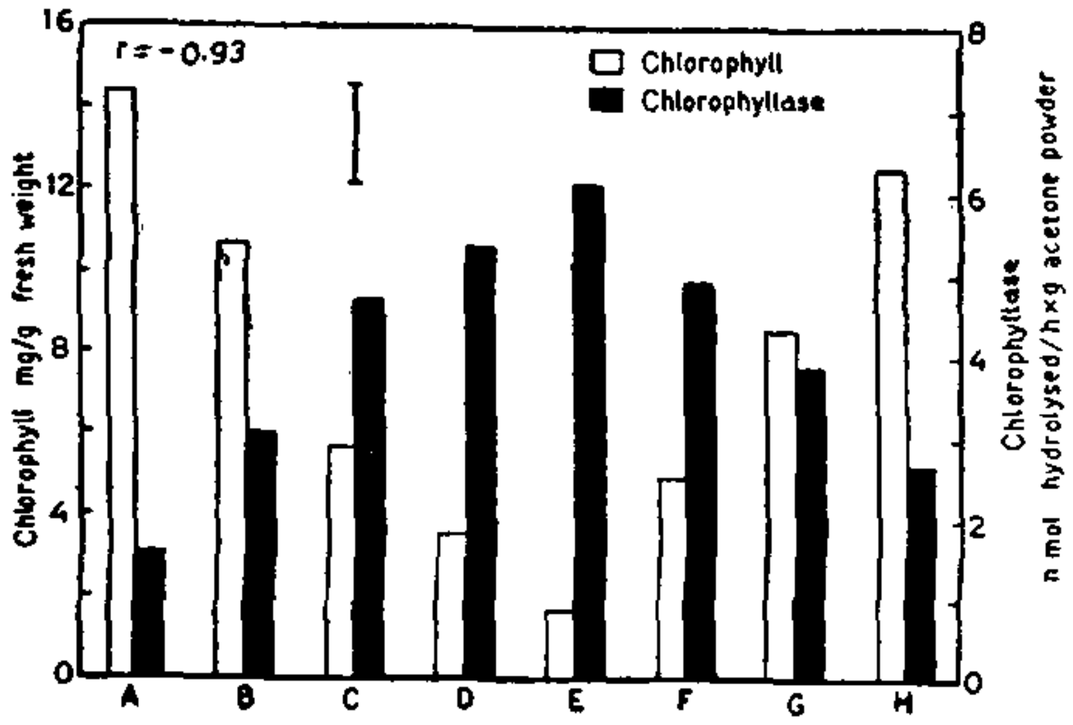

FIG. 1. Effect of dikegulac and urea used alone and in combination on chlorophyll retention and chlorophyllase activity in leaves on *Helianthus annuus*. The treatments are indicated as *A* = water; B = dikegulac 100 mg/l; C = dikegulac 250 mg/l; D = dikegulac 500 mg/l; E = dikegulac 750 mg/l; F = dikegulac 750 mg/l + urea 100 mg/l; G = dikegulac 750 mg/l + urea 250 mg/l; H = dikegulac 750 mg/l + urea 500 mg/l. Values are mean of three determinations. Vertical line indicates LSD ($p = 0{\cdot}05$).

loss of chlorophyll was high at higher concentrations of dikegulac. The loss of chlorophyll by dikegulac treatment was overcome by urea. The chlorophyllase activity was inversely proportional to chlorophyll retention (Karl Pearson's coefficient of correlation. $r = -0{\cdot}930$). Clearly chlorophyllase is involved in the protective effects of urea against chlorophyll loss.

Purohit and Chandra[9] observed that effect of dikegulac on chlorophyll degradation during senescence of detached leaves of *Avena sativa* is controlled by chlorophyllase. *It is also known* that the loss of chlorophyll may be mediated through increased ethylene level in dikegulac treated plants[2,10]. Since nitrogeneous compounds promote chlorophyll synthesis[4,11], urea antagonises the effect of dikegulac on chlorophyll loss. Therefore, it is possible that urea may directly reduce chlorophyllase activity or indirectly may reduce ethylene level which in turn decreases the enzyme activity.

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1. Arzee, T. Langenauer, H. and Gressel, J., *Bot. Gaz.*, 1977, **138**, 18.
2. Bocion, P. F. and DeSilva, W. H., "Some effects of dikegulac on the physiology of whole plants and tissue : Interaction with plant hormones," In *Plant Growth Regulation*, ed. P. E. Pilet, Springer-Verlag, Berlin, 1977, p. 189.
3. Gressel, J., Kadouri, A., Atsmon, D. and Cohan, H., "Collections of abstracts of paper demonstrations," In *Plant Growth Regulation*, 9th International Conference on Plant Growth Substances, ed. P. E. Pilet, Springer-Verlag, 1977, p. 177.
4. Purohit, S. S., *Comp. Physiol. Ecol.*, 1979, **4**, 264.
5. —, *Ibid.*, 1980, **5**, 24.
6. —, *Ibid.*, 1980, **5**, 83.
7. —, *Ibid.*, 1980, **5**, 159.
8. — and Chandra, K., *Ibid.*, 1980, **5**, 246.
9. — and —, *Curr. Sci.*, 1980, **49**, 635.
10. Shimokawa, K., Shimada, S. and Yoco, K., *Sci. Hort.*, 1978, **8**, 129.
11. Vyas, L. N., Jain, S. L. and Sharma, S., *Biochem. Physiol. Pflanzen.*, 1975, **67**, 343.

RUMINATE ENDOSPERM IN *DILLENIA SUFFRUTICOSA* (GRIFF.) MARTELLI

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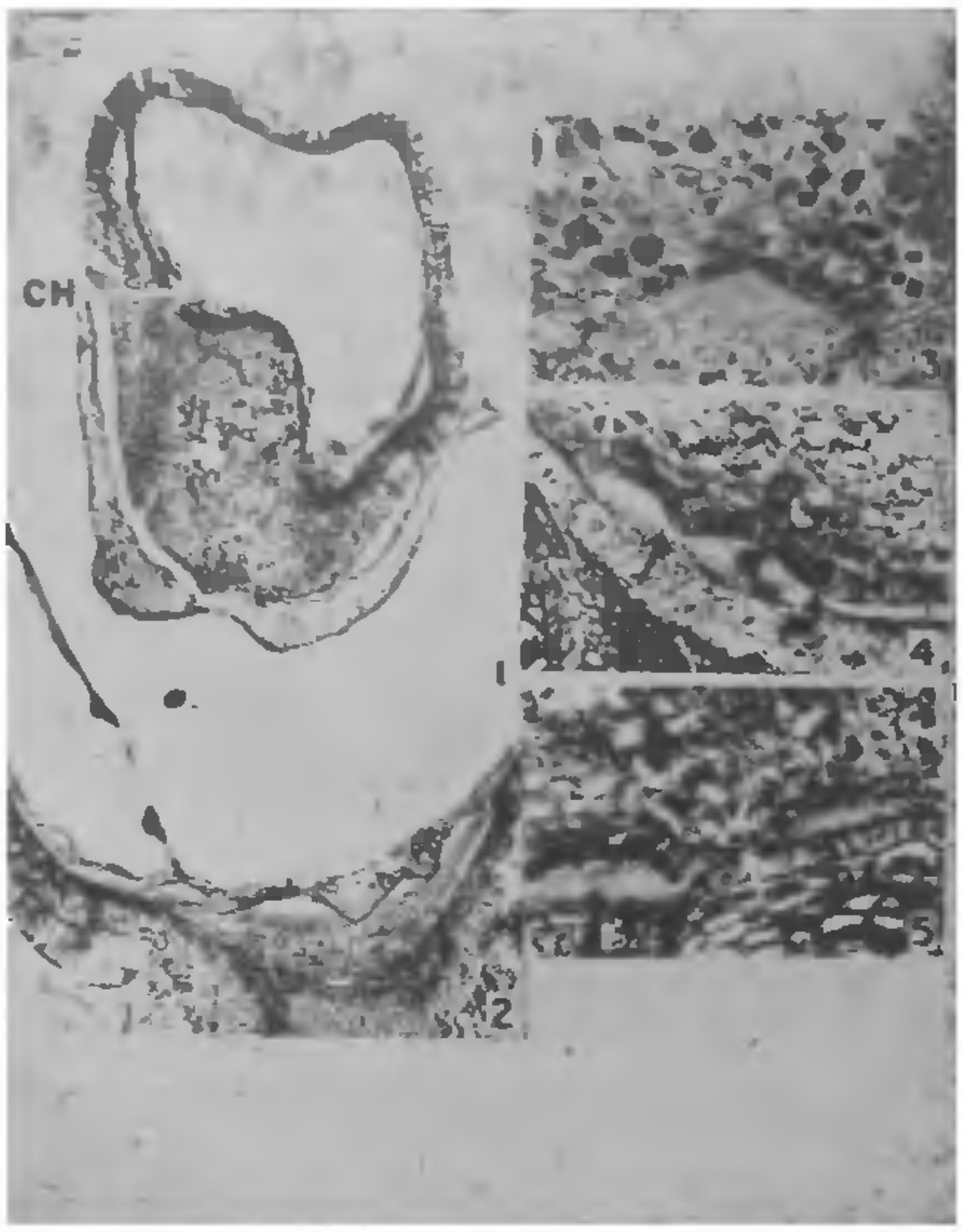
THE phenomenon rumination first reported in the nineteenth century[1,2] is now known in about 30 families of dicotyledons and one family in each of monocotyledons and gymnosperms[3]. Rumination due to unequal growth of the endosperm, rarely reported, as in *Elytraria*[4], *Nelsonia*[5] and *Haplanthus*[6] of Acanthaceae and also in *Psychotria*[7] belonging to Rubiaceae.

The devleopment of the ruminate endosperm in the seeds of *Dillenia suffruticosa* is reported here. Even at the young free nuclear stage, the protoplast of the endosperm at the chalazal half of the embryo sac becomes undulated (Figs. 1, 2). Cell wall formation sets in making the endosperm completely cellular (Fig. 3). At irregular loci the peripheral cells become dense, undergo mitotic divisions, forming group of cells of meristematic nature (Fig. 4). By further divisions and enlargement of cells the endosperm presents a well manifested ruminate condition. The ruminate endosperm pushes through the nucellar tissue and reaches the seed coat (Fig. 5).

In the majority of the genera, reported to have ruminate endosperm, it is the inner seed coat that causes rumination. In a few members of Rubiaceae and Acanthaceae, rumination is due to the activity



FIGS. 1-5. *Dillenia suffruticosa* (Griff.) Martelli. Fig. 1. Longisection of a seed with nuclear endosperm × 20. CH–Chalaza. Fig. 2. as above; chalazal part enlarged to show initiation of rumination at Nuclear endosperm stage × 30. Fig. 3. Chalazal part of the seed with cellular endosperm exhibiting rumination (arrow) × 95. Fig. 4. as above; cells at irregular loci (arrow) becoming meristematic × 95. Fig. 5. as above; Meristematic cells after division and pushing into the nucellar tissue (arrow) × 95.

of the mature endosperm. Interestingly enough in *Dillenia suffruticosa*, the rumination is due to the behaviour of the endosperm originating at an early stage of its development from the chalazal region of the embryo sac. The configuration of the seed coat remains unaffected by the activity of the endosperm.

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1. Hegelmaier, F., *Bot. Ztg.*, 1886, **44**, 585.
2. Voigt, A., *Ann. Jard. bot. Buitenz.*, 1888. **7**, 150.
3. Periasamy, K., *Plant Embryology, Symposium*, CSIR, New Delhi, 1962, 62.
4. Johri, B. M. and Singh, H., *Bot. Notiser*, 1959, **112**, 227.
5. Mohanram, H. Y. and Pushpa Masand., *Phytomorphology*, 1963, **13**, 82.
6. Phatak, V. G. and K. B. Ambegaokar., *J. Indian bot. Soc.*, 1961, **40**, 525.
7. Fagerlind, F., *Acta Hort. berg.*, 1937, **11**, 195.

INTERACTIONS BETWEEN SOIL FUSARIA AND THERMOPHILIC FUNGI

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THE concept of biological control has come to forefront again due to recalcitrant nature of the pesticides and their possible biomagnification in the ecosystem[1–3]. The reasons for attempting this study were: (i) at least some thermophiles, *viz.*, *Malbranchea pulchella* var. *sulfurea* produce an extra-cellular antibiotic, (ii) the colonising capacity of the thermophiles is generally good, and (iii) the minima for spore germination and mycelial growth of thermophiles[4] falls below the optima for most species of *Fusarium*.

Five species of *Fusarium* were recovered from cultivated soil (wheat-linseed cropping in the previous two years) using PCNB medium and were maintained on PDA[5]. Thermophilic fungi were isolated and maintained on YpSs medium[6]. Conidial germination of *Fusarium* was tested using a cellophane agar disc[7] and direct cellophane techniques[8]. Ten and 15-day old culture filtrates, staled agar circles[9] or soil culture of thermophiles were used for germination tests. Since starch served as the carbon source, levels of reducing sugar in the liquid medium were tested by dinitrosalicylic acid reagent.

Eleven thermophilic strains were used which included, *Absidia* sp., *Aspergillus* sp., *Chaetomium thermophile*, *Humicola grisea*, *H. lanuginosa*, *Malbranchea pulchella* var. *sulfurea*, *Papulaspora thermophila*, *Penicillium* sp., *Sporotrichum. thermophile*, and *Thermoascus aurantiacus* (conidial and cleistothecial isolates). Among these, only thermotolerant *Aspergillus* and *Penicillium* were able to inhibit conidial germination of *Fusarium culmorum*, *F. dimerum*, *F. nivale*, *F. oxysporum*, and *F. solani* (20 to 50%). The fungistatic influence of these two general differed in extent depending upon the technique employed; conidia of *F. nivale* and *F. oxysporum* were more sensitive to *Penicillium* sp. while species of *Aspergillus* was more effective against *F. dimerum*. A considerable stimulation of germ tube length (40–100 μm over 10–40 μm in control) was noted when filtrates from thermophilic *Absidia*, *Malbranchea*, *Papulaspora*, and *Sporotrichum* were used; part of this stimulation was at least attributable to residual glucose released from