Research reports

Chromosome numbers of Cape tulips (*Homeria* species) in South Australia and Western Australia

S.M. Morrison and **J.K. Scott**, CSIRO Division of Entomology, Private Bag, PO Wembley, Western Australia 6014, Australia.

Summary

Chromosome numbers were determined for 54 plants from five South Australian collections of *Homeria flaccida* and 16 Western Australian collections of three *Homeria* species. All (12) collections of *H. flaccida* were hexaploid (2 *n*=36). All (seven) collections of *H. miniata* were triploid (2*n*=18). The two collections of *H. ochroleuca* from Western Australia were diploid (2*n*=12+1B) and pentaploid (2*n*=30+2B) indicating that the latter plant was probably a hybrid. The chromosome counts show that introduced Cape tulips represent only part of the genetic range from the original habitat in southern Africa. Future research on biological control of Cape tulips will need to consider chromosome races of the weed as part of the selection and assessment of potential agents.

Introduction

Cape tulips (*Homeria* species) (Iridaceae) are native to southern Africa (Goldblatt 1981). Both one-leaf Cape tulip (*H. flaccida* Sweet) and two-leaf Cape tulip (*H. miniata* (Andr.) Sweet) have attractive orange or salmon pink flowers. They were introduced into Australia in the mid-nineteenth century as ornamental plants (Meadly 1954, Parsons and Cuthbertson 1992). By the early 1900s both species were established as weeds of pasture in New South Wales, Victoria, South Australia and Western Australia. Cape tulip infestations are currently most extensive in parts of Victoria, South Australia and Western Australia (Parsons 1973, Parsons and Cuthbertson 1992). A third, yellow flowered species, *H. ochroleuca* Salisb., is uncommon and is naturalized discontinuously across southern Australia (Cooke 1986). It was probably also introduced as a garden ornamental.

Control options for Cape tulips include herbicides (Pearce 1968, Carter *et al.* 1993) and cultivation (Peirce 1979, Parsons and Cuthbertson 1992). Biological control is an option that has yet to be investigated, and there is interest in implementing this type of control against Cape tulip in Western Australia (Agriculture Protection Board of Western Australia 1988). Cape tulips would be suitable targets for biological control because there are few close relatives among Australian native species and crops (Scott and Delfosse 1992). Also, some potential biological control agents are known to exist, such as the rust fungus *Puccinia moraeae* Syd. (Doidge and Bottomley 1931). Before biological control can be considered, however, a clear understanding of the taxonomy of the introduced Cape tulips must be established to ensure the correct matching of control agent with the target weeds.

A comprehensive description of *Homeria* species is given by Goldblatt (1981). In southern Africa, *H. flaccida* is reported to have chromosomes with two ploidy levels (2*n*=24 and 36), *H. miniata* has three ploidy levels (2*n*=12, 18 and 24) and *H. ochroleuca* has two ploidy levels (2*n*=12 and 24) (Goldblatt 1981). Here we report on the chromosome numbers of Cape tulip in Western and South Australia to determine which ploidy levels have been introduced.

Methods

Cape tulip collections were obtained from pastures and nature conservation areas of south eastern South Australia and from within the Western Australian Cape tulip infestation region as defined by Roberts *et al.* (1988). Whole plants were dug up soon after the parent corm had resprouted. The plants were transplanted into commercial potting mix, kept outside and watered every second day. New root growth occurred within a week of replanting.

Chromosome preparation methods

Some root tips were harvested in the field and others were harvested after replanting. Approximately 10 mm of root tip was excised and immersed in 0.01% colchicine for approximately 2 hours. The root tips were then fixed in a cold mixture of acetic acid and 100% ethanol in the ratio 1:3 and stored below -20ºC until needed. If they were kept for more than seven days, the fixative was replaced with 70% ethanol. Additionally, some fresh, untreated root tips were successfully used for chromosome preparations.

Root tips were prepared for chromosome squashes as follows. The extreme end of the root tip (1 mm) was excised, hydrolysed in a drop of 1.0 M hydrochloric acid on a glass slide and gently heated to approximately 60ºC. After 5 minutes of acid treatment, the material was placed on a clean slide and finely macerated with a scalpel. Once the cells had almost dried, they were stained with 4 drops of acetocarmine stain (50% acetic acid) and left for 5 minutes. The cells were squashed under a coverslip and the preparation sealed with nail varnish. Two or three counts from each of two to four plants were made from each collection. When the count was not clear, the result is indicated by 'circa'.

Voucher specimens were made once the plants flowered. The vouchers have been lodged with the Western Australian Herbarium (PERTH).

Results and discussion

Chromosome numbers were obtained from five South Australian and 16 Western Australian populations. The collections examined, except one, were polyploid. The chromosomes were large (5–8 µm) as reported by Goldblatt (1981), and resembled those described in Goldblatt (1971) for each of the three species.

All 34 plants from 12 Australian collections of *H. flaccida* were hexaploid and had 2*n*=36 (Table 1). Six of eight chromosome counts from South Africa had 2*n*=36 and two counts had 2*n*=24 (Goldblatt 1971, 1973, 1980). The chromosome counts confirm Cooke's (1986) identification of one-leaf Cape tulip in Australia as *H. flaccida* and not *H. collina* (which has 2*n*=24) as mentioned by Goldblatt (1981). It has also been suggested that the Australian one-leaf Cape tulip could be of hybrid origin with the most likely parents being *H. flaccida* and *H. collina* (Cooke 1986). Goldblatt (1973) found natural hybrids between *H. collina* (2*n*=24) and *H. flaccida* (2*n*=36) on the Cape Peninsula in South Africa. The resulting hybrid pentaploid had 2*n*=30 and was sterile. Also, the Australian material is most likely derived from horticultural stock, the latter often being hybrid and polyploid in the Iridaceae (Goldblatt 1971). The Australian one-leaf Cape tulip has 2*n*=36 and reproduces abundantly by seed (Parsons 1973, Parsons and Cuthbertson 1992). This supports the simplest view that the Australian one-leaf

Table 1. Collection sites and chromosome numbers counted in *H. flaccida*, *H. miniata* and *H. ochroleuca*.

Homeria species Location	Latitude, longitude	2*n* chromosome count (plants examined)
H. flaccida		
Western Australia		
Cut Hill Road, W. of York	31° 55'S, 116° 43'E	36 (1), circa 36 (3)
Mason's Landing, Ferndale	32° 01'S, 115° 56'E	36 (1), circa 36 (2)
Yanchep National Park	31° 31'S, 115° 41'E	36 (2), circa 36 (2)
Wandering	32° 36'S, 116° 34'E	36 (3), circa 36 (1)
Williams	32° 57'S, 116° 46'E	36 (3)
Crossman	32° 47'S, 116° 35'E	36 (1), circa 36 (2)
Boddington	32° 39'S, 116° 30'E	36 (3)
South Australia		
Benara	37° 51'S, 140° 25'E	36 (2)
Black Hill	34° 42'S, 139° 28'E	36 (2)
Mount Benson	37° 03'S, 139° 48'E	36 (2)
Kongorong	37° 54'S, 140° 33'E	36 (2)
Mount Muirhead	37° 34'S, 140° 24'E	36 (2)
H. miniata		
Western Australia		
Yarramoney	31° 31'S, 116° 40'E	18 (3)
Gilgering	31° 49'S, 116° 49'E	18 (2)
Avondale	32° 07'S, 116° 52'E	18 (3)
Bullsbrook	31° 40'S, 115° 59'E	18 (3), circa 18 (1)
Pingelly	32° 31'S, 117° 05'E	18 (2)
Narrogin	32° 56'S, 117° 09'E	18 (2)
Williams	33° 01'S, 116° 54'E	18 (2)
H. ochroleuca		
Western Australia		
Beckenham	32° 01'S, 115° 58'E	12+1B (1)
Kulin	32° 40'S, 118° 09'E	30+2B (1)

Cape tulip matches the hexaploid form of *H. flaccida* that occurs naturally in South Africa.

All 18 counts from seven Australian collections of *H. miniata* were triploid and had 2*n*=18. Goldblatt (1971, 1980, 1981) reports chromosome numbers from 11 collections, 10 of which had 2*n*=12 and the remainder, 2*n*=24. Goldblatt (1980) mentions weedy forms found near Stellenbosch, South Africa, which are triploid (i.e. 2*n*=18), sterile, but reproduce readily from axillary cormlets. Thus it is likely that the Australian two-leaf Cape tulip, which reproduces in a like manner, matches the plants from Stellenbosch.

The counts from the two collections of *H. ochroleuca* from Western Australia were diploid (2*n*=12+1B) and pentaploid (2*n*=30+2B). Goldblatt (1971, 1980) reports from South Africa, two collections with 2*n*=12, two collections with 2*n*=24 and a collection with 2*n*=24+2–3B, none of which correspond exactly with the counts obtained from Australian material. The two chromosome counts indicate that there has been more than one introduction and establishment of *H. ochroleuca* in Australia. Further study of Australian and South African material of *H. ochroleuca* is needed to establish the range of chromosome numbers that have been introduced. In contrast, it is likely that populations of *H. flaccida* and *H. miniata* not examined in this study e.g. Victoria, have the same chromosome numbers observed in South Australia and Western Australia. This would need to be examined during any future biological control program.

Most *Homeria* species will cross with each other and produce hybrids (Goldblatt 1980). *H. flaccida* and *H. miniata* are known to hybridize in South Africa and produce fertile seed (Goldblatt 1980). This appears not to have happened in Australia as the cross would produce a tetraploid of 2*n*=24, which so far has not been observed. It is possible that the Kulin material with 2*n*=30 represents a hybrid between *H. flaccida* (2*n*=36) and *H. ochroleuca* (2*n*=24), as these species are known to hybridize (Goldblatt 1980). However, *H. ochroleuca* plants with 2*n*=24 are yet to be found in Australia. Alternatively, the 2*n*=30 plants may represent a horticultural hybrid.

It appears from this study that forms of the two principal Cape tulips existing in Australia can be matched with forms known from South Africa, and on this basis a search for biological control agents can be initiated. Using the distributions given in Goldblatt (1981) it is possible to identify the west coast of south west Cape Province as the source area for *H. flaccida* and the Stellenbosch region as the source area for *H. miniata*. These areas should be examined first during the search for biological control agents in South Africa. The possible source of *H. ochroleuca* is uncertain, but this species is insignificant as a weed and does not warrant biological control.

It would be desirable to confirm the chromosome number and identification of the plants examined in South Africa. Luckily the chromosomes are readily determined and there are excellent taxonomic sources available in Goldblatt (1981). The importance of chromosome races is likely to be most critical in the study of one of the potential biological control agents, the rust fungus, *P. moraeae*. Other biological control projects using rust fungi have been very successful, but the extent of the success has been limited by the very high degree of host plant specificity to forms of the weed, for example *Puccinia chondrillina* Bubak & Syd. on skeleton weed, *Chondrilla juncea* L. (Burdon *et al.* 1981).

Acknowledgments

We are most grateful to R. Carter, R. Sage, D. Guerin, and A. Kurray for collecting material from South Australia. We thank the Western Australian Departments of Agriculture, Department of Conservation and Land Management and the Agricultural Protection Board (G. Gordon, G. Keighery, D. Lund, P. Neilson, B. Rayner, L. Stace, and A. Stewart) for help with the collection of samples. We also thank J. Dodd, M. Lonsdale, T. Woodburn and P. Yeoh for comments on the manuscript.

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