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STUDIES ON THE PROGENIES OF A CROSS BETWEEN DIPLOID AND TETRAPLOID TEA

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A comparative study had been made with F_1 plants derived from the cross between diploid clone TV1 and tetraploid TR1 All the plants showed variability in their morphogenetic attributes. Of the five growing plants, four resembled either of the parents in most of the non parametric characters Cytological studies in one of the plants showed it to be diploid Another plant with weak growth habit exhibited a mixed character of both the parents Chromosome studies showed 23 bivalents to 22 bivalents and one univalent in its pollen mother cells indicating it to be triploid

It was observed that tetraploid and its crosses with desired diploid clones were found to be promising indicating their probable importance in yield and quality potential in tea breeding

INTRODUCTION

In a highly heterozygous crop like tea with a variable pattern of inheritance, the general breeding approach is to increase the genetic variability of potential importance in the population through diversified crossing or polyploidization and to base selection on important criteria There are reports of the occurrence of desirable polyploids which has a special significance in a crop like tea (Katsuo, 1966, Anon , 1969-70 , Bezbaruah, 1971 , Amma, 1974 , Sebastiampillai, 1976) Therefore, in order to study the differential performances of the progenies and their probable contribution to the improvement of tea, a hybridization programme between a diploid clone and tetraploid tea was carried out

In this paper, the F_1 seedling population of the cross between diploid (TV1) and tetraploid (TR1) tea have been evaluated for their variability in morphogenetic attributes, determination of their ploidy level as well as for dependable selection criteria

MATERIALS AND METHODS

All the six F_1 progeny of the cross TV1♀ X TR1♂ and their parental stocks were chosen for the investigation Most of the chosen characters were measured on a numerical scale The procedure adopted was as follows

(*a*) *Mature leaves* Measurement for attributes were made on twenty mature leaves per plant The outline of each leaf was drawn on paper and the length (L) from the leaf base to the leaf apex and the width (W) at the widest point were measured The product L X W was used as an index of leaf size and the ratio L/W as an indication of shape Stomatal density was also calculated while measurement of guard cells were done by micrometer

(*b*) *Pollen* Pollen was collected from flowers Staining was done in 5% aceto-carmine solution to study the pollen fertility Pollen germination and pollen tube growth following two hours treatment in 5% sucrose solution were done at room temperature Measurements were done by disc micrometer Camera lucida drawings were made to show the pollen tube growth

(*c*) *Cytology* Flower buds were fixed in standard Carnoy's solution and smear preparation was made permanent (Rashid, 1969) Camera lucida drawings were made to show the chromosome distribution

(*d*) *Non-parametric characters* Variation in non-parametric characters e g patina, texture, colour, apex etc was determined from notes taken in the field as well as from inspection of the samples used for other measurements

RESULTS AND DISCUSSION

Differences in morphological and anatomical characteristics were sufficiently distinct (Tables 1 and 2 , Figs 1 and 2)

Mature leaves of all the hybrid progenies varied in comparison to their parental types They ranged from tiny narrow to large broadly elliptical leaves

Plant No 1 Showed stunted and abnormal growth while the leaves were narrow and very small (Table 1) The stomatal density was lower than the diploid but higher than the tetraploid (Table 2) The plant did not correspond to any of the parental types The cause of the abnormal growth could not be studied as the plant did not survive

Plant No 2 Vigorous growth habit and has close morphological resemblance to the tetraploid plant Stomatal density was lower than the diploid but a little higher than the tetraploid This plant has not yet flowered

Plant No 3 Small bushy plant with slow and weak growth habit Leaves were light green and soft Stomatal density was lower than the diploid but a little higher than the tetraploid Pollen fertility, germination and pollen tube growth were low in comparison to parental types (Table 3 and Fig 3) Cytological studies showed 23 bivalents and sometimes 22 bivalents and 1 univalent at Metaphase I (Fig 4) which indicated its triploid status

Plant No 4 Vigorous growth habit and close to the tetraploid plant in its morphological characteristics Stomatal density was also very close to the tetraploid plant On the other hand, pollen fertility, germination, size and pollen tube growth were lower than the tetraploid parent Cytological studies could not be carried out due to the non availability of appropriate flower buds.

TABLE 1—*Comparative non-parametric characteristics*

	Clone/Hybrid							
Characteristics	*TVI* (2*x*)	*TRI* (4*x*)	*Plant No* 1	*Plant No* 2	*Plant No* 3	*Plant No* 4	*Plant No* 5	*Plant No* 6
Bush	Large and orthotropic	Large and semi-orthotropic	Very small and semi-orthotropic	Medium and semi- orthotropic	Small and semi-orthotropic	Medium and semi-orthotropic	Large and orthotropic	Large and orthotropic
Leaf								
Shape	Oblong	Obovate	Narrow	Obovate	Broadly elliptical	Elliptical	Elliptical	Elliptical
Size	Medium	Medium	Small	Medium	Medium	Medium	Comparatively large	Comparatively large
Pose	Erect	Semi erect	Semi erect	Semi erect	Erect	Semi erect	Erect	Erect
Colour	Green	Dark green	Light green	Dark green	Light green	Green	Light green	Green
Texture	Thick and soft	Very thick and tough	Thin and soft	Fairly thick and rather tough	Comparatively soft	Thick	Thick and embossed	Thick
Patina	Glossy	Matt	Glossy	Matt	Matt	Matt	Glossy	Glossy
Apex	Acuminate	Without definite apex	Blunt	Blunt	Without definite apex	Definite	Acute	Acute
Growth	Vigorous	Vigorous	Retarded	Vigorous	Weak and poor	Vigorous	Vigorous	Vigorous

TABLE 2—*Comparative leaf characteristics*

Clone/Hybrids	Mature leaf characteristics (mean values mm)				Stomatal density (mean of 20 Observations)	Mean B/L ratio of guard cells (μ)
	Length (L)	Width (W)	L×W	L/W		
TV1 (2x)	116 6	61 2	7135 42	1 90	15	0 36
TR1 (4x)	136 6	47 4	6474 84	2 58	6	0 49
Plant No 1	47 3	26 0	1229 80	1 82	9	0 34
Plant No 2	110 8	63 3	7013 64	1 75	8	0 30
Plant No 3	97 1	44 5	4320 95	2 18	8	0 29
Plant No 4	108 5	42 5	4611 25	2 55	7	0 31
Plant No 5	151 6	49 7	7534 52	3 05	13	0 33
Plant No 6	165 8	54 4	9019 52	3 05	16	0 32

TABLE 3—*Comparative pollen characteristics*

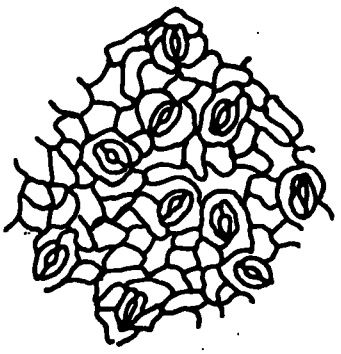
Clone/Hybrids	Pollen fertility (%)	Pollen size (μ)		Pollen germination (%)	Pollen tube growth (%)
		Longitudinal	Cross diameter		
TV1 (2x)	89 37±1 54	42 52±1 62	39 80±1 54	43 75±1 45	80 60±1 62
TR1 (4x)	83 43±1 56	58 07±1 48	50 85±1 66	62 97±1 52	147 25±1 38
Plant No 3	27 96±2 83	57 79±1 90	48 89±1 68	27 76±0 86	49 60±0 94
Plant No 4	67 08±2 97	47 82±2 38	46 44±2 07	11 57±2 16	115 48±0 57
Plant No 6	99 47±0 53	49 19±2 51	41 62±1 49	74 33±2 40	149 26±3 4

Note Others have not yet flowered

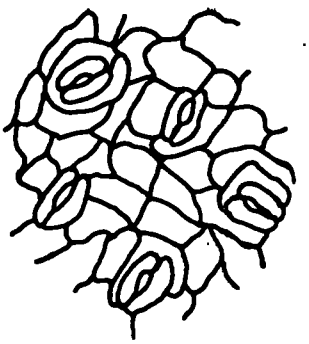
Plant No 5 Moderately large bush with bigger and thick shoots resembling the diploid parent Stomatal density was higher in comparison to the tetraploid but slightly lower than the diploid Has not yet flowered

Plant No 6 Large bush with larger leaves and thick shoots corresponding to the diploid parent Stomatal density was higher in comparison to parental types Pollen fertility, germination percentage, pollen tube growth were also comparatively higher than either of the parents Cytological studies showed 15 bivalents at Metaphase I which indicated its diploid nature

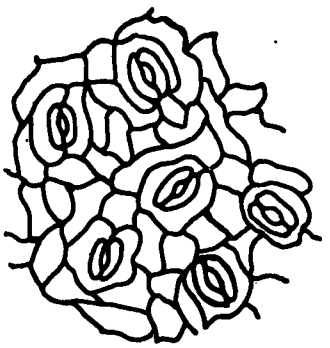
Of the five growing F_1 plants, four have close resemblances to either of the parents, while the other one showed mixed morphological characteristics Plant Nos 5 and 6 have resemblances to the diploid parent in most of the non-parametric characters like leaf pose, texture, patina, etc , while they differed in leaf shape and size etc Deviation in other morphogenetic features from the diploid parent might be due to polygenic effect



TV 1 (2 x)



TR 1 (4 x)



Scales = ← 1 μ

Plant No. 3 (♀ TV 1 x ♂ TR 1)

Fig. 2 — Semi diagrammatic representation of stomatal density

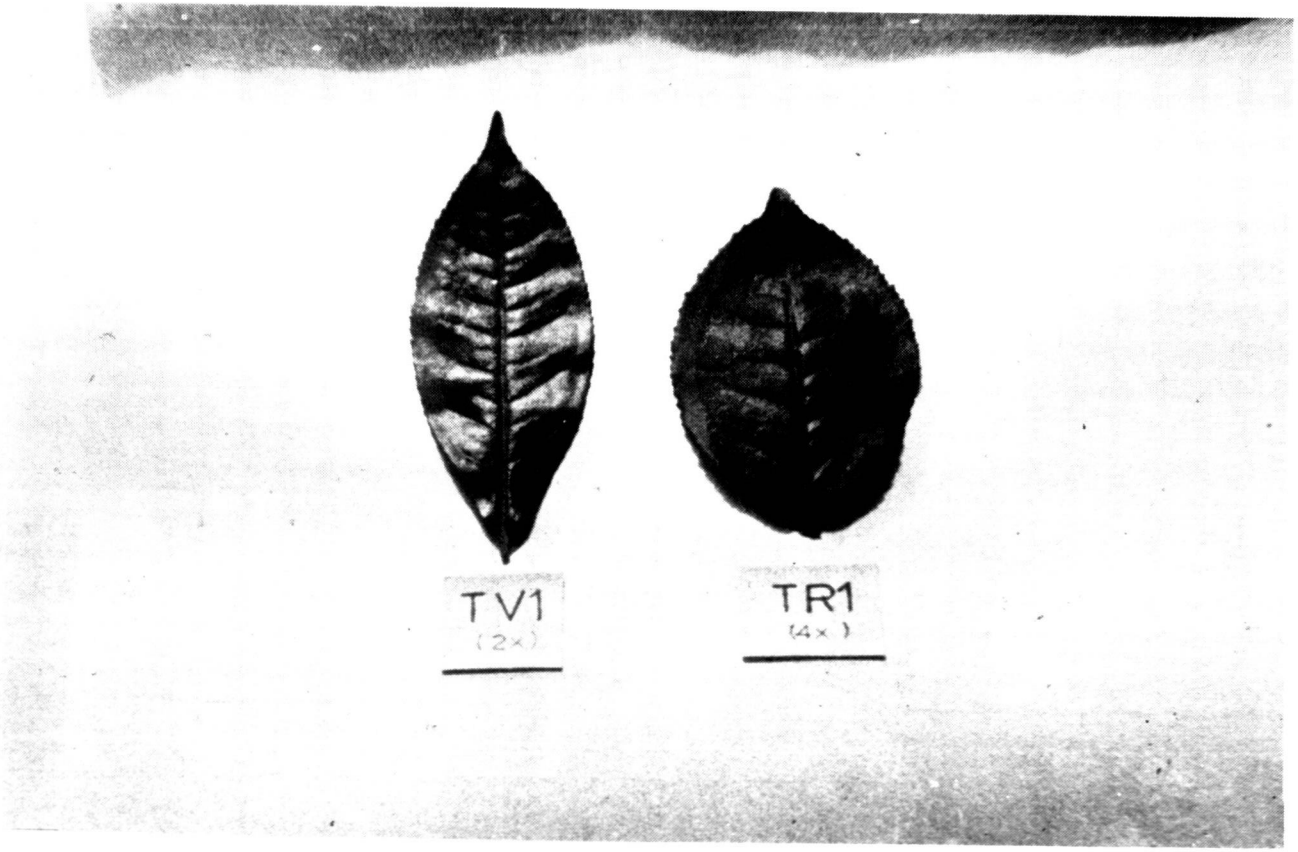


Fig. 1 (a) — Mature leaves of parental stocks : TV1 (2x) and TR1 (4x)

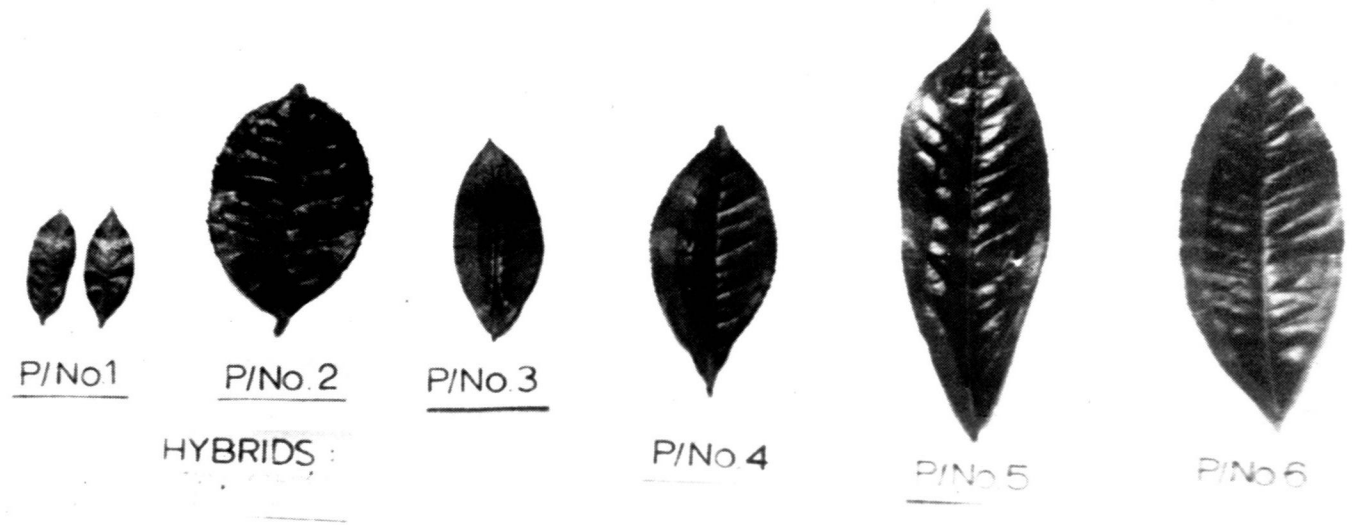


Fig. 1 (*b*) — *Mature leaves of the hybrid progenies.*

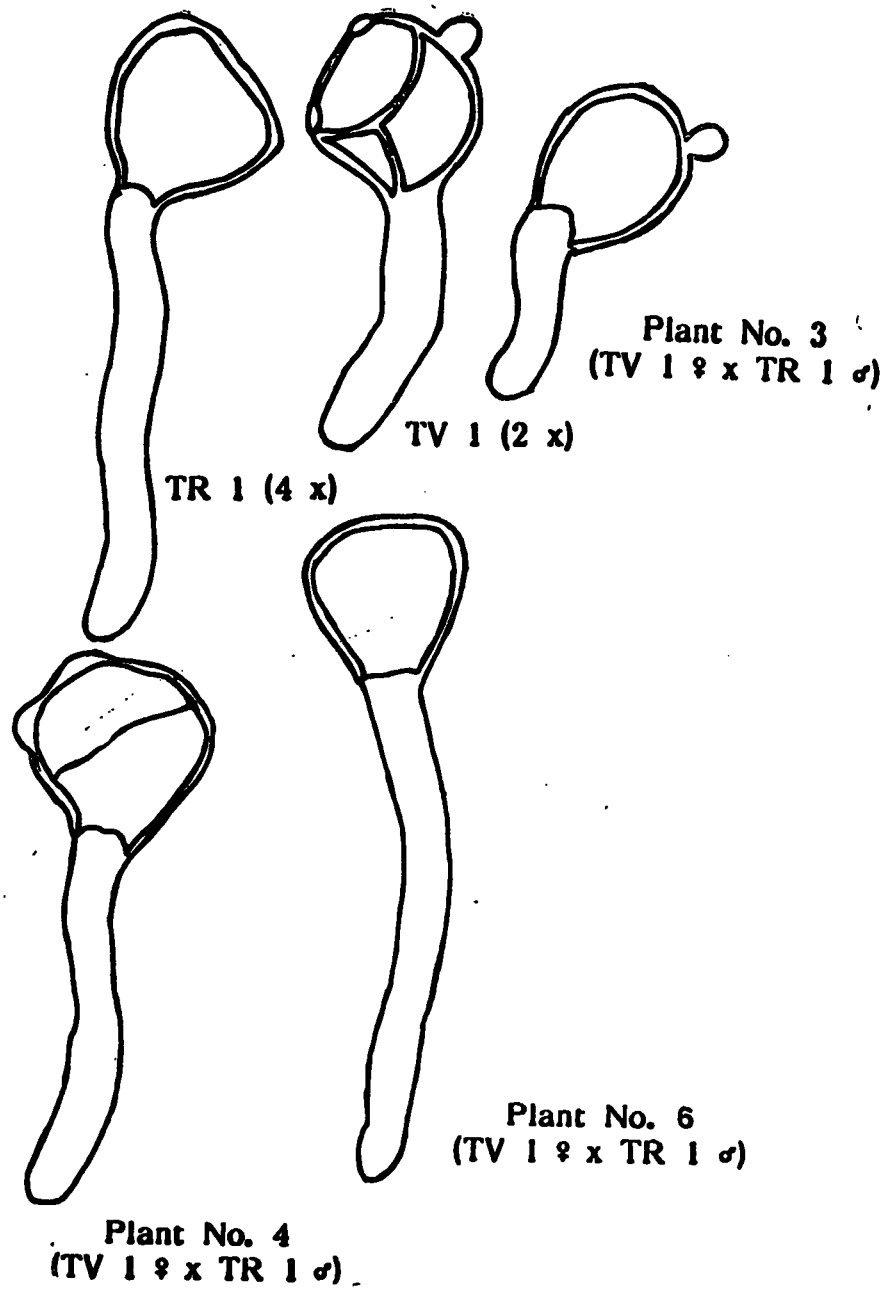


Fig. 3 — *Pollen tube growth* (*X*1250)

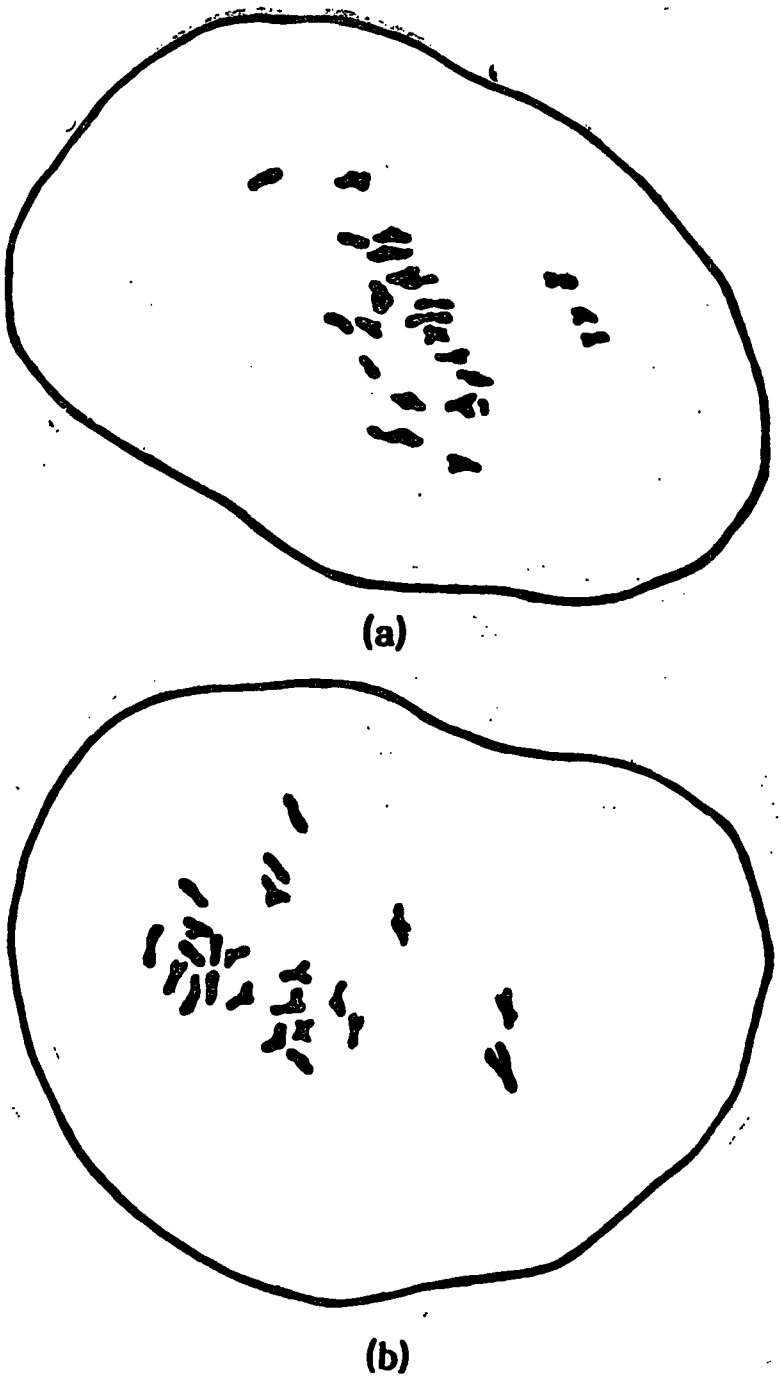


Fig. 4 — *Stages of Meiosis I showing chromosome distribution in Plant No.* 3 (*TV*1♀ *X TR*1♂)
(*a*) *Metaphase I showing* 22 *bivalents and* 1 *univalent.* (*X*1250)
(*b*) *Metaphase I showing* 23 *bivalents.* (*X*1250)

Pollen fertility, size and pollen tube growth in Plant No. 6 was higher than the diploid. Cytological studies confirmed its diploid nature.

Plant Nos. 2 and 4 show close resemblance to their tetraploid parent in most of the non-parametric characters. Pollen fertility, size and pollen tube growth in Plant No. 4 were, by comparison, lower to the tetraploid. Pollen germination was found to be very much reduced. The ploidy level of this plant is yet to be studied.

Plant No. 3 showed a slow and weak growth habit and exhibited a mixed character of both the parents. Chromosome studies revealed the triploid nature of this plant which might have induced this weak growth habit.

From the foregoing it is apparent that all the characteristics of the progenies showed variation and provided a fair degree of hybridity, which usually implies polygenic determination requiring more biometric approaches. Whatever be the genetic basis of these plants, the contrasting characters had their origin in the two parental stocks from which they were derived. These results, clearly point out that when yield and quality improvement through polyploidization is sought for it is desirable that emphasis is given to hybridization between tetraploid and desired diploid clone types.

REFERENCES

AMMA, S (1974) Characteristics of tetraploid tea induced from Gamma irradiated Yabukita variety. *Study of Tea.* 46, 1-6.

ANONYMOUS (1969 - 70), *Ann. Rep. Tea Res. Assn.* Calcutta p. 40.

BEZBARUAH, H. P. (1971). Cytological investigation in the family Theaceae 1. Chromosome numbers in some *Camellia* species and allied genera. *Caryologia.* 24 (4), 421-426.

KATSUO, K (1966). Methods of inducing the polyploid tea plant by colchicine treatment of the axillary bud. *Study of Tea.* 33, 1-4.

RASHID, A. (1969). Contribution a l'etude caryosystematique des halophytes et psammophytes de la zone littorals languedocienne. PhD. Thesis. University of Montpellier, France. pp. 8-9.

SEBASTIAMPILLAI, A. R. (1976). A simple technique for the induction of polyploids in the tea. *Tea Q.* 46, 12-15.