TABLE II

*Anaphase separation in* S. farinacea *var. Royal Blue*

| Nature of separation | Frequency |
|---|---|
| Regular anaphase separation | 130 |
| Early separation of a pair | 1 |
| Late separation | 1 |
| Unequal separation | 2 |
| Chromosome isolated in one corner | 2 |
| Two chromosomes isolated in one corner | 3 |
| Chromatid bridge | 3 |
| Laggards | 2 |
| Tripolar separation | 9 |
| Total | 153 |

*thinum*. Whether they are all due to a single basic cause which upsets the spindle (Vaarama[5]) or whether they arise due to separate causes cannot be stated without inducing them experimentally as has been done by Huskins *et al.*[3] Nevertheless, it is noteworthy that they exhibit a wide range and occur naturally with a high frequency.

From the above observations it can be assumed that the species represents an example of natural abnormalities found in plants. The meiotic studies in this species have also shown the presence of translocation as well as inversion.

*March* 14, 1980.


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## POLYPLOIDY AND SPECIATION IN *COSTUS SPECIOSUS* (KOEN.) SM.


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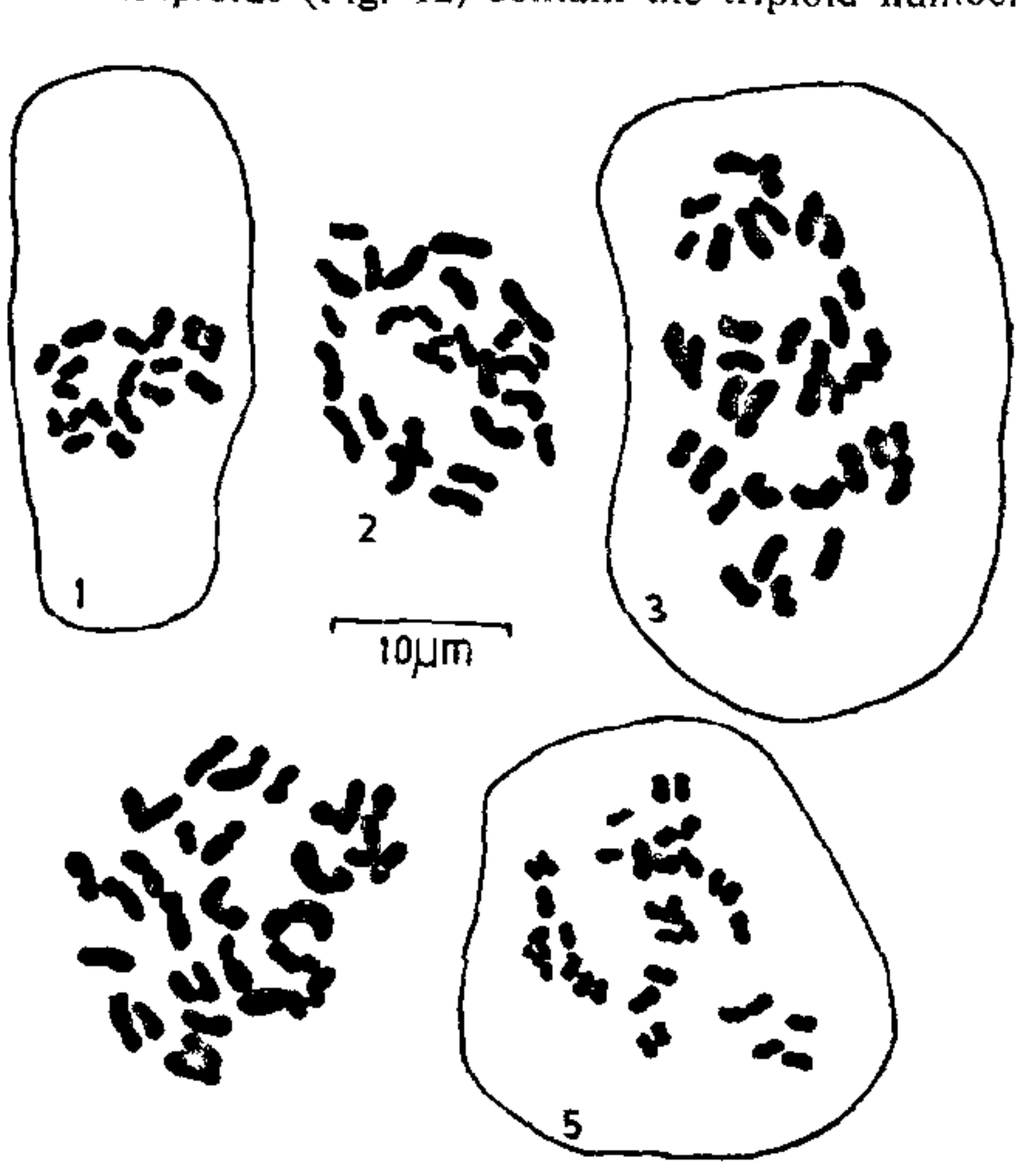
*Costus speciosus* (Koen.) Sm. belonging to the family Zingiberaceae has attained importance recently as a source of diosgenin, a precursor in the synthesis of steroidal hormones from the rhizome[1]. It has an extensive distribution in India and is more common in Bengal, Konkan[2] and the humid tropics of South India. It thrives well on rich moist soil, in shady localities under mixed deciduous forests. Propagation is usually by means of underground stem cuttings[3].

Occurrence of intraspecific polyploidy in *C. speciosus* has been reported by Subrahmanyam[4]. The cytological characteristics of polyploids of this species are being studied in this centre on a number of clones collected from Kerala and Jammu. Polyploidy, geographical distribution and probable origin of this species in the humid tropics of Kerala are discussed.

Cytological observations were made on races collected from Jammu, Kottayam, Shoranur, Kakkayam and Nedumboyil. Actively growing root tips were pre-fixed in 0·2 per cent aqueous colchicine for 2 h at 4° C and fixed in 1 : 3 acetic acid and ethanol for 24 h at 4° C. Fixed root tips were processed following the usual procedure and stained in 2% acetic orcein and 1 N HCl (9 : 1) mixture. Several metaphase plates were examined for each material and those with well spread chromosomes were drawn at a magnification of × 1,800. Microphotographs were taken from temporary preparations using a ZORKI 4 camera.

Evidently, this species shows intraspecific chromosomal races, namely, diploidy ($2n = 2x = 18$) (Figs. 1, 6 and 7), triploidy ($2n = 3x = 27$) (Figs. 2 and 8) and tetraploidy ($2n = 4x = 36$) (Figs. 3, 4, 5, 9 and 10). Relatively a few cells in the diploids (Fig. 11) as well as in tetraploids (Fig. 12) contain the triploid number




FIGS. 1–5. Camera lucida drawings of somatic chromosomes of *C. speciosus* at metaphase. Fig. 1. Nedumboyil (diploid), Fig. 2. Kakkayam (triploid), Fig. 3. Shoranur (tetraploid), Fig. 4. Kottayam (tetraploid) and Fig. 5. Jammu (tetraploid).

of chromosomes suggesting inconstancy in chromosome complements in somatic tissue. The diploids are distinguished from the triploid and tetraploids on account of their smaller leaves. Seed setting is 5·9% in the triploid whereas in the tetraploid and diploid races, it is 63·6 and 30·7% respectively. Our attempts on the diploid race from Nedumboyil showed that vegetative multiplication by aerial stem cuttings is a possibility (Figs. 13 and 14).

Chromosomes in general are very small in size ranging from 1·33 $\mu$m to 5·33 $\mu$m in length with the centromeres in the median or submedian positions.

Several species belonging to Liliaceae, Amaryllidaceae, Araceae, Zingiberaceae and other monocotyledonous members which are predominantly asexually reproducing show differential chromosome behaviour as evidenced by inconstancy in chromosome complements in somatic tissue[5]. That the absence of sexual reproduction limiting the origin of new combinations of genotype is an established fact. To compensate the absence of sexual reproduction, asexually reproducing species have evolved means of producing new genotypes. The origin of such new genotypes arises through non-disjunction, somatic reduction and partial endomitosis[6]. The regular occurrence of inconstancey in the chromosome complement plays an important role in speciation by participating in the formation of new daughter shoots[7]. The presence of chromosomal mosaicism, profuse vegetative reproduction and non-viable seeds in *C. speciosus* are thus the reflection of chromosome dynamism leading to speciation. Occurrence of both diploid and tetraploid races together at Shoranur strengthens this observation.

The diosgenin content seemed to vary among the different clones collected from different localities as well as in portions of the same rhizome[8]. This variation in diosgenin content can be attributed to the genetic consequences of chromosomal mosaicism seen in the somatic tissue of this species.

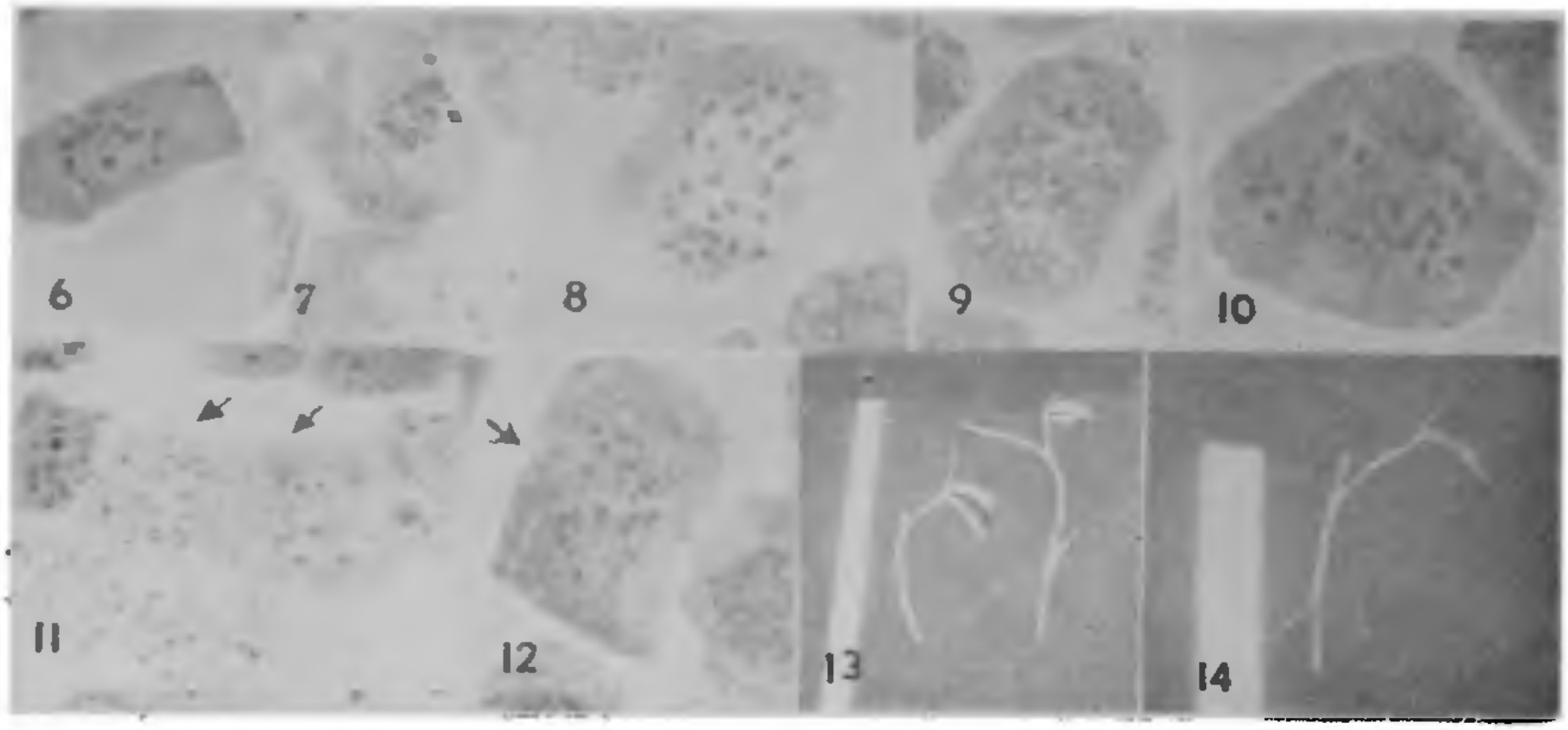
The occurrence of both the diploid and the tetraploid races in the same place at Shoranur and the occurrence of diploids, triploid and tetraploids in Kerala and adjoining places suggest that speciation could have occurred in the humid tropics of Kerala and adjoining regions. Their preference for humid tropic climate also substantiates this claim.

As far as we are aware, this is the first record on the occurrence of triploidy in *C. speciosus* in the mainland of India and the occurrence of diploids in South India. Details of present and past reports of chromosome numbers in this species are presented in Table I.

TABLE I

*Chromosome numbers in* Costus speciosus (*Koen.*) *Sm.*

| Locality | *n* | 2*n* | Author |
|---|---|---|---|
| Nedumboyil, Kerala | .. | 18 | Present study |
| Shoranur, Kerala | .. | 18 | do. |
| Japan | .. | 18 | Sato[9, 10] |
| Jorhat, Assam | .. | 18 | Subrahmanyam[1] |
| Arunachal Pradesh | .. | 18 | do. |
| Kakkayam, Kerala | .. | 27 | Present study |
| Trinidad | 9 II + 9 I | 27 | Simmonds[11] |
| Andaman | .. | 27 | Subrahmanyam[1] |
| Shoranur, Kerala | .. | 36 | Present study |
| Kottayam, Kerala | .. | 36 | do. |
| Jammu, Jammu and Kashmir | .. | 36 | do. |
| University College Experimental Garden, Calcutta | 18 II | 36 | Banerji[12] |
| Khumani, Darjeeling | .. | 36 | Sharma and Bhattacharyya[13] |
| Sibpore, West Bengal | 18 II | .. | Mitra and Datta[14] |
| South India | 18 II | 36 | Ramachandran[15] |
| Tenmalai forests, Tamil Nadu | .. | 36 | Raghavan and Venkatasubban[16] |
| ? | .. | 36 | Chakravorti[17] |
| Jammu, Jammu and Kashmir | 18 II | 36 | Subrahmanyam[9] |
| Kangra, Himachal Pradesh | 18 II | 36 | do. |
| Dehra Dun, Uttar Pradesh | .. | 36 | do. |
| Bamboo forest, Andaman | .. | 36 | do. |
| Mohanlalganj, Gopalkhera, Lucknow | 18 II | 36 | do. |




FIGS. 6–14. Photomicrographs of somatic chromosomes of *C. speciosus* at metaphase. Fig. 6. Shoranur (diploid), × 628. Fig. 7. Nedumboyil (diploid), × 593. Fig. 8. Kakkayam (triploid), × 620. Fig. 9. Shoranur (tetraploid), × 630. Fig. 10. Jammu (tetraploid), × 630. Fig. 11. Nedumboyil—arrows indicate triploid cells in diploid tissue, × 655. Fig. 12. Jammu—arrow indicates a triploid cell in tetraploid tissue, × 614. Figs. 13–14. Rooted aerial stem cuttings, after 10 and 20 days respectively.

We are indebted to Dr. E. K. Janaki Ammal, Emeritus Scientist, for guidance and critically going through the manuscript. We are thankful to Prof. A. Mahadevan, Director, for facilities. Dr. R. Balasubramanian, Lecturer, is thanked for many fruitful suggestions. Financial assistance from the Department of Science and Technology (Government of India) is gratefully acknowledged.

*May* 14, 1980.

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## INDUCED TETRAPLOIDY IN *SOLANUM NIGRUM* L. COMPLEX

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*Solanum nodiflorum* Jacq. and *Solanum americanum* Mill. are diploids ($2n = 24$) of the *Solanum nigrum* L. complex. Autotetraploidy was induced in *S. nodiflorum* and *S. americanum* with the help of 0·2% colchicine at the seedling stage. The induced tetraploids were an enlarged replica of their corresponding diploids and resembled them in all characters, including the colour of the fruit. A comparative morphological and cytological study of induced tetraploids with natural tetraploid *S. nigrum* showed that the natural tetraploids are not the autotetraploids of either *S. nodiflorum* or *S. americanum*. It is thus clear that