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CYTOLOGY OF THE NATIVE AUSTRALIAN PASSIFLORA SPECIES. 1. CHROMOSOME NUMBER AND HORTICULTURAL VALUE

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Summary

Chromosome numbers have been determined for three native Australian species of *Passiflora: P. aurantia* **Forst.,** *P. herbertiana* **Lindl. and** *P. cinnabarina* **Lindl. All have the same chromosome number (2n = 12) and are diploids with the six bivalents normally paired at metaphase I of PMC meiosis. The difference in chromosome number from that of commercial** *P. edulis* **(2n = 18) will preclude their use as parents in a breeding programme which involves this species. Their thin stems and trailing habit of growth probably make them unsuitable as rootstocks.**

I. INTRODUCTION

The genus *Passiflora* consists of some 400 species, of which all but 40 are indigenous to tropical and subtropical regions of North and South America and the West Indies. The remaining species occur in South East Asia, Islands of the Pacific and Australia (Killip 1938).

Moore (1893, p. 253) recognized the occurrence of three native *Passiflora* species in Australia as *P. aurantia, P. herbertiana* and *P. cinnabarina.* Exotic species are also found in Australia and several producing edible fruit have achieved commercial significance. The purple passion-fruit (*P. edulis*) is cultivated widely both in Australia and overseas.

Native passion-fruit with tolerance if not immunity to certain pests and diseases attacking *P. edulis* would be of potential value as rootstocks or in hybridization programmes with the commercial species. A prerequisite to a breeding programme would be compatibility between the native and the exotic species. The chromosome number and chromosome behaviour of the native species were therefore investigated.

II. MATERIALS AND METHODS

The three native species were collected from various sources (Table 1) and subsequently grown at the Redlands Horticultural Research Station. They were grown in the glasshouse in 2-gal containers and in the field over a single-wire commercial passion-fruit trellis. After 12 months' growth the stem diameters of the native species were measured. Data on stem diameter were obtained at the same time from six exotic *Passiflora* species (see Table 2) which were also grown. All measurements were made 1 ft above ground level on at least three vines.

The time of flowering was recorded and flower colour was observed in each native species. Voucher specimens for chromosome number determinations were lodged in the Queensland Herbarium.

Chromosome number determinations were made from both sporophytic tissue (root tips) and at meiosis in PMC. Root tips were taken from potted plants grown in the glasshouse or from the radicles of seeds germinated in moist sand. These were placed for 2 hr in a saturated solution of aqueous para-dichlorobenzene at 45°F. After fixation in 3:1 alcohol-acetic acid solution, maceration and staining were carried out by heating the root tips in acid aceto-orcein (Darlington and La Cour 1962, p. 157). Staining was completed after squashing the tissues between slide and coverslip in 1% aceto-orcein.

For the observation of meiosis, flower buds were fixed in alcohol-acetic acid (3:1) and stored in 70% alcohol at 45°F. Pollen mother cells (PMC) were stained in 1% aceto-orcein.

III. RESULTS AND DISCUSSION

The three native species have a somatic number $2n = 12$ with a gametic number $n = 6$ (Table 1 and Figures 1-4). They can therefore be grouped with four other *Passiflora* species—*P. capsularis, P. bryonoides, P. pulchella* and *P. suberosa*—in the $2n = 12$ category (Darlington and Wylie 1955, p. 97; Diers 1961). In contrast, all commercial horticultural *Passiflora* species so far studied (Storey 1950) are found in the $2n = 18$ group.

While a high degree of interspecific compatibility has been observed by Bailey (1935, p. 2476) in the $2n = 18$ group, interspecific hybrids are almost invariably sterile. There is even greater difficulty (Clausen 1962) in hybridizing two species differing in chromosome number. If a hybrid between *P. edulis* ($2n = 18$) and a native *Passiflora* species ($2n = 12$) could survive mitosis, there would be numerical disjunction in meiosis and inevitable sterility. As the native Australian species are only distantly related both cytologically and taxonomically to *P. edulis* (Killip 1938), they must be considered of doubtful value in a hybridization programme.

TABLE 1

CHROMOSOME NUMBERS OF NATIVE *Passiflora* SPECIES AT REDLANDS HORTICULTURAL RESEARCH STATION

Species	Source	Chromosome Number		Herbarium Number	Flowering Time	Flower Colour
		2n	n			
P. aurantia . .	Mt. Gravatt, Qd. . .	12	6	BRI 057816	October–December March–May	White flower (red corona) turns red at anthesis
P. herbertiana	Mt. Gravatt, Qd. . .	12	6	BRI 057166	August–October March–May	Pale yellow flower (yellow corona) turns pink-yellow at anthesis
P. herbertiana	Mt. Glorious, Qd. . .	12	6	BRI 066788	. .	. .
P. cinnabarina	Nindethana Nursery, N.S.W.	12	6	BRI 063791	October–December February–May	Brick red flower (yellow corona)
P. edulis . .	Redlands Horticultural Research Station, Qd.	18	9	BRI 064068	. .	. .

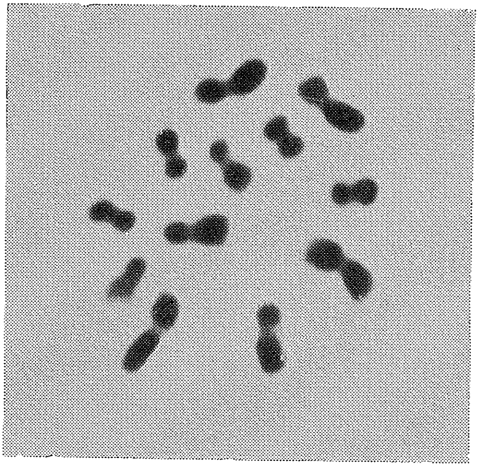

Fig. 1.—*P. aurantia* (2n = 12) 12 mitotic chromosomes at metaphase (x 3,500).

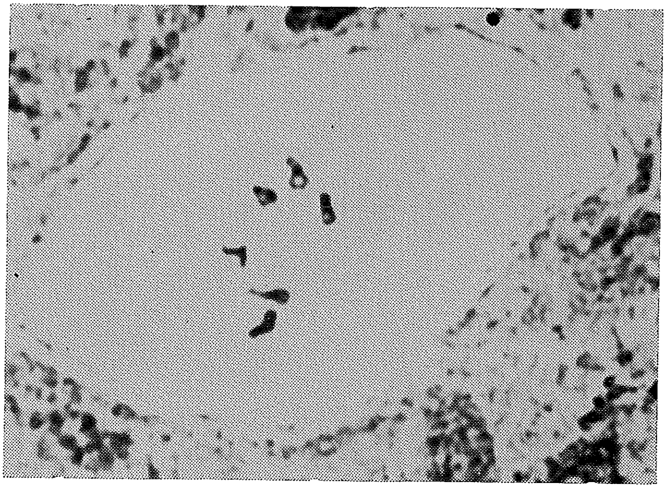

Fig. 2.—*P. herbertiana* (2n = 12) 6 bivalent chromosomes at premetaphase I of PMC meiosis (x 1,250).

Other *Passiflora* species with the same chromosome number (Darlington and La Cour 1962) as *P. edulis* would be a better choice as possible parents. Exotic species of South American origin (Table 2), such as *P. caerulea, P. quadrangularis, P. seemanni, P. incarnata* and *P. mollissima,* with 2n = 18 chromosomes are available. Killip (1938) places these five species and *P. edulis* in the sub-genus *Granadilla.* The chances of fertile hybrids being formed within this group of six species is enhanced by this closer relationship.

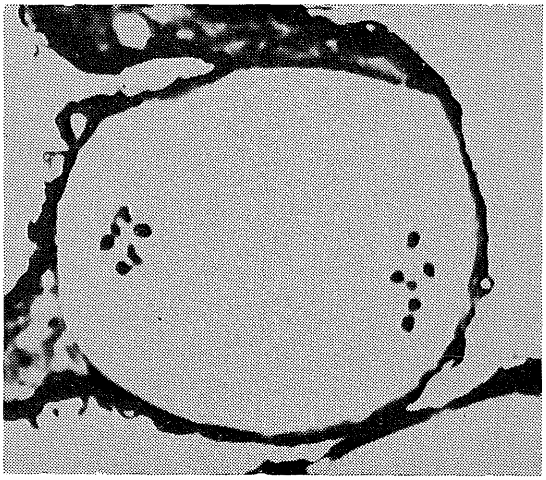

Fig. 3.—*P. herbertiana* normal disjunction showing 6 chromosomes at each pole at telophase I of PMC meiosis (x 1,250).

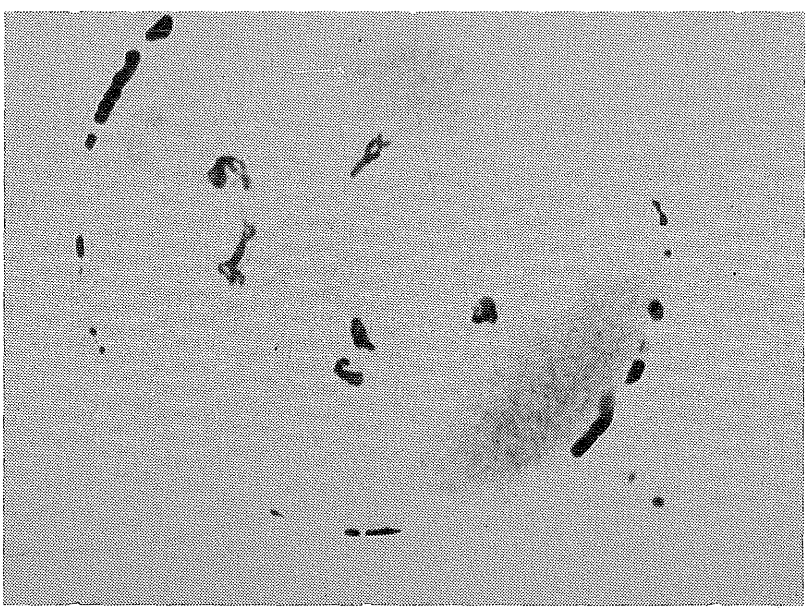

Fig. 4.—*P. cinnabarina* 6 bivalents at premetaphase I (diplotene) of PMC meiosis (x 1,250).

TABLE 2

Stem Diameter of Native *Passiflora* Species at Redlands Horticultural Research Station

Species	Source	Stem Diameter* at 12 Months (cm)
P. aurantia Forst. ..	Mt. Gravatt, Qd.	1·0–1·5
P. herbertiana Lindl. ..	Mt. Gravatt, Qd.	1·0–1·5
P. herbertiana Lindl. ..	Mt. Glorious, Qd.	1·0–1·5
P. cinnabarina Lindl. ..	Nindethana Nursery, N.S.W. ..	1·0–1·5
P. edulis Sims.	Redlands Horticultural Research Station, Qd.	2·5–3·5
P. caerulea L.	Redlands Horticultural Research Station, Qd.	2·5–3·5
P. quadrangularis L. ..	Redlands Horticultural Research Station, Qd.	2·5–3·5
P. seemanni Griseb. ..	Redlands Horticultural Research Station, Qd.	2·0–3·0
P. incarnata L.	Redlands Horticultural Research Station, Qd.	2·0–3·0
P. mollissima H.B.K. ..	Redlands Horticultural Research Station, Qd.	2·0–3·0

* One foot from ground level.

The native *Passiflora* species characteristically have thin stems and a trailing habit. Stem diameters of the exotic species are consistently greater (Table 2) than those of the native species. This would indicate an inherent difference in vigour between the two groups. The lower relative vigour of the native species is apparently related to their lower chromosome number.

Flowering is seasonal and is similar in the three native species (Table 1). An early winter flowering period is followed by a smaller flowering of similar duration. The solitary axillary flowers are smaller and generally less colorful (Table 1) than those of the more common ornamental *Passiflora* species. The fruits of the native species are green at maturity and the pulp with its numerous seeds is rather unpalatable.

Commercial *P. edulis* is susceptible to Fusarium wilt, a major disease caused by *Fusarium oxysporum,* a soil-inhabiting fungal pathogen. Purss (1958) found two of the native Australian *Passiflora* species (*P. aurantia* and *P. herbertiana*) to have resistance to *Fusarium oxysporum. P. herbertiana* was tested for use as a rootstock for commercial *P. edulis* by Cox and Kielly (1961) in New South Wales but proved unsuitable because of its trailing habit of growth. *P. cinnabarina* is restricted to the coast and tablelands of New South Wales and Victoria and is better adapted to cool conditions than *P. aurantia* and *P. herbertina,* which occur in coastal and sub-coastal New South Wales and Queensland. As cold-hardiness is a desirable characteristic in a rootstock for *P. edulis* in some climatic regions, *P. cinnabarina* is being tested by New Zealand workers (personal communication).

The native *Passiflora* species, even with their useful characteristics, are not vigorous enough as rootstocks for commercial *P. edulis.* Exotic species of a greater inherent vigor are available. The low chromosome number of the native species would preclude them as parents in a breeding programme to improve *P. edulis,* the edible passion-fruit. As garden ornamentals, their potential is limited. Their flowers are quite striking but far less conspicuous than those of the more common horticultural forms.

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