Chromosome number in a Victorian population of *Amsinckia calycina*

D. A. Friend
Botany Department,
University of Melbourne, Parkville, Victoria 3052*

Summary

Cytological examination of a population of yellow burrweed (*Amsinckia calycina*) from Victoria revealed a somatic chromosome number of 34 (n = 17). This indicates the close relationship between *A. calycina*, a native of South America, and the two North American species *Amsinckia lycopsoides* and *A. intermedia*, which also occur as weeds in Victoria.

Introduction

The three species *Amsinckia calycina* (Moris) Chater (= *A. hispida* (Ruiz and Pavon) I.M. Johnston), *A. lycopsoides* Lehm. and *A. intermedia* Fisch. and C.A. Meyer occur in Victoria as serious annual weeds, particularly of wheat crops in the Wimmera and southern Mallee regions of the State (Connor, 1965; Willis, 1972; Parsons, 1973). All three species are known as yellow burrweed.

Amsinckia lycopsoides and *A. intermedia* are natives of North America (Ray and Chisaki, 1957a; Munz, 1959) and have been examined cytologically by Ray and Chisaki (1957a, 1957b, 1957c) in a taxonomic study of the North American species of *Amsinckia*. *A. calycina*, which is the most widespread species in Victoria (Connor, 1965) is a native of South America (MacBride, 1960; Chater, 1971), and was not included in Ray and Chisaki's study. Morphologically *A. calycina* is most closely related to the North American species *A. menziesii* (MacBride, 1960; Connor, 1965), which was examined by Ray and Chisaki. Both are characterized by a small flower size, with the corolla 2 to 3 mm broad and 4 to 6 mm long in *A. menziesii* and 2 to 4 mm broad and 5 to 8 mm long in *A. calycina*. *A. lycopsoides* and *A. intermedia* have larger flowers, being up to 8 mm broad and 15 mm long. All species are homostylic, and the small flower size ensures self-pollination through actual contact between the stigma and the anthers at the time of pollen release.

Cytological examination by Ray and Chisaki (1957c) of members of the section Muricatae (to which all the Victorian species belong) revealed an aneuploid series with haploid chromosome numbers of n = 8, 12, 13, 15, 17, 18 and 19. Several chromosome numbers were encountered in *A. intermedia* (n = 15, 17 and 19) and *A. menziesii* (n = 8, 13 and 17), whereas *A. lycopsoides* had a single haploid number of n = 15. Members of the Muricatae were shown to be capable of producting hybrids both naturally and experimentally. Connor (1965) considered that *A. calycina* also hybridized naturally with the two North American species that are present in Victoria.

Chromosome number was determined in a Victorian population of *A. calycina* as part of an extensive study of the biology and ecology of *Amsinckia* spp. in Victoria (Connor, 1965; Friend, 1977), in order to clarify the cytological relationship between *A. calycina* and the North American species of *Amsinckia*.

Methods

The material examined was from plants grown from seed collected from Beulah in north-western Victoria (latitude 35°56'S, longitude 142°25'E). Single anthers were removed from flowers taken from the terminal portion of inflorescences and examined by squashing in aceto-carmine to determine the state of meiosis of the pollen mother cells. The remaining anthers of flowers found to be at a suitable stage were then put into a stain-fixer consisting of 3:1 glacial aceto-carmine to which had been added either ferric acetate or ferric chloride saturated in glacial acetic acid. Staining of the chromosome improved over a period of up to four days in the stain-fixer. Squashes of the anthers were prepared using aceto-carmine to which a solution of 4% iron alum had been added at the rate of a few drops per 100 mL. After squashing and removing all debris with fine forceps, the size of the drop of stain was adjusted to the size of the coverslip, which was then applied. Spreading of the chromosomes was achieved by gentle heat applied to the slide followed by firm pressure on the coverslip, which was held at the same time under absorbent paper to prevent lateral movement. These procedures were repeated several times, adding new stain each time until maximum staining had been achieved on several cells which were located initially and then examined periodically. At this stage the coverslip was surrounded by Vaseline and the whole of the material examined thoroughly. Photographs of cells at different meiotic stages were taken from this temporary mount. If it was felt that further heating and pressure on the coverslip could enhance spreading of the chromosomes of a particular cell, the Vaseline could be removed from around the coverslip using cotton wool and alcohol and the foregoing procedure repeated. Finally, permanent euparol mounts were prepared, following the techniques outlined by Hair (1968).

Twelve such preparations were obtained for examination using material from six plants.

Results and Discussion

The population of *A. calycina* examined had a somatic chromosome number of 2n = 34 (n = 17). Pollen mother cells from which counts were obtained are shown in Figures 1 to 3. This chromosome number is common to the North American species of the section Muricatae and indicates the close cytological relationship of *A. calycina* to this group. It is possible that the Australian population of *A. calycina* is represented by several races or forms having different chromosome numbers in a manner similar to that described for *A. menziesii* and *A. intermedia* by Ray and Chisaki (1957b, 1957c), and a full examination of the Australian material needs to be undertaken in order to determine whether this is so. Indeed, the whole of the *Amsinckia* complex in Australia requires cytological investigation to provide further information on the relationship between the Australian and the American species.

Ray and Chisaki (1957a, 1957b, 1957c) discuss their studies on *Amsinckia* from the viewpoint of the evolution of a colonizing species. Based on characters including nutlet morphology, flower size, stamen insertion and style length, they link the North American species in an evolutionary sequence from the large-flowered heterostylic species to the small-flowered homostylic species. Cytologically the evolutionary sequence was shown to be from low chromosome numbers (n = 4 to 7) in the heterostylic species to high chromosome numbers (n = 8 to 19) in the homostylic species.

*Present address: Tasmanian Department of Agriculture, South Launceston, Tasmania 7250.

The section Muricatae contains species with homostylic flowers and the majority of the small flowered, self-pollinated species with high chromosome numbers, and would therefore appear to be the most advanced. The advantages of self-pollination to a colonizing species in allowing for a rapid increase in population from an initially present few or even one individual have been recognized for a long time (Stebbins, 1950), whilst a high chromosome number confers a higher genetic recombination on the occasional cross-pollinations that do occur (Allard, 1965). It is quite striking that it is to the section Muricatae that most of the weedy members of the genus *Amsinckia* belong.

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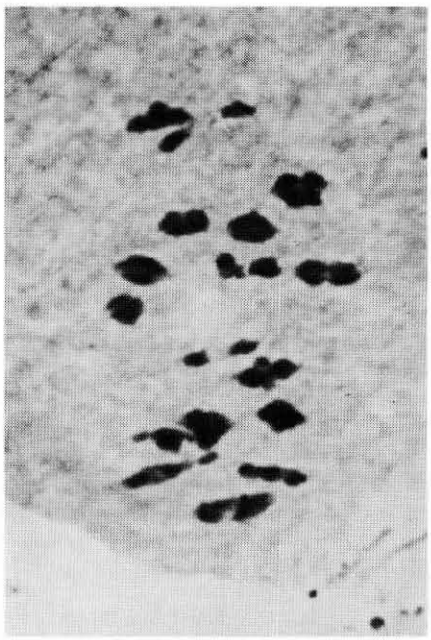

Figure 1 metaphase I (X 6140)

Figure 2 metaphase II (X6140)

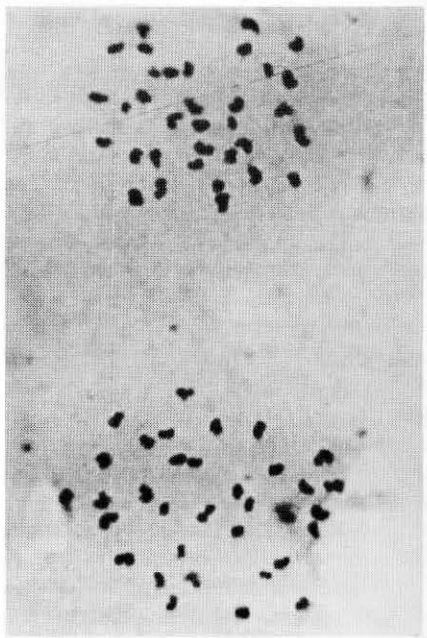

Figure 3 anaphase II (X4650)

Figures 1 to 3 Meiosis in pollen mother cells of *Amsinckia calycina*: haploid chromosome number, n = 17.