

# About The Plant

## 1 INTRODUCTION

Among the monocots Liliaceae is one of the largest families. Genus Gloriosa belongs to this family. This family has attracted the interest of taxonomist, horticulturists, cytologists, morphologists, phytochemists and geneticists. This family is interesting to taxonomists because of its taxonomic position while horticulturists are interested due to its attractive flowers and easy propagation by tubers, corms and such other vegetative means. Often the Liliaceous flowers are used as cut flowers in the market because of its grandiose nature. It is interesting to cytologists because of its large prominent chromosomes. In the recent years it has attracted the interest of phytochemists because almost all of Liliaceae have one or the other active principle of medicinal value. Gloriosa a member of Liliaceae is known from the ancient time both in the West as well as in the East because of its medicinal importance. The underground tubers are often used to treat the gout. With a discovery that the tuber contains colchicine which is often used to induce polyploidy its importance has doubled. Similarly many other medicinal principles that it contained and vast majority of taxa belonging to this family contained made the Liliaceous plants a center of attraction for chemist, drugist and pharmacists.

Clewer et al (1915) discovered that the tubers of Gloriosa superba contain colchicine, an alkaloid. Till then it was known only in Colchicum autumnale and this temperate species was commonly exploited. With a knowledge that Gloriosa superba L. contain 0.3% colchicine on dry weight basis many pharmaceutical companies became interested in it for unlike Colchicum autumnale is tropical in nature.

## 2 DISTRIBUTION

Genus Gloriosa L. is widely distributed over varied climatic and geographical zone though it is found abundantly in western tropical regions. It has an underground tuberous roots which strikes the shoot with the onset of monsoon. It starts flowering within a month of its emergence and produces grandiose flowers. The fruits are capsules having red seeds. The aerial shoot is a climber in nature with a leaf tip modified into tendril and has a life span of 3-4 months. Shoots die in autumn.

Genus Gloriosa L. is indigenous to tropical Asia including India, Pakistan, Sri Lanka, Burma, Andaman and Nicobar islands, Borneo, Great Comoros Islands, Indonesia, Lakshdweep and Malayan Peninsula. They are also found to be abundantly distributed in the African continent. They are found to growing widely in Angola, Bechuanaland, Basuto land, Cameroon, Xongo, Ethiopia, Federation of Rhodesia and Nyasa

land, French Congo, Gabon, Ghana, Kenya, Mosambique, Nigeria, Sierra Leone, Sudan, Swaziland, South Africa, South West Africa, Tanganyika, Uganda and Zanzibar.

Percy Lancaster and Percy Lancaster (1966) who made a sort of monographic study of Gloriosa have reported that these plants are growing at Beira and East London near the sea sustaining all the storms and strong wind of sea water and salt, spray over them, they are also known to be growing at high altitude, 7500-8000MSL luxuriently.

### 3 TAXONOMY

Genus Gloriosa L. is originally instituted by Linnaeus and its taxonomic identity has been maintained since then (Hutchinson 1959). However Hutchinson separated most woody nonxerophytic members from the family Liliaceae and placed them into several distinct families such as Smilacaceae, Ruscaceae and Phillesiaceae. The family Liliaceae today consists of 250 genera and 3700 species, whereas the family Smilacaceae has 4 genera and 375 species (Willis, 1966).

In India one of the most commonly and widely growing species is Gloriosa superba. L. However there are 6 species known besides G. superba are G. carsonii, G. plantii, G. lutea, where among the former two tetraploids are found later is consisting is diploid. In addition two hexaploid species G. rothschildiana and G. Shrimati Bhima are known to be hexaploid and are possibly horticultural species. Among these species of Gloriosa, Gloriosa superba L. is diploid with  $n=11$  and widely growing in deccan all along the Western Ghats.

It is known to be a stable species not showing greater morphological variation despite its wide, geographical distribution. The other species are known to be occurring in the semitemperate regions of Himalayan ranges. Nonetheless they grow very well in the tropical parts of the Deccan although they are not found distributed widely.

#### 4 GENERAL MORPHOLOGY

Gloriosa like any other Liliaceous plant propagates by means of underground organ as well as by seeds. The tubers are flat and horse shoe shaped with eye-bud at the tip. The eye-bud sprouts giving rise to an aerial partially woody slender shoot. Shoot bearing leaves whose tips are modified into tendrils. The leaves are lanceolate, entire and with parallel venation. However they do not bear axillary buds. They occasionally branch at a height of 4-5 feet. The flowers are terminal as well as axillary, mostly solitary, rarely 2-3 while the shoot grows the underground tuber on the either side of the shoot differentiates or sprouts giving rise to new horse shoe shaped tubers with two terminal eye-buds. It matures within 2-3 months, separate out from the parent tuber. Aerial part after flowering and fruiting dies down while the underground tuber undergoes dormant stage. Thus Gloriosa is having the habit of multiplying in the vicinity as the tubers multiply. Seeds that fall on ground when

germinate first develop in to underground tuber. Such a new tuber produced from seeds takes almost three years before it comes to maturity and flowers. The growth of shoot is determinate with the meristem, only at the tip. Once the apical meristem differentiates into reproductive organ the growth stops. Therefore, if the meristematic region is lost either by cutting or damaged by pest, the plant loses its ability to regenerate.

Two important species which are of great interest and are of significance are Gloriosa superba L. and Gloriosa lutea. Both these species are deplod with  $n=11$  but morphologically distinct (Miller, 1930, Naraiian, 1972). No greater variation in chromosome number is seen in these species. In the present discussion the morphological character of only these two species which are of interest to use are given.

Percy Lancaster<sup>x</sup> and Percy Lancaster (1966) in their monographic publication have given systematic account of morphology of the genus based on detailed record of all Gloriosa species. They are (1) Height of plant, (2) Stem colour below basal leaf, (3) Distance from ground to basal leaf, (4) Colour of the foliage, (5) Colour of the reverse side (6) Measurement of leaf (7) Arrangement of leaves (8) Distance apart, (9) Shape of leaf, (10) Tendril, (11) Number of basal leaves, (12) Bud colour and shape (13) Flower number per

PLATE I

- 1 Gloriosa superba L.plant with flowers
- 2 Gloriosa lutea ort.plant with flowers

PLATE II

- 3 Shoot apical meristem showing initiation of callus in  
B<sub>MS</sub> + CW 20% + 2,4-D, 4 ppm + K<sub>2</sub>, 5 ppm + CH 10 ppm
- 4 Growing shoot apical meristem in B<sub>MS</sub> 20% +  
IAA 8 ppm + K 5 ppm + CH 5 ppm
- 5 Tubers induced from callus in  
B<sub>MS</sub> + CW 20% + IBA 5 ppm + K 5 ppm + CH 10 ppm
- 6 Swollen shoot portion below apical meristem in  
B<sub>MS</sub> + CW 20% + 2,4-D 4 ppm + K 5 ppm + CH 10 ppm



PLATE III

- 7 Regenerated plantlet in B<sub>MS</sub> + CW 20% + IBA 5ppm  
+ K 5 ppm + CH 10 ppm

PLATE IV

- 8 Apical shoot meristem in  $B_{\gamma}$  + CW 20% + K 4 ppm  
remained green for long time
- 9 Apical shoot meristem showing slight sign of  
growth in  $B_{\gamma}$  + CW 20% + 2,4-D 4 ppm  
+ IAA 4 ppm + K 4 ppm

PLATE V

- 10 Drying shoot apical meristem in  
B<sub>w</sub> + 2,4-D 4 ppm + K 5 ppm + CH 10 ppm
- 11 Slightly swollen shoot portion below apical region

PLATE VI

- 12 Subcultural callus in  $B_{MS}$  + CW 20% + IBA 1 ppm  
BAP 5 ppm ± CH 50 ppm showing greenish patches
- 13 Subcultured callus in  $B_{MS}$  + CW 20% + 2,4-D 4 pm +  
BAP 50 ppm + CH 10 ppm showing emergence shoot bud
- 14 Cuallus in  $B_{MS}$  + CW 20% + CH 50 ppm showing  
numerous embryoid like structures

PLATE VII

- 15 Callus mass used in suspension culture
- 16-18 Cells of various shapes and size from  
suspension culture

PLATE VIII

- 19 Clump of cells in auxin free liquid MS medium
- 20-21 Cell showing initial stage of embryoid formation

PLATE IX

Thin layer chromatographic plates spread with  
Draggendorffs reagent

- a. Callus extract
- b. Standard colchicine

PLATE X

- 23 Normal large turgid cell with prominent nucleus
- 24 Two dividing cells of more or less equal size and shape
- 25-28 Differentiated cells of various size and shapes
- 29-30 Cytological structure of callus cells showing chromosomes  
under condensation



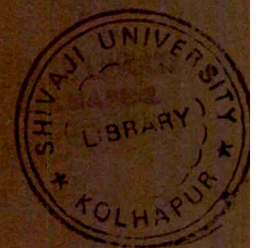
PLATE XI

- 31 Fruits of Gloriosa superba
- 32 Fruits of Gloriosa lutea
- 33 Fruit of hybrid between G.superba and G.lutea





PLATE I





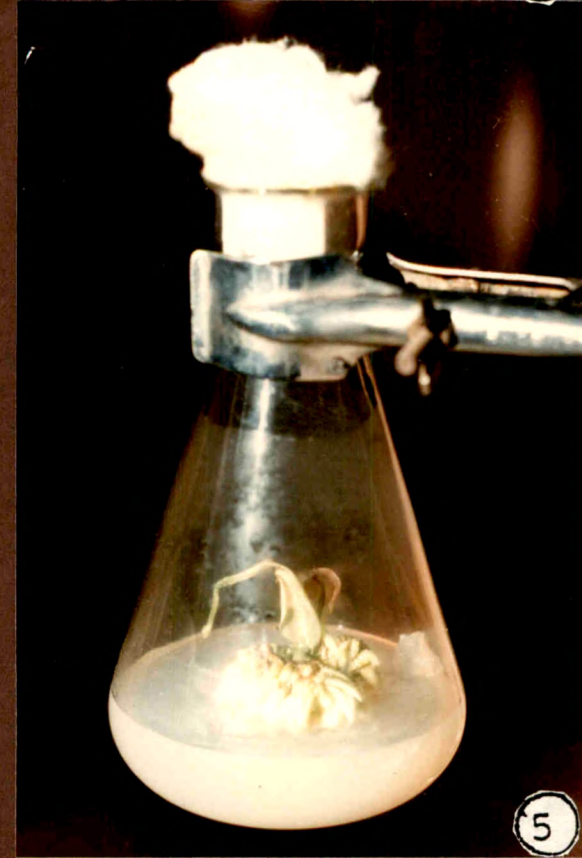


PLATE II



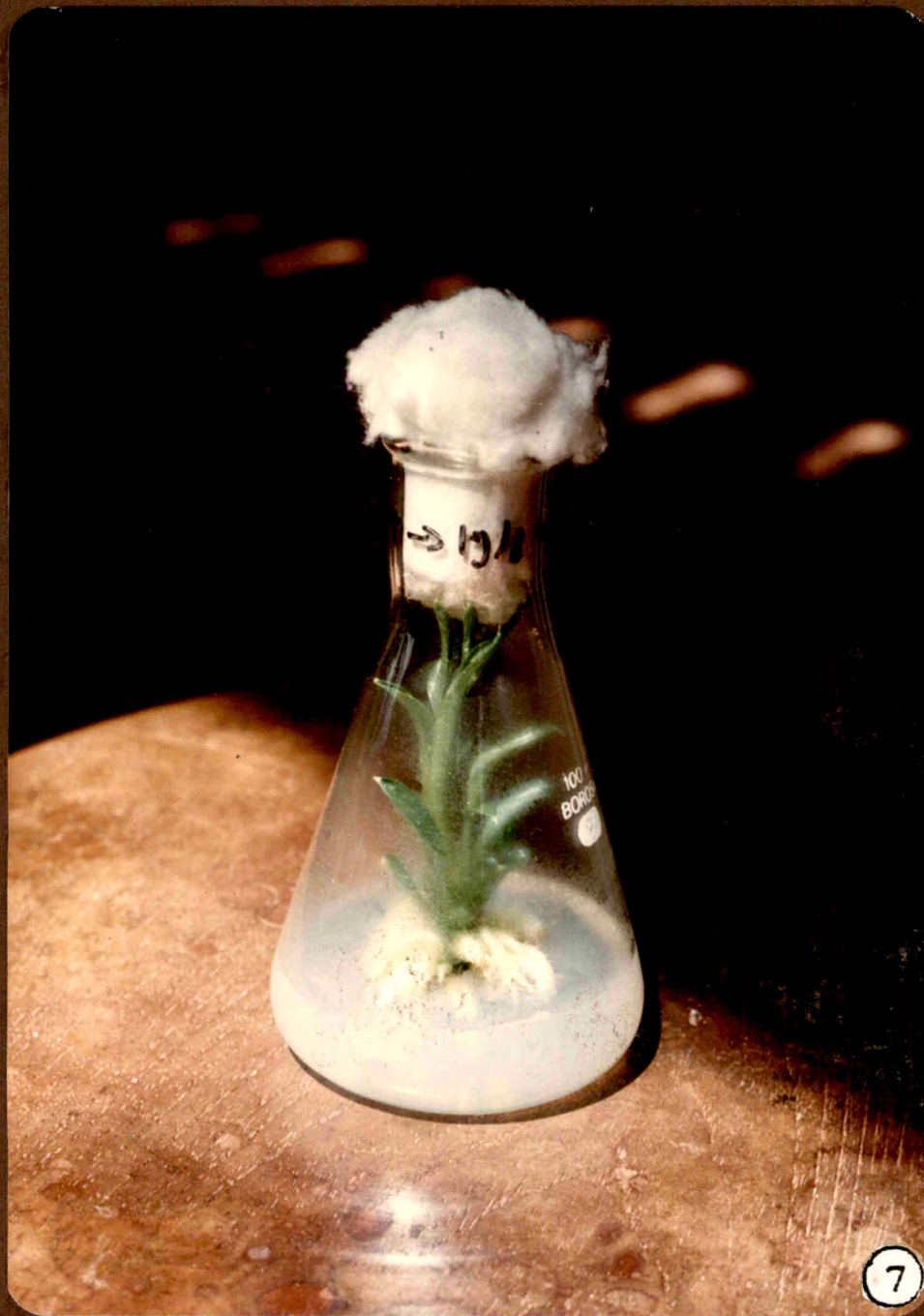


PLATE III



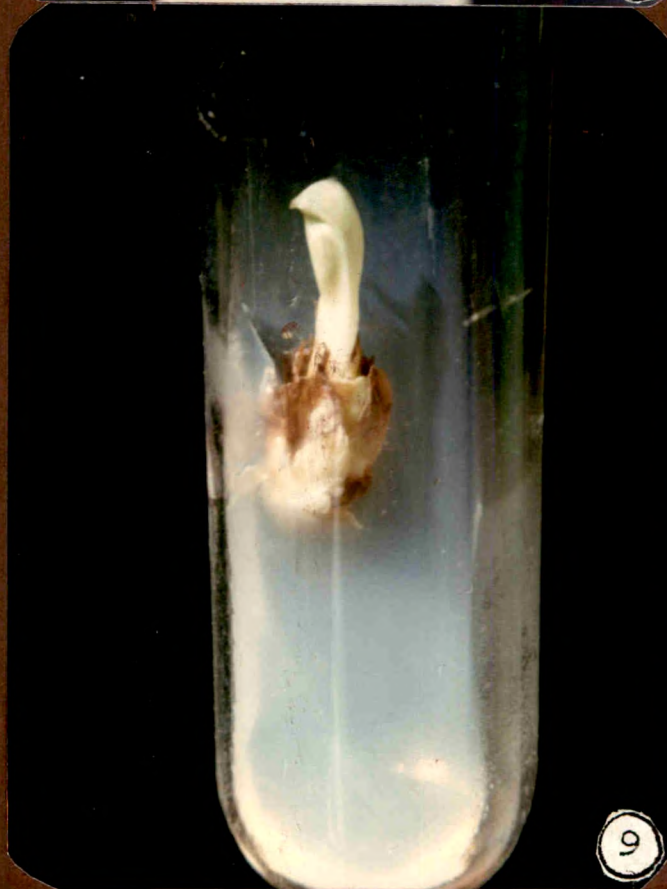


PLATE IV



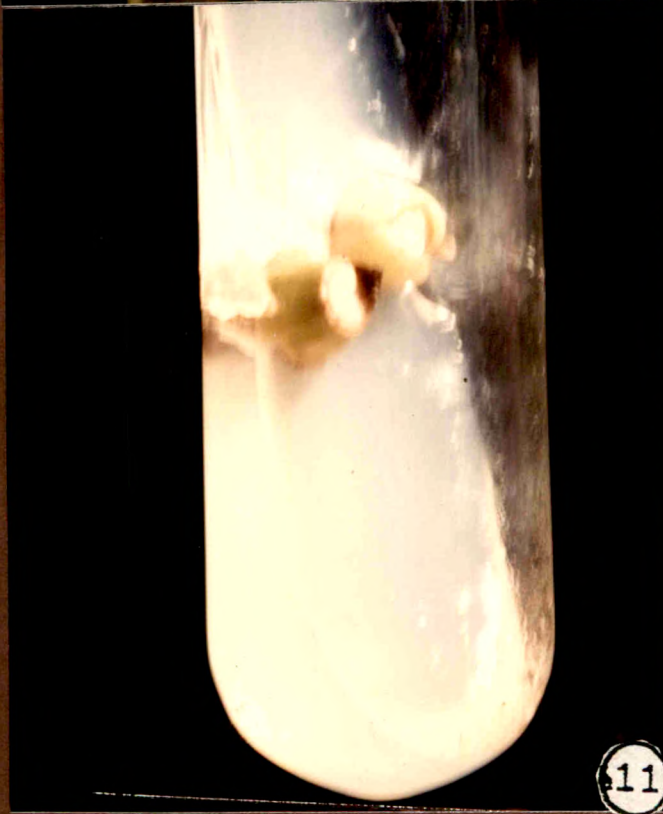


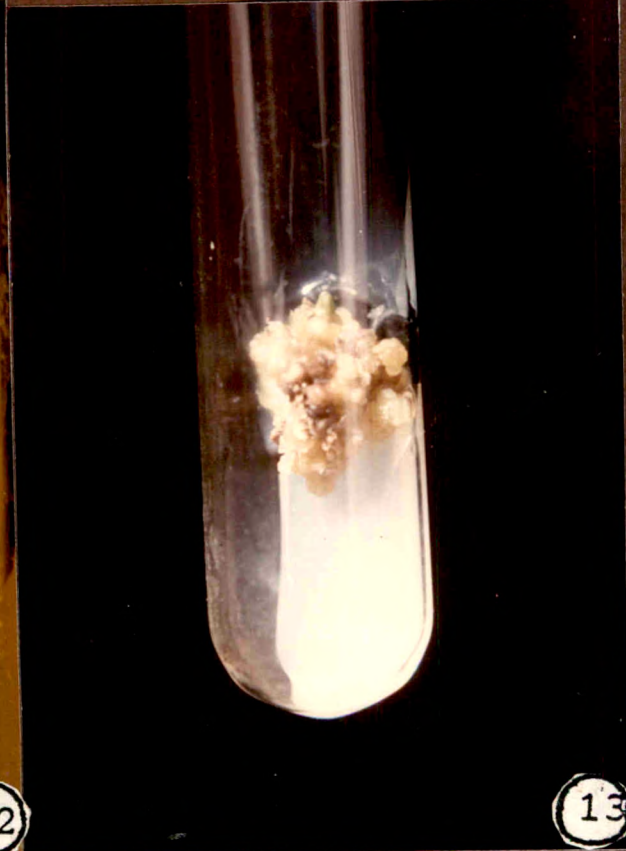
PLATE V







12



13



14

PLATE VI





PLATE VII



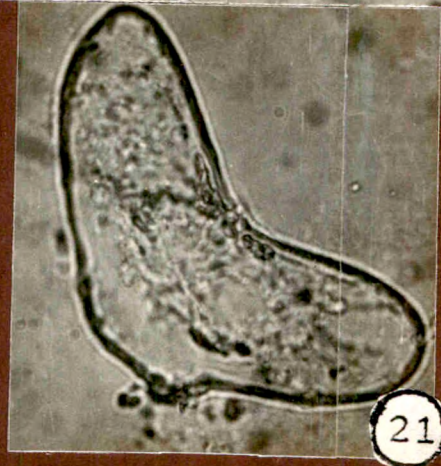
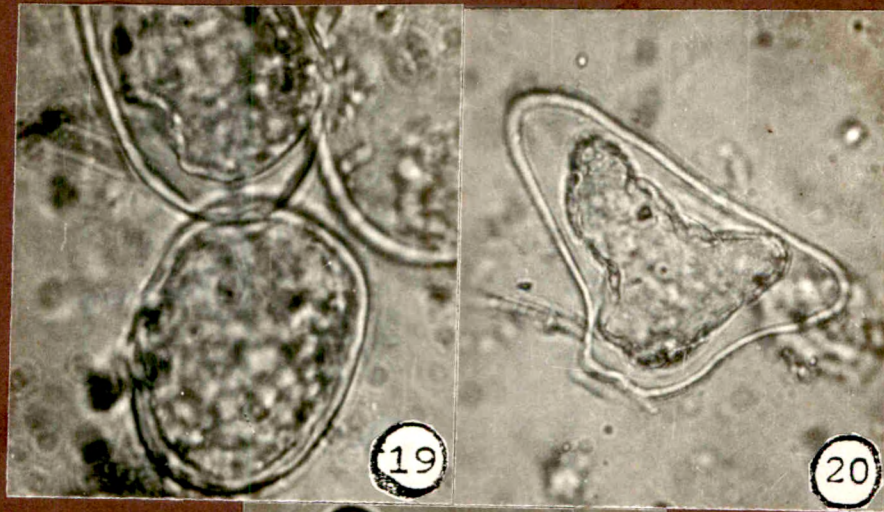


PLATE VIII



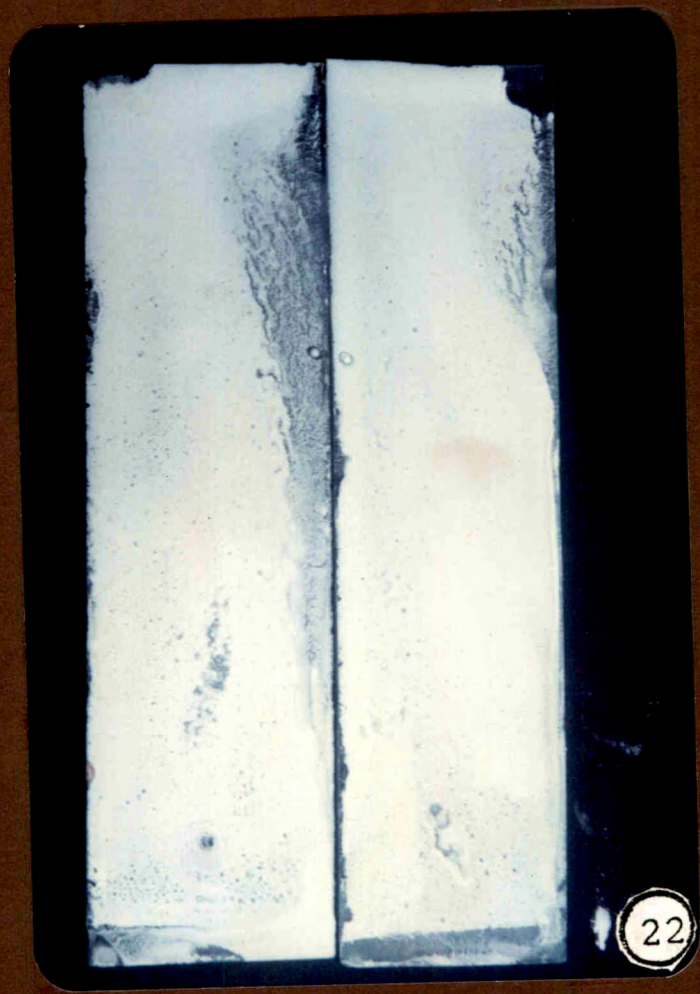


PLATE IX



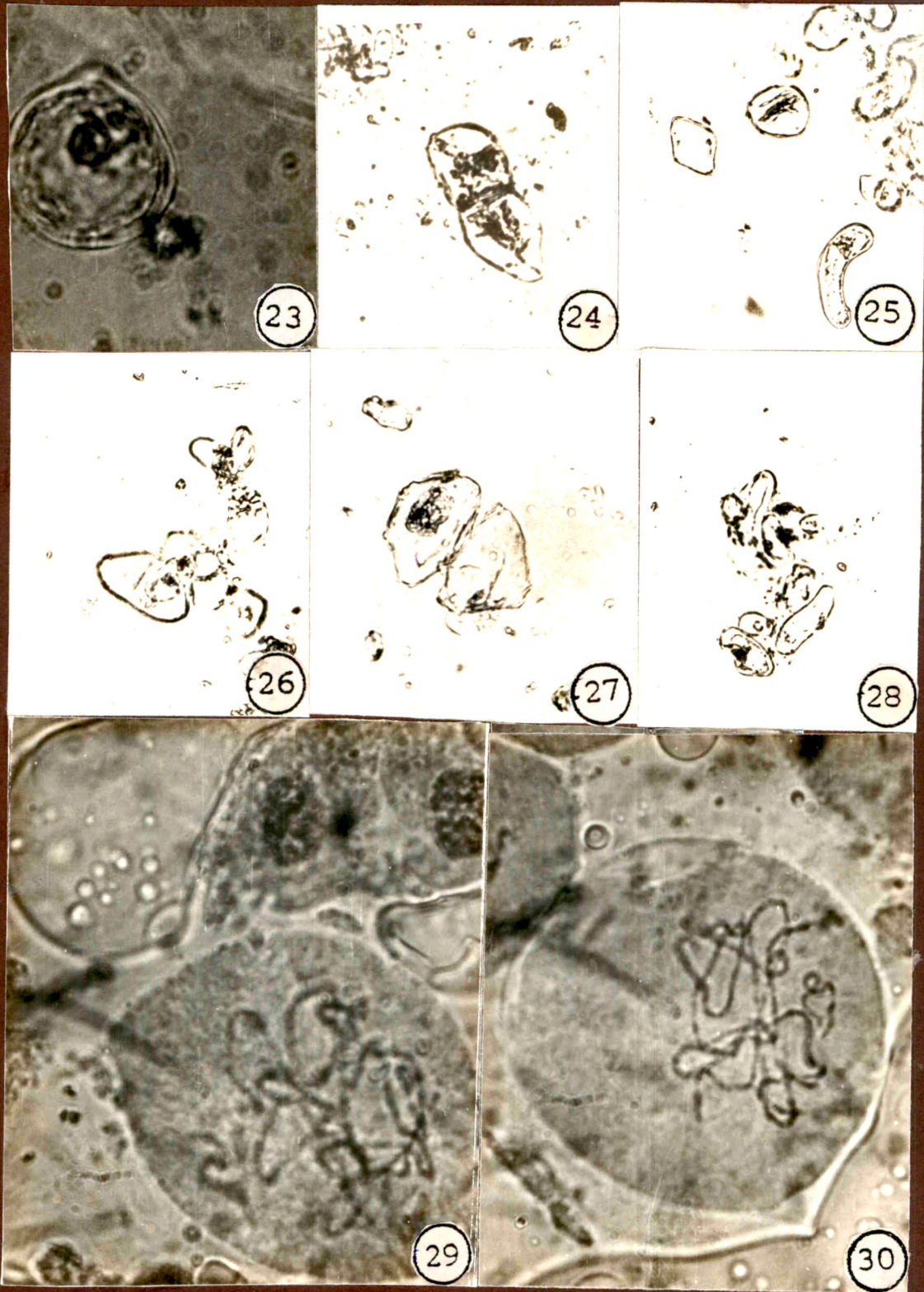


PLATE X





GLORIOSA SUPERBA

31



GLORIOSA LUTEA

32



GLORIOSA SUPERBA (♀)

X

GLORIOSA LUTEA (♂)

33

PLATE XI

plant, (14) Colour of fresh flower, (15) Colour of faded flower, (16) Flower shape, (17) Flower dimension (fresh), (18) Dimensions (faded), (19) Perianth edges, (20) Perianth dimensions, (21) Length of pedicels, (22) Stamen colour and length (fresh), (23) Stamen faded, (24) Anthers, (25) Pistil fresh, (26) Pistil faded, (27) Stigma arms, (28) Ovary, (29) Seeds in pods, (30) Tuber.

The Gloriosa L. falls in to a certain well marked division and it is suggested that the following points should be taken in to consideration while identifying species. Amongst them flower colour and habit of the plant are most important as the key character (Percy Lancaster and Percy Lancaster, 1966 and Narian, 1972).

a) Gloriosa superba L. :

Abundantly distributed throughout western ghats of India. However this species is not found in Africa with the same colour of flowers. The flowers are much twisted, crisped and erect with six recurved or reflexed petals, meeting of red and yellow colour. Size of the tuber varies in length from 10-12cm leaves green, irregular, length/breadth ratio 5.2, lanceolate, flower diameter 7 cm, flower colour at the base is napples, at the top yellow single red, perianth linear, margins heavily crisped colour of seed pale orange, pollen fertility is 97%.

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A

b) Gloriosa lutea Hort :

Size of the tuber 6-8 cm with green leaves, arrangement of leaves, irregular, length/breadth ratio 4.2 leaves linear lanceolate. Diameter of flower 6.5 cm, crisped and erect. Flowers chrome yellow in colour, monocoloured, perianth linear, crisped with pale orange seeds. It opens a rich citron yellow and turns tawny red gradually as the flowers matures and fades. It is a beautiful thing as the light golden colour holds after picking at the right stage. It is being propogated to increase the stock. Pollen fertility is 83.8%.

## 5 IMPORTANCE

Gloriosa L. colchicine yielding plant, belonging to Liliaceae has been of great interest to the pharmaceutical industries because it yield valuable chemical principles especially alkaloides and glycosides or the other principles is distributed not only in Gloriosa L. but in almost all members of this family in various organs such as tubers, corms, rhizomes, in general underground parts as well as in seeds. The alkaloides found in this family are many and diversified. More than 2000 different alkaloides have been so far isolated from different plants. Amongst them colchicine has been the prominent one occurring in genera Gloriosa, Colchicum and Iphigenia (Cook and Loudon, 1952), Oberlin, 1857, Kaul et al, 1964).

The colchicine was first isolated from the seeds of the Meadow saffron or autumn crocus called Colchicum autumnale L. belonging to Liliaceae (Oberlin, 1857). Since then all other species of Colchicum were looked for colchicine. Because of the importance of this chemical in medicine and agriculture extensive search of this principle in other genera was carried out. Clewer et al (1915) showed that tubers of G. superba L. also contain colchicine. Subsequently the distribution of colchicine in Colchicum autumnale and Gloriosa species have been investigated by number of workers and today it has been well documented that all organs of these plants contain this alkaloid (Bryan and Luster, 1951, Santavy, 1956, 1957). The histochemical localization of colchicine in the tissue of Colchicum autumnale has been carried out by Liptak, (1927). This study has clearly demonstrated that the colchicine is located in the endosperm and the 3rd layer of seed coat. Similar histological studies have been carried out in Gloriosa virescens Lindl. by Burden et al (1955) and they reported that the poisoning principle and the toxic properties of the tubers of species are one and the same i.e. colchicine. Today much more than tubers, the seeds of Gloriosa are used for commercial tapping of the colchicine by industries and moreover the seeds are known to yield more colchicine content than tubers. However the quantum of seed yield per plant is relatively very low. The isotope labelling technique utilizing  $^{14}\text{C}$ -Sodium acetate

as a precursor of this alkaloid and subsequently tracing the activity in colchicine, distributed in the different organs of two major colchicine yielding plants of this region, Gloriosa and Iphigenia employed by Hegde and Lugade (1986 d) clearly demonstrated that the accumulation of colchicine takes place in the tuber of Gloriosa. This observation and plus the cytoassay technique clearly showed the colchicine content of different organs more reliably. A brief schematic presentation of biochemical path way leading to the Colchicinesynthesis is as follows :

