TABLE II

Frequency of different kinds of chiasma per cell at diakinesis in Lathyrus sativus L. *following seed irradiation* (M_1 *generation*)

Total cells observed in each case = 50

Doses in kR	Interstitial chiasmata per cell	Terminal chiasmata per cell	Total chiasmata per cell	Terminalization coefficient per cell
		(A) P_{593}		
0	1·18	8·12	9·70	0·84
10	2·54	8·98	11·32	0·79
20	2·96	9·52	12·48	0·75
30	3·86	9·30	13·16	0·70
40	3·76	9·92	14·48	0·68
50	4·61	9·90	14·56	0·68
		(B) P_{585}		
0	2·70	8·60	10·94	0·77
10	2·14	9·04	11·18	0·81
20	2·50	8·88	11·42	0·77
30	4·38	7·78	12·36	0·63
40	4·66	7·62	13·04	0·58
50	5·88	8·81	14·70	0·59
		(C) LC_{76}		
0	2·02	8·98	10·58	0·85
10	2·14	8·60	10·74	0·80
20	2·34	8·60	10·94	0·78
30	3·06	8·66	12·10	0·71
40	3·26	9·06	12·12	0·74
50	3·70	9·06	12·66	0·71

in control or irradiated samples. The number of interstitial chiasmata per cell (Table II), although differ between varieties, has been noted to depend on dose and variety. So far as terminal and total chiasma and terminalization coefficient are concerned, the main difference has not been recorded between treated and untreated samples but between varieties as expected. The increase in terminalization coefficient per cell with increase in dose indicates variation between varieties.

Positive, negative and non-significant correlation of chiasma frequencies between bivalents have been ascribed to the effect of environment by Mather[3] and to ploidy by Prasad and Godward.[1] Since in the present experiment, control and irradiated plants were grown under similar environments, the variation encountered for distribution of chiasmata between and within nuclei and the frequency of interstitial, terminal and total chiasma may be the consequence of genotypic differences of varieties and doses of gamma-rays. Irradiation is known to affect pairing properties of homologous segment of chromosomes through altering chromosomal structure. Observation of bridges and fragments at M_1 meiosis in the present case (Das[4]) indicates the persistent nature of induced cryptic changes in somatic chromosomes. The dependence of the rate of elimination of chromosomal aberrations on dose and variety (Das and Prasad[2]), may be considered as a probable cause of difference in the occurrence of interstitial, terminal and total chiasmata between varieties. The occurrence of non-significant correlation is similar to that reported by Prasad and Godward[1].

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TEMPERATURE RESPONSES TO SEED GERMINATION IN TWO CLOSELY RELATED TREE SPECIES OF *SCHIMA*, REINW

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A NUMBER of studies on germination ecology of species are available wherein germination requirements are closely related to their adaptation and distribution pattern in space[1–3] and in time[4]. Temperature requirement is one such factor which has received considerable attention[3–6]. However this aspect of the problem in relation to adaptive strategy of tree species has not received much attention[7]. The present study is concerned with temperature responses of the seeds of *Schima khasiana*, Dyer and *S. wallichii*, Choisy, two closely related and economically important timber tree species of north-east India, which are also extensively distributed in Meghalaya, on an altitudinal basis. The former is restricted to higher elevations (1600 to 1900 m), whereas the latter occurs at lower elevations (300 to 1600 m).

Seeds of *S. khasiana* and *S. wallichii* were collected from upper Shillong (1800 m) and Mawlai (1300 m) respectively during February-March 1978, which were separated out from fruits by air drying. Germination

TABLE I

Germination total (%) (with S.E. values) for S. khasiana *and* S. wallichii *at different temperature regimes*

Species	Constant temperatures (° C)						Alternating temperatures (° C)	
	10	15	20	25	30	35	25/20	25/15
S. khasiana	10±2·3	55±2·7	46±3·6	44±2·9	42±2·2	0	45±5·5	46±2·3
S. wallichii	0	37±4·3	48±6·0	48±6·8	33±4·1	20±7·5	50±4·6	48±4·1

TABLE II

Germination values (with S.E.) for S. khasiana *and* S. wallichii

Species	Constant temperatures (° C)						Alternating temperatures (° C)	
	10	15	20	25	30	35	25/20	25/15
S. khasiana	0·32±0·12	12·08±0·9	6·08±0·9	8·66±1·7	3·41±0·43	0	2·36±1·18	3·82±0·58
S. wallichii	0	6·34±1·6	9·4±2·0	8·83±1·6	4·06±0·5	3·23±2·0	10·95±2·2	2·36±1·18

tests were performed, at a given temperature in incubators, on fresh seeds between moist filter papers. Only alternating temperature regimes received 14 hour light period at the time of higher temperature in the cycle. Fifty seeds in four replicates were used for all treatments.

Table I shows that seeds of both the species could germinate well over a wide range of temperatures, though the germination of *S. khasiana* was poor at 10° C and no germination occurs for *S. wallichii* at this temperature. At constant temperature regimes, while *S. khasiana* gave optimum germination at 15° C, that for *S. wallichii* occurred at 20 and 25° C. The two alternating temperature regimes did not have any favourable effect on the germination of *S. khasiana*, whereas the germination of *S. wallichii* improved slightly at 25/20° C alternating temperature regime compared to that at a constant 20 or 25° C. Further the range of temperature at which at least some germination occurred varied for the two species, *S. khasiana* having a range of 10 to 30° C and *S. wallichii* with a range of 15° to 35° C.

Germination values are given in Table II which are indices of germinability combining speed and completeness of germination, and are calculated using the formula PV × MDG where PV represents peak value of germination and MDG represents mean daily germination[8]. This is a better indicator of germination behaviour of the species concerned. *S. khasiana* gave maximum value at a constant temperature of 15° C. It is significant that the values at alternating temperature regimes for *S. khasiana* were extremely low though the final germination total was fairly good as seen from Table I. This is due to very low mean daily germination at alternating temperature regimes compared to that at constant temperatures of 20 or 25° C, where also the final germination total is more or less similar. *S. wallichii*, on the other hand, gave maximum germination value at 20° C followed by 25° C constant. It is significant that much better germination value was observed for this species at an alternating temperature of 25/20° C.

These results indicate that the two species are closely adapted to their altitudinal restriction at least as far as temperature response to seed germination is concerned. Thus, *S. khasiana* exclusively found at higher elevations tends to germinate better at lower temperatures and *S. wallichii* from lower elevations responds better to comparatively higher temperatures. Though such studies are lacking in this country, particularly on tree adaptation, similar conclusions have been made on some temperate trees like *Pinus contorta*[9], *P. sylvestris*[10] and *Acer negundo*[11].

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PINJORIAPOLLIS, A NEW FOSSIL POLLEN FROM THE PINJOR FORMATION (UPPER SIWALIK) EXPOSED NEAR CHANDIGARH

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A Palynoflora consisting of 19 genera and 23 species of fungal and pteridophytic spores and gymnospermous and angiospermous pollen grains from the Pinjor Formation (Upper Siwalik) exposed near Chandigarh has been recorded by Saxena and Singh[2]. In this assemblage one genus, *viz.*, *Pinjoriapollis* is new. The systematic description of this genus along with its two new species, *viz.*, *P. magnus* and *P. lanceolatus* is given below.

Genus—*Pinjoriapollis* gen. nov.

Type species.—*Pinjoriapollis magnus* sp. nov.

Generic diagnosis.—Pollen grains elliptical or lanceolate in shape (length two and a half times of breadth), heteropolar; large in size, 120–170 × 51–70 μ. Monosulcate, sulcus wide throughout its length, extending from one end to the other. Exine up to 3·5 μ thick, laevigate, faintly intrapunctate, tegillate.

Comparison.—The present genus is comparable with *Palmidites* Couper in having single furrow (sulcus) and laevigate exine. However, *Pinjoriapollis* can easily be distinguished by its tegillate exine and exceptionally big size (120–170 × 51–70 μ) while *Palmidites* is only 70–88 × 30–57 μ in size. Besides, there is remarkable difference in the length/breadth ratio of the said two genera; in *Pinjoriapollis* length is about two and a half times of the breadth providing it an elongated-elliptical shape; while in *Palmidites* length is little less than twice of its breadth providing it a ± oval shape. The present genus is also comparable with *Arecipites* Wodehouse in being monosulcate but in the latter furrow is closely tight throughout its length, not gapping at its ends, which is not the case with *Pinjoriapollis*. Moreover, the type species of *Arecipites*, *viz.*, *A. punctatus* has minutely pitted exine and thus differs from the present genus. The other comparable genus, *Palmaepollenites* differs from the present genus by its very small size (24 μ in length) and by having a small and narrow sulcus which does not extend from one end to the other and is slightly globular at its ends. *Liliacidites* Couper and *Clavatipollenites* Couper are also monosulcate but are distinguishable by their reticulate and clavate exine respectively.

Among the extant pollen grains, *Pinjoriapollis* resembles with these of *Magnolia grandiflora* and *M. hamorii* except for the size. The length of *Pinjoriapollis* ranges between 120 to 170 μ while length of pollen of *Magnolia* spp. is up to 110 μ. It is therefore most likely that *Pinjoriapollis* may be related to some membes of the family Magnoliaceae.

Pinjoriapollis magnus sp. nov.

Diagnosis.—Pollen grains oval-elliptical, 120–148 × 62–70 μ. Monosulcate, sulcus wide, extending from one end to the other, sulcus widening more towards one end. Exine 2·5–3·5 μ thick, laevigate, occasionally faintly intrapunctate (Figs. 1–2).

Holotype.—Fig. 1, size 148 × 62 μ; Regd. Slide No. 6196/5, Birbal Sahni Institute of Palaeobotany, Lucknow.

Type Horizon and Locality.—Pinjor Formation (Upper Siwalik), near Chandigarh, India.

Pinjoriapollis lanceolatus sp. nov.

Diagnosis.—Pollen grains lanceolate, 123–170 × 51–62 μ. Monosulcate, sulcus generally reaching from one end to the other, occasionally shorter. Exine upto 1·5 μ thick, laevigate (Fig. 3).

Holotype.—Fig. 3, size 170 × 62 μ; Regd. Slide No. 6193/9, Birbal Sahni Institute of Palaeobotany, Lucknow.