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 $2n = 36; \chi = 9$ (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. suffrutescens 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. suffrutescens or an allied species as follows:

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\begin{align*}
\text{C. persica} & \quad 2n = 44 \\
\times & \\
\text{C. suffrutescens} & \quad 2n = 28 \\
\end{align*}
\]

C. arvensis

2n = 36

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. suffrutescens 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. suffrutescens 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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