

CHROMOSOME RELATIONSHIP IN CALENDULA SPECIES

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THERE are about 20 species of *Calendula*—distributed from the Canary islands through North Africa and the Mediterranean to Persia and North-Western India.

Calendula officinalis native of S. Europe and *C. suffruticosa* of Western Mediterranean have been cultivated plants from ancient times for the yellow dye extracted from their petals. *C. suffruticosa* has a single row of ligulate flowers whereas in *C. officinalis* is double. The chromosome numbers reported for these 2 species are $2n = 28$ and $2n = 32$ (see Darlington and Wylie, 1955). The plants of *C. officinalis* growing in Jammu had $2n = 32$. These two species resemble each other except in the colour of the petals, which is orange yellow in *C. officinalis* and sulphur yellow in *C. suffruticosa*. Hybrids between these two species have given rise to many garden varieties of Pot-Marigolds.

The only diploid species so far reported is *Calendula aegyptiaca* $2n = 14$ (Negodi, 1935) which is found in the Mediterranean region up to Mesopotamia.

Calendula arvensis is a weed found all over S. Europe extending to S. Asia. It has been collected as far East as the Punjab. Its chromosome number has been reported as $2n = 36$; $x = 9$ (Negodi, 1935). Recently we found a *Calendula* with very small leaves and flowers growing as a weed in the Drug Farm, Jammu. This plant had sulphur-coloured flowers like *C. arvensis* and *C. suffruticosa* and resembled *C. arvensis* in having beaked achenes. Its flowers and leaves however were much smaller than those of *C. arvensis*. It was identified as *C. arvensis* var. *persica* at Kew. A cytological examination revealed $2n = 44$ ($n = 22$) chromosomes, instead of 36 chromosomes found in *C. arvensis* (Figs. 1 and 2). Meiosis was very regular and 22 bivalents were found. It is, therefore, genetically different from *C. arvensis* proper.

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Calendula persica C. A. May has been reported from Caucasia, Persia and Afghanistan. We consider the Jammu *Calendula* as being more closely related, if not identical to *C. persica* than *C. arvensis*. Its entry into India from Afghanistan or Persia must have been a recent event. Chromosome doubling of a sterile triploid hybrid between a tetraploid form like *C. suffruticosa* $2n = 28$ and an unknown diploid *Calendula* with $2n = 16$ would account for the regular pairing observed in our *Calendula*. It is thus a secondary hexaploid.

It has already been stated that *C. arvensis* resembles *C. persica* except in the larger leaves and flowers found in *C. arvensis*. The origin of *C. arvensis* $2n = 36$ from *C. persica* $2n = 44$ is easy to understand if we consider it as a back-cross between *C. persica* $2n = 44$ and a larger flowered $2n = 28$ parent presumably *C. suffruticosa* or an allied species as follows:

$$\begin{array}{ccc} C. \textit{persica} & & C. \textit{suffruticosa} \\ 2n = 44 & \times & 2n = 28 \\ & & : \\ & & C. \textit{arvensis} \\ & & 2n = 36 \end{array}$$

Further back-crossing, with the 28-chromosome parent can also account for the number $2n = 32$ found in cultivated *Calendula*.

The evolution of *Calendula* species with different basic chromosome numbers as a result of hybridization and back-crossing is reminiscent of the same process found in species of *Viburnum* (E. K. Janaki Ammal, 1953). It is also interesting to note that *C. persica* which has a higher chromosome number than other species of *Calendula* has much smaller flowers than the cultivated tetraploid species. As in *Narcissus* (E. K. Janaki Ammal, 1949) tetraploidy in *Calendula* provides the best form suitable for cultivation as garden plant. It is very likely that while *C. persica* spread eastwards often into Persia and Afghanistan its back-crosses with *C. suffruticosa* spread westwards as *C. arvensis* complex.

SUMMARY

A new basic number $x = 11$ for the genus *Calendula* is reported for the first time in *C. persica* $2n = 44$ from Jammu. Its chromosome relationship with *C. suffruticosa* $2n = 28$, *C. officinalis* $2n = 32$ and *C. arvensis* $2n = 32$ are discussed. As in *Narcissus* the tetraploidy in *Calendula* provides the best form suitable for cultivation as garden plant.

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