CYTOLOGICAL STUDIES IN THE GENUS AMARYLLIS

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ABSTRACT

One species and eight horticultural varieties of Amaryllis show a basic number of $x=11$, which is the predominant basic number of the family. In both Amaryllis belladonna and Amaryllis—Mrs. Garfield the normal somatic number is $2n=22$. All the seven colour varieties of Amaryllis—Giant Dutch have $2n=44$ chromosomes. These varieties differ from one another in the minor alterations of the chromosome types suggesting the role of minor structural alterations in evolution. In addition to the normal somatic complement a number of variant nuclei with altered karyotypes have been recorded.

INTRODUCTION

Amaryllis is a vegetatively propagated ornamental plant belonging to the family Amaryllidaceae. Many cultivated forms of Amaryllis occur in India and other parts of the world. Some amount of cytological work (Inariyama 1937, Sato 1938, 1942, Mookerjea 1955, Sharma 1956, Sharma and Jash 1958, Larsen 1960, Kapoor and Tandcn 1963, Nelson and Traub 1963, Mallick 1976) has been carried out on this genus. Most of the species of Amaryllis are diploid with $2n=22$ chromosomes and some are polyploids. Among polyploids tetraploids ($2n=44$), hexaploids ($2n=66$) and heptaploids ($2n=77$) have been reported, of these tetraploids are most frequent. Since several cultivated forms of Amaryllis are available and some of them have not yet been cytologically investigated, it is worthwhile to investigate them cytologically for elucidating their relationship. Another interesting point is the nature of speciation related to their asexual mode of propagation.

MATERIALS AND METHODS

One species and eight horticultural varieties of Amaryllis were investigated. These plants were collected from the Royal Agricultural Society Garden, Calcutta.

The names of the plants investigated are given below:

1. Amaryllis belladonna L.
2. Amaryllis—Mrs. Garfield
3. Amaryllis—Giant Dutch—Bouquet
4. Amaryllis—Giant Dutch—Fire Dance
5. Amaryllis—Giant Dutch—Happy Memory
6. Amaryllis—Giant Dutch—LaForest Morton
7. Amaryllis—Giant Dutch—Peppermint
8. Amaryllis—Giant Dutch—Trixi
9. Amaryllis—Giant Dutch—Winter Carnival

For somatic study temporary acetic carmine squash was found to be the most suitable method. Different pretreating chemicals were tried of which saturated aqueous paradichlorobenzene (Sharma and Mookerjea 1955) was found to be most suitable at 16-18°C. The time required for the pretreatment was three hours for Amaryllis belladonna and Amaryllis—Mrs. Garfield and four hours in case of all colour varieties of Amaryllis—Giant Dutch.

OBSERVATIONS

Cytological analysis of the nine members
of the genus *Amaryllis* shows similarities in their chromosome morphology. The length of the chromosome varies from 21.24 μm to 4.71 μm. On the basis of the length and position of the constrictions, the chromosomes can be divided into several types, which are seen to be common to all the members, though with different relative frequency in different taxa.

A general description of the types is given below:

**Type A**—Very long chromosomes having a length of 25-15.1 μm with sub-median to subterminal primary constriction.

**Type B**—Long chromosomes having a length of 15-9.5 μm with sub-median to subterminal primary constriction.

**Type C**—Long chromosomes having a length of 15.5-9.5 μm and with two constrictions, at opposite ends of long middle arm, one nearly submedian and the other subterminal.

**Type D**—Long chromosomes having a length of 15.9-5.5 μm and with two constrictions, primary and secondary, one nearly median and the other nearly subterminal at the distal end of one of the arms.

**Type D’**—Long chromosomes having a length of 15.9-5.5 μm and with two constrictions, primary and secondary, one nearly median and the other located in the middle of the longer arm.

**Type E**—Long chromosomes having a length of 15.9-5.5 μm and with two constrictions, one subterminal and the distal end of the short arm is a satellite.

**Type F**—Medium sized chromosomes having a length of 9-6.5 μm and with nearly median to nearly subterminal primary constriction.

**Type G**—Short chromosomes having a length of 6.4-4 μm and with median to subterminal primary constriction.

The species and the varieties studied contained different numbers of the above mentioned types in their complement.

1. *Amaryllis belladonna* Linn.
   \[2n = 22 = A_2 + B_6 + C_2 + E_2 + F_8\] (Fig. 1);
   16.47 μm-6.5 μm.

2. *Amaryllis*—Mrs. Garfield
   \[2n = 22 = B_4 + C_2 + D_2 + E_6 + F_6 + G_{10}\] (Fig. 2);
   12.35 μm-4.71 μm.

3. *Amaryllis*—Giant Dutch—Bouquet
   \[2n = 44 = A_8 + B_{16} + C_4 + D_4 + E_8 + F_{16}\] (Fig. 3);
   18.24 μm-6.5 μm. Variation plates with \[2n = 28\] and \[46\] chromosomes have been recorded.

4. *Amaryllis*—Giant Dutch—Fire Dance
   \[2n = 44 = A_8 + B_{20} + D_4 + F_4 + G_8\] (Fig. 4);
   15.29 μm-4.71 μm. A variation nucleus with \[2n = 45\] chromosomes has been observed.

5. *Amaryllis*—Giant Dutch—Happy Memory
   \[2n = 44 = A_8 + B_{18} + D_5 + E_2 + F_{16} + G_8\] (Fig. 5);
   15.2 μm-5 μm.

6. *Amaryllis*—Giant Dutch—LaForest Morton
   \[2n = 44 = A_8 + B_{20} + C_2 + D_4 + F_{16}\] (Fig. 6);
   15.59 μm-6.58 μm.

7. *Amaryllis*—Giant Dutch—Peppermint
   \[2n = 44 = A_4 + B_{22} + D_3 + E_2 + F_{17} + G_8\] (Fig. 7);
   15.59 μm-5.59 μm.

8. *Amaryllis*—Giant Dutch—Trixie
   \[2n = 44 = A_4 + B_{18} + D_5 + F_{16}\] (Fig. 8);
   15.59 μm-5.8 μm. A variation nucleus with \[2n = 22\] chromosomes also has been recorded.

9. *Amaryllis*—Giant Dutch—Winter Carnival
   \[2n = 44 = A_8 + B_{18} + C_9 + D_4 + F_{16}\] (Fig. 9);
21.24 μ m-5.5 μ m. A variation nucleus with 2n=22 chromosomes has also been recorded.

**DISCUSSION**

The chromosome number of the different taxa of *Amaryllis* studied here is a multiple of eleven, which is the predominant basic number of the family occurring in about half of the genera studied cytologically.

According to Flory (1958) *Amaryllis* (x=11) represent static genera in which the species are clearly differentiated and the cytological picture is essentially constant. All previous investigations support this view (Inariyama 1937; Sato 1938, 1942; Mookerjea 1955; Sharma 1956; Sharma and Jash 1958; Larsen 1960; Kapoor and Tandon 1963; Nelson and Traub 1963). Our observations also confirm the basic number of x=11. From this study it is evident that the different species and varieties of *Amaryllis* differ from each other in different combinations of the seven principal chromosome types. This indicates the role of structural alterations in the origin of new species. The structural alterations according to Sato (1948) may range from fusion, deletion, duplication, translocation and inversion. Meiotic studies are required to specify the particular changes involved in the origin of a species. A study of seven colour varieties of *Amaryllis—Giant Dutch* shows a somatic number of 2n=44 chromosomes. Although the somatic chromosome number is same in all of them but they differ in the relative
amount of chromatin matter. These varieties differ from each other only in the chromosome type indicating that the minor structural alterations in addition to gene mutations have been responsible for their evolution (Sharma and Sharma 1959).

The importance of minor structural alterations is also evident from a comparison of the karyotypes studied here with the karyotypes of cytotypes of the same species studied previously. For example, a plant of Amaryllis belladonna studied by Ficker (1951) shows a karyotype with \(2n=22\) chromosomes having four long rod, six short rod and two short V-shaped chromosomes. The plant of the same species studied here shows the same chromosome number but differs in the relative number of long, medium sized and short chromosomes and in the positions of the constrictions, showing that minor structural alterations are present even within different cytotypes of the same species.

In some of the colour varieties of Amaryllis—Giant Dutch in addition to the normal somatic complement as indicated by the highest frequency of occurrence, other nuclei having altered karyotypes occur within the same tissue. An altered nucleus in a vegetatively propagated plant may enter a growing apex, thus giving rise to a new form with an altered karyotype.

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