City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Ishimaru, Tonami City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Izumicho, Oyabe City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>Yatsuomachi-mita, Toyama City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>Kamifutasugi, Toyama City</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>Oojima, Namerikawa City</td>
</tr>
<tr>
<td>Temple / Shrine</td>
<td>1</td>
<td>Bakurohouhonmachi, Takaoka City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Yokotahonmachi, Takaoka City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Toide, Takaoka City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Daimon, Imizu City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Taikouyama, Imizu City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Yatsuomachi-mita, Toyama City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Kamifutasugi, Toyama City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Oojima, Namerikawa City</td>
<td></td>
</tr>
<tr>
<td>Public garden</td>
<td>1</td>
<td>Takiouyama, Imizu City</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Kitadai, Toyama City</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 1. Photographs of somatic metaphase chromosomes of two chromosome forms of cultivated *Ophiopogon japonicus*. A: 2n = 67, B: 2n = 68. Arrows indicate secondary constrictions. Bar represents 5 μm.
Ishikawa, Shiga, Osaka, Nara and Wakayama
Prefectures in Honshu; and that from Fukuoka,
Saga, and Kumamoto Prefectures in Kyushu,
Japan, all had 2n = 67 chromosomes. The pres-
ent study, however, found that the majority of
cultivated *O. japonicus* in Toyama Prefecture
has 2n = 68 chromosomes, with a mere 6% of
examined plants having 2n = 67 chromosomes.

Our results and the previous report of Naga-
matsu and Noda (1971) demonstrate that, out
of the chromosome forms of *O. japonicus*
with 2n = 36, 67, 68, 70 and 72 in Japan, the forms
with primarily 2n = 68 and rarely 2n = 67 are
cultivated in Toyama Prefecture.

The difference in chromosome form between
the cultivated *O. japonicus* from Toyama Pre-
fecture examined in the present study and that
reported by Nagamatsu and Noda (1971) is un-
clear. Toyama Prefecture is situated on the Ja-
pan Sea side of central Honshu, and this area
has more snowfall than the majority of areas
where *O. japonicus* was collected by Nagamatsu
and Noda (1971).

References

Darlington D. C. and Wylie A. P. 1955. Chro-

Hasegawa, K. M. 1968. Cytotaxonomic studies
on the genera *Liriope* and *Ophiopogon* in Ja-

Hsu, C-C. 1971. Preliminary chromosome stud-
ies on the vascular plants of Taiwan (IV).
Counts and systematic notes on some mono-
cotyledons. Taiwania 16: 123–133.

Liang, G.-L., Yang, M.-Q. and Yan, Y. 1998.
Karyotypical analysis of *Ophiopogon japoni-
cus* in Sichuan. J. South W. Agric. Univ.

hypotetraploids in *Ophiopogon japonicus* and

Oinuma, T. 1949. Further studies on chromo-

Satô, D. 1942. Karyotype alteration and phy-
logeny in Liliaceae and allied families. Japan-

Sharma A. K. and Chaudhuri, M. 1964. Cyto-
tological studies as an aid in assessing the
status of *Sansevieria, Ophiopogon* and *Curcu-

Yamashita, J. and Tamura, M. N. 2001. Karyo-
type analysis of six species of the genus
*Ophiopogon* (Convallariaceae–Ophiopogoneae).

Yang, Y.-P., Li, H., Liu, X.-Z. and Kondo, K.
1990. Karyotype study on the genus *Ophi-