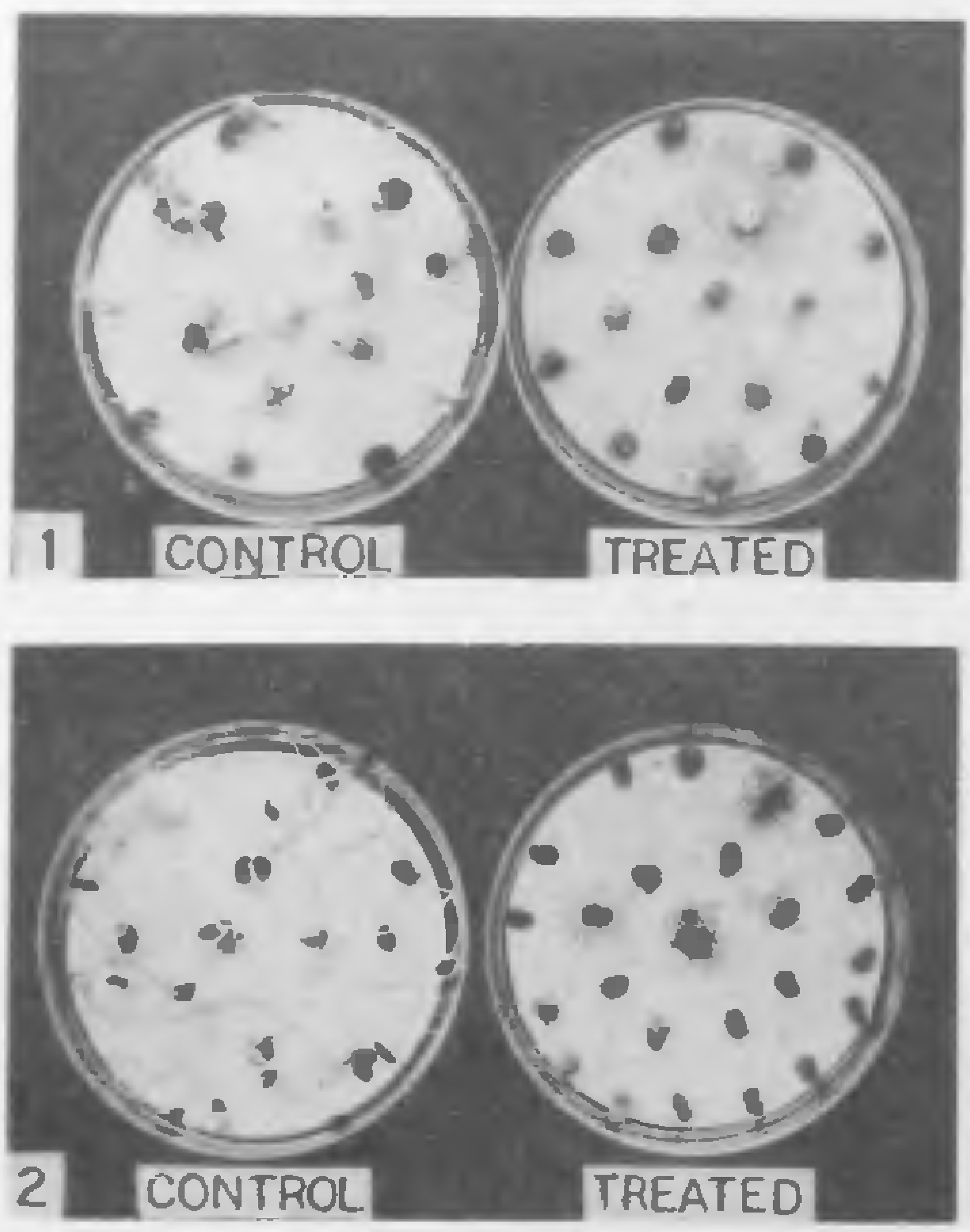
Table 1 *Incidence of seed-borne Phoma species and Macrophomina phaseolina on standard blotter and modified blotter*

	Percent incidence on			
	Standard blotter		Modified blotter	
Crop	*Phoma* spp	*Macrophomina phaseolina*	*Phoma* spp	*Macrophomina phaseolina*
Cluster bean	6	–	11.8	–
Groundnut	9	–	14.0	–
Cow pea	5	–	11.5	–
Sorghum	32	–	51.5	–
Chilli	–	6.5	–	11
Horse gram	–	20.0	–	32



Figures 1, 2. **1.** Profuse growth of *Phoma* species on clusterbean seed incubated on the blotters treated with 5% calcium chloride solution: **2.** Profuse growth of *Macrophomina phaseolina* on horse gram seed incubated on the blotters treated with 5% calcium chloride solution

all the known methods which help in determining even traces of the inoculum present on the seed.

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1. Neergaard, P., *Seed pathology.* The Macmillan Press, London, Vols 1 and 2, 1977.
2. Hagborg, W. A. F., Warner, G. M. and Phillips, N. A., *Science*, 1950, **111**, 91.
3. ISTA, *Proc. Int. Seed Test. Assoc.*, 1966, **31**, 152.

CYTOLOGICAL OBSERVATIONS ON SOME AUTOTETRAPLOIDS AND AMPHIDIPLOIDS IN SPINOUS SOLANUMS AND THEIR BEARING ON INTERRELATIONSHIPS

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SEVERAL interspecific hybrids involving *Solanum melongena* L and its wild forms, *S. indicum* L, *S. integrifolium* Poir, *S. surattense* Burm F (= *S. xanthocarpum* Schrad and Wendl) were produced. In all hybrids, formation of twelve bivalents per PMC was common ($2n = 24$) with higher chromosome associations prevailing to varying extents suggesting close genome relationships with chromosomal repatterning to varying extents in their speciation. The objective of the present communication is to further our knowledge on spinous solanums in this direction.

Propionic carmine schedule was used in cytological analyses. Statistical calculations were made following Snedecor and Cochran[1].

General chromosome behaviour and chiasma frequencies in the amphidiploids and autotetraploids are summarised in table 1. A comparative study of the doubled mean chiasma frequencies of the diploids and tetraploids revealed that the three autotetraploids had significantly lower chiasma frequency than the doub-

Table 1 *Mean number of chiasmata per association in various amphidiploids and autotetraploids*

Cultures	Bivalents	Trivalents	Quadrivalents	Mean chiasma frequency per PMC
Amphidiploids				
S. indicum × *S. integrifolium*	1.68	2.06	3.82	40.60
	(17.27)	(0.64)	(2.73)	
S. integrifolium × *S. indicum*	(1.71	2.21	3.77	40.83
	(17.00)	(0.50)	(3.00)	
S. integrifolium × *S. melongena*	1.85	2.09	3.86	44.24
	(18.14)	(0.22)	(2.64)	
S. surattense × *S. melongena*	1.40	2.00	3.67	34.83
	(18.93)	(0.29)	(2.11)	
Autotetraploids				
S. melongena var *insanum*	1.66	2.13	3.74	40.00
	(12.40)	(1.60)	(4.20)	
S. integrifolium	1.39	2.08	3.51	34.50
	(15.02)	(1.47)	(3.00)	
S. indicum	1.52	2.13	3.75	38.16
	(14.53)	(1.05)	(3.68)	

Figures in parentheses indicate mean frequency of each association per PMC

led values of the corresponding diploids. This reduction is by about 4–5 chiasmata. Such a reduction is seen in many species[2–4]. Upcott[4] argues that the reduction is due to delayed pairing and an increase in the size of the nucleus irrespective of the type of ploidy.

With reference to the amphidiploids, chiasma frequency was reduced in *S. surattense* × *S. melongena*. Reduced chiasma frequency in this could be due to the influence of *S. surattense* genotype used in hybridization. The different populations of this species exhibit wide variability in chiasma frequency[5,6] indicating the existence of genomic differences among the different populations. Such a situation was also encountered by Westermann[7] in *Phaeacridium* and Rees and Dale[8] in *Lolium* and *Festuca*. In the rest of the amphidiploids, chiasma frequencies were significantly greater than the doubled values of the corresponding F_1s.

The bivalent frequency ranged from 17.00 to 18.93 as against 24 if autosyndesis were expected in amphidiploids. In the autotetraploids, the frequency of bivalents ranged from 12.40 to 15.02.

Because of irregular distribution of chromosomes at anaphase-I, autotetraploids were pollen sterile[9] (sterility upto 50%). In contrast, amphidiploids were partially sterile despite comparatively regular chromosome behaviour. Amphidiploids do have allosyndetic pairing which might result in the formation of genetically unbalanced gametes[10]. Also physiological factors do play a significant role in the sterility of amphidiploids.

The three F_1 hybrids, *i.e. S. integrifolium* × *S. melongena* and its reciprocal and *S. surattense* × *S. melongena* showed $I_{IV} + 10_{II}$ per PMC as most frequent association and the F_1 *S. integrifolium* × *S. melongena* evidenced bivalent pairing in about 95% of PMCs[11–13]. The two hybrids, *S. integrifolium* × *S. melongena* and *S. surattense* × *S. melongena* had mean chiasma frequencies greater than in their respective female parents and almost approached that in *S. melongena*, which showed the highest value in the group. The other two F_1 hybrids had chiasma frequencies slightly lower than in their parents.

The general expectation in the amphidiploids then would be the realization of good frequency of quadrivalents, comparable to that in corresponding species autotetraploids, which, however did not come true. *S. melongena* var *insanum* had similar chromosome pairing and chiasma frequency as *S. melongena*. So tentative conclusions can be drawn from the comparisons of the autotetraploid *S. melongena* var *insanum*. The reciprocal amphidiploids of *S. integrifolium* and *S. indicum* showed almost similar chromosome behaviour as the corresponding species autotetraploids except that the amphidiploids had significantly greater frequency of ring bivalents. The amphidiploid *S. integrifolium* × *S. melongena* showed significantly greater frequency of ring bivalents and lower frequency of rod bivalents than the corresponding autotetraploids. However, the amphidiploid had lower quadrivalent frequency than the tetraploid *S. melongena* var *insanum*. Preferential pairing could be

Table 2 *t values of comparisons of mean frequencies of various chromosome associations between amphidiploids and autotetraploids*

Comparison	Bivalents (rods)	Bivalents (rings)	Quadrivalents
S. indicum × *S. integrifolium* vs *S. integrifolium*	1.2261	2.6165**	0.9181
S. indicum × *S. integrifolium* vs *S. indicum*	1.3765	1.2316	2.0981*
S. integrifolium × *S. indicum* vs *S. integrifolium*	2.2603*	4.1691**	—
S. integrifolium × *S. indicum* vs *S. indicum*	0.0207	2.4595*	1.2078
S. integrifolium × *S. melongena* vs *S. melongena* var *insanum*	4.4602**	2.8031**	5.3516**
S. integrifolium × *S. melongena* vs *S. integrifolium*	9.8778**	3.3991**	1.2350

* Significant at 5 % level ** Significant at 1 % level

prevalent to greater extent in this amphidiploid than in the rest of the amphidiploids. It can also be inferred from the above observations that the level of chromosome differentiation between the genomes of *S. integrifolium* and *S. indicum* is at a lower degree (table 2).

S. surattense is supposed to have played an important role in the origin of *S. melongena*[14]. In the amphidiploid *S. surattense* × *S. melongena*, nonavailability of the required number of chiasmata could have resulted in a lower quadrivalent and a high rod bivalent frequency; possibly the association of four chromosomes could have broken into two rod bivalents.

Thus, *S. melongena*, *S. indicum* and *S. surattense* form a closely related group. *S. integrifolium* is farther apart from *S. melongena* and closer to *S. indicum*. It is also not very close to *S. surattense* because obtaining a hybrid with it is very difficult. These relationships are not surprising because *S. integrifolium* is an exotic species.

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1. Snedecor, G. W. and Cochran, W. G., *Statistical methods*, Iowa Univ. Press, Ames, Iowa, 1967.
2. Hazairka, M. H. and Rees, H., *Heredity*, 1967, **22**, 317.
3. Narsinga Rao, P. S. R. L. N., *Cytogenetic studies of autotetraploid pearl millet (Pennisetum typhoides S & H)*. Unpublished Ph.D. thesis, Andhra Univ., Waltair, 1978.
4. Upcott, M., *J. Genet*., 1939, **39**, 79.
5. Rattankumar, S., Moorty, K. V. and Rao, B. G. S., *Indian J. Bot*., 1981, **4**, 91.
6. Rao, S. V., *Studies on the crossability relationships of some spinous solanums*. Unpublished Ph.D. thesis, Andhra Univ., Waltair, 1977.
7. Westermann, M., *Chromosoma*, 1974, **46**, 207.
8. Rees, H. and Dale, P. J., *Chromosoma*, 1974, **47**, 335.
9. Darlington, C. D., *J. Genet*., 1931, **24**, 65.
10. Kirti, P. B. and Rao, B. G. S., *Caryologia*, 1983, **36**, 155.
11. Kirti, P. B. and Rao, B. G. S., *Proc. Indian Acad. Sci*., 1982a, **B91**, 83.
12. Kirti, P. B. and Rao, B. G. S., *Genetica*, 1982b, **59**, 127.
13. Rao, S. V. and Rao, B. G. S., *Curr. Sci*., 1977, **46**, 124.
14. Raju, D. S. S., Moorty, K. V., Kirti, P. B. and Rao, B. G. S., *Indian J. Bot*., 1981, **4**, 91.

CYTOMIXIS IN MULBERRY

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GATES[1] first observed a frequent migration of chromatin material from one PMC to another in *Oenothera biennis* and *O. gigas* and called it cytomixis. Since then, this phenomenon has been observed in several other plants[2, 3]. We report here the occurrence of this phenomenon in mulberry.

Cytomixis is generally observed in genetically unbalanced types such as hybrids, haploids, triploids[4]. At this Research Institute, triploid mulberry (*Morus*) was evolved by crossing induced tetraploids with diploids[5]. Triploids are superior to other varieties in leaf yield