The Chromosomes of *Pseudolarix amabilis*

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Introduction

Pseudolarix amabilis (Nels.) Rehd., or golden larch, occurs as a monotypic species, and its natural range is restricted to a limited area in the mountainous region of eastern China. Because of its handsome foliage and striking growth pattern it has been planted widely in southern and central Europe, and in various regions of the United States. *Pseudolarix* is a member of the Pinaceae, and more specifically it is classified in Rehder's Manual (1954) under the sub-family Abietineae.

The members of the Pinaceae are very uniform in their chromosome number, and with the exception of *Pseudotsuga* sp. they all possess a basic chromosome number of 12 ($n=12$). According to Miyake and Yasui (1911) who first described the cytology of *Pseudolarix*, this species has also $n=12$ chromosomes when checked in the division stages of the microspores. However, Sax and Sax (1933) reported that *Pseudolarix* has 22 chromosomes in the endosperm tissue, which would make this species unique within the Pinaceae as far as chromosome number is concerned. Of the 22 chromosomes, 20 are rod-shaped and two are V-shaped. They postulated that this condition had possibly arisen as a doubling of an aneuploid condition with the basic number as $n=12-1=11$. Hair and Beuzenberg³ checked the report by Sax and Sax because of its deviation from the more common $n=12$ found within the family to which they belong, and they secured the same idiograms (2 metacentric and 20 acrocentric pairs). In her review on the cytology of conifers, Miss De Ferré (1958) referred to yet unpublished observations by Mrs. Durrieu-Vabre who found 12 V-shaped chromosomes which break often in the region of the centromere, and mentioned that the error in interpretation by Sax and Sax was caused by this fact.

Although none of the other members of the Pinaceae differ in the basic chromosome number, polyploid individuals have been described in *Larix Kaempferi* (Chiba and Watanabe 1952), *Larix decidua* (Christiansen 1950), *Picea Abies* (Kiellander 1950), *Pinus densiflora* (Zinnai 1952), and *Pinus*

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³ Personal letter to Dr. Karl Sax (1960).

elliottii (Mergen 1958). Most of these were polyploid individuals with a basic chromosome number of 12, with only isolated instances of aneuploid conditions.

In view of the conflicting reports on the chromosome number, and because the abnormal condition was described in haploid tissue by Drs. Sax, an attempt was made to obtain metaphase plates in somatic cells that were clear enough so that the chromosomes could be counted and observed in vegetative tissue. In addition to the observations in vegetative cells, series of smears were made on dividing cells in female gametophyte tissue to verify the precise location of the attachment points for the spindle fibers.

Material and methods

The buds and root tips were collected from two six-year-old trees that had been obtained from the Arnold Arboretum, Jamaica Plains, Massachusetts, and from ten three-year-old seedlings that were received from the U. S. D. A., Northeastern Forest Experiment Station, Upper Darby, Pennsylvania. The developing cones came from a mature tree in the Yale Nursery. The smaller trees were moved into a heated greenhouse during the latter part of the winter and placed under a 14-hour-photoperiod to force the seedlings into active growth. Actively growing buds and root tips, 5 mm

Fig. 1. Photographs and diagrammatic interpretations of chromosomes during metaphase in somatic cells of *Pseudolarix amabilis*. ($\times 2000$).

long, were prepared according to the technique by Mergen and Novotny (1957), and the chromosomes were counted by drawing idiograms at an enlargement of about $2000\times$ with the aid of a camera lucida. The observations on the chromosomes in the female gametophyte cells were made on

acetocarmine smears that had been prepared with great care. Various intensities of hydrolysis were tried to prevent breakage of the chromosomes. In addition, some cells were evaluated under a phase-contrast microscope, so that the tissue had received a minimum of chemical pretreatment.

Results

The chromosome number in somatic cells was definitely established as $2n=44$, which agrees with the number of $n=22$ that was reported by Sax and Sax (1933). Two typical metaphase configurations are illustrated in Fig. 1. The striking feature of the majority of the chromosomes was the lack of median or near median centromeres that is common for members of the Pinaceae. With the exception of four chromosomes, the remaining 40 were nearly rod-shaped in appearance, and during the movement from metaphase to the telophase stages the fiber attachment points appeared to be located at the ends of the chromosomes. This condition was observed in all of the vegetative cells of the twelve trees studied, as well as in the female gametophyte tissue of the mature tree.

Discussion

There is probably a close relationship between the chromosomal evolution in *Pseudolarix* and that in the Podocarpaceae as was described by Hair and Beuzenberg (1958). Their results demonstrated a good relationship between the two common classes of chromosomes, the "V's", and "I's", where in each successive change in the basic number a "V" was replaced by two "I's". Because all the conifers have a base number of 10-12, and real polyploidy is rare if it occurs at all, it seems rational to assume that the 20 rod or "I" chromosomes in *Pseudolarix* were originally derived from the fracture at the centromere of 10 V-shaped chromosomes, rather than from the doubling of an aneuploid condition with the basic number as $n=12-1=11$. In none of the preparations was any indication that more than two, or respectively, four "V" chromosomes were present at metaphase. However, during the movement to the poles in anaphase and telophase the arrangement of the chromosomes was such that they all appeared to be "V's", which probably accounts for the diverse reports.

Because of the limited natural range of *Pseudolarix*, and the fact that it is a monotypic species, one would not expect any significant variations within the chromosome complement in various geographic regions, but rather a stable condition. It is planned to make a detailed cytological study of the chronological steps in micro- and macrosporogenesis, hoping that this might elucidate its evolutionary history.

Summary

The chromosome complement in vegetative and female gametophyte tissue of *Pseudolarix amabilis* was determined to be $n=22$, and $2n=44$. The 22 chromosomes are made up of 20 I-shaped and 4 V-shaped chromosomes. It is postulated that this condition arose from the breakage of 10 V-shaped chromosomes at the centromere from an original complement of $n=12$.

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