Development of uredia and telia of the rust *Ravenelia kirganelliae* Mund. & Thirum.

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The rust *Ravenelia kirganelliae* has been described by Mundkur and Thirumalacher (1946) on *Phyllanthus reticulatus* Poir. The life cycle of the fungus was worked out by Chavan (1966) who described it is an autcecious and eu-cyclic rust. This paper describes the development of uredia and telia in this fungus.

Infected leaves of *Phyllanthus reticulatus* Poir. showing uredial and telial stages were collected from Western Ghats near Radhanagari (Kolhapur) during December-January and fixed in FAA solution on the spot. The fixed material was passed through different grades alcohol, then to alcohol-xylene series and later embedded in paraffin wax. Microtome sections of the material of 5-7 μ thickness was processed and stained in Heidenhain's haematoxylin and Orange G. For differentiation, saturated solution of picric acid and iron alum were used.

The subepidermal uredosori as reddish tiny spots appeared to originate from dikaryotic mycellium produced after germination of aeciospores. The hyphal mass consists binucleate cells, which get arranged in a layer as uredospore mother cell initials (Pl. 1, fig. 1). Each of these initials divides to form an upper and a lower cell. The upper cell is the binucleate uredospore mother cell (Pl. 1, fig. 2) which subsequently divides to form the uredospore cell, while the lower cell develops into a stalk cell (Pl. 1, fig. 2).

The formation of uredospores was studied by Harder (1976) in *Puccinia*, who reported that the uredospores originated from the buds of sporogenous cells. The cells destined to form the uredospores enlarged and develop a thick wall, while the stalk cell becomes elongated. Thus, the development of uredospores was similar to that described by Harder (1976). The spores then acquire their charactersistic red rusty colour and develop minute echinulation on their walls. Due to the pressure of spores epidermis ultimately ruptures, exposing uredospores. The contents of the stalk cell may persist or they may degenerate completely. The uredospores are mixed with a few paraphyses (Pl. 1, fig. 3).

Uredia mostly hypophyllous, irregularly scattered, subepidermal; paraphysate, erumpent 62.5 x 170 μm, paraphyses mostly capitate, a few cylindrical, peripheral; stalk cylindrical, 22.5-35 x 1.5-4.2 μm thick, broad at apex to a head of 14.6-24.6 x 15.8-20 μm with wall of 1.5-4.2 μm thickness, smooth; uredospores ellipsoidal to ovoidal, sometimes short, cylindrical to clavate, 15.5-23.8 x 10.2-16.5 μm, wall yellowish white, verrucose, upto 1.5 μm thick.

The telia were observed to develop late in December and continue till February on the leaves. These are epiphyllous and scattered. Irregularly shaped cells begin to grow inside the epidermal cells (Pl. 1, fig. 4) and later extend below in the palisade tissues. The conjugate nuclei in the vegetative cells are conspicuous and compact and are stained well in haematoxylin showing presence of granular chromatin material. The development of telia begins with the sub-cuticular space. Initially the cells are arranged irregularly. Afterwards they are rearranged in the form of a compact layer of rectangular to oval cells forming the stromatic base for the development of a telium. At this stage the nuclei in these cells elongate and undergo mitotic division with cross septation resulting in the formation of two layers of cells in the sub-cuticular space. The cells of outer layer form spore mother cells as a result of which the cuticle gets raised and thickened (Pl. 1, fig. 5).

The spore mother cells enlarge and sometimes 2-4 cells coalesce laterally. Mitotic nuclear division occurs simultaneously in all the coalesced cells producing terminal daugher cells, which in turn divide asynchronously (Pl. 1, fig. 6). The spore motehr cell subtends the telial head from the pedicel and an immature telial head is formed consisting of two layers of cells (Pl. 1, figs 6-7).

The cells in the upper layer are sporiferous and form the teliospores, whereas those in the lower layer convert into cysts. The lateral (peripheral) cells in the sporiferous layer and cyst-forming layer undergo division adding daughter cells to the outside. The telial head contains 5-7 cells in two layers. Telial heads in various developmental stages formed at different levels were observed in the developing sori. The nuclei which are unexpanded during early stages, progressively expand during development. The nuclei regain their expanded state, when differentiation of the telial head is complete.

The outermost wall of the teliospores gradually thickens by deposition of a material probably chitinous in nature. The cells of the teliospores begin to enlarge whereas the cyst cells do not expand to the same extent (Pl. 1, fig. 8). Nuclear fusion follows proceeding centrifugally in the sorus. The teliospore cells further enlarge in to columnar cells. The central teliospore are somehwat rectangular in shape and the peripheral cells are triangular or urn shaped. The pedicellular cells enlarge raising the telial head above, which causes rupture of the overlying cuticle. The two nuclei (Pl. 1, figs 7, 8) move towards each other and the nuclear membrane dissolves at the point of contact allowing the chromatin material to merge. A common nuclear membrane surrounds the two nuclei forming the diploid fusion nucleus which appears oval to ovate (pl. 1, figs 8,9).

The diploid nucleus enlarges 2-3 times the total volume of the two fusing nuclei. The fusion nuclei measure 2-4 µm in diameter. Similar increase in the volume of diploid nucleus in *Cronartium ribicola* has been reported by Colley (1918) and in *Ravenelia sessilis* by Hiremath and Pavgi (1976). The cyst cells convert into a frill of thin- walled, hyaline, vacuolate circular to oval cell that vary in their nuclear status. Unlike those in the teliospores the nuclei remain unexpanded. They may or may not fuse before disintegration. One to two deeply stained bodies may be observed in a few cysts representing the degenerate nuclear remains. The deposition of thickening material on the outer and collateral wall continues and converges around the teliospore head which is more towards the central portion and decreases gradually towards periphery. Segmentation of the deposited outer thickening material takes place along the collateral walls distinguishing each teliospore. No similar segmentation was discerned in *R. breyniae* (Singh, 1967).

The pedicel consisting of 2-3 nonseptate cells elongates in a maturing teliospore. The nuclei in those cells later disintegrate. During the process of elongation, the pedical weakens at the base and the telial head segments radially making the teliospores wind-borne. The cysts help them to propel in the air, settle over and attach to a suitable host leaf substrate as shown by Thirumalacher (1951). Mature telial head is 35-60 µm in length and 80-95 µm in diameter, containing 16-30 teliospores. The central teliospores which are longer in size measure 18-25 x 6-12 µm and those in the periphery are 10-18 x 9-12 µm in thickness.

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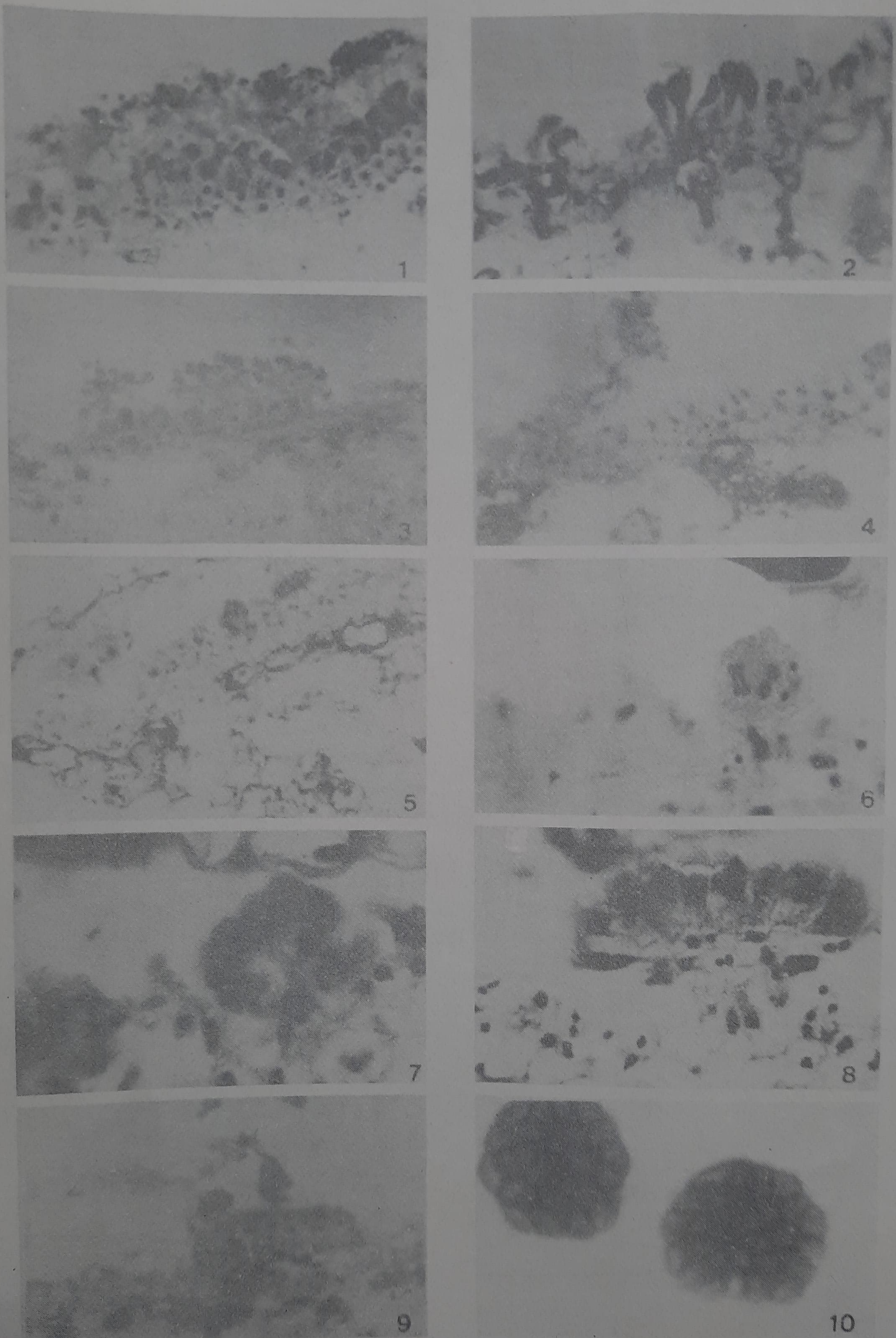
PLATE 1

1. Section showing dikaryotic cells in the sub-epidermal region, x 450.
2. Section showing the formation of stalk cell and terminal uredospore, x 450.
3. Mature uredinal cup with uredospores, x 450.
4. Section showing intra epidermal vegetative growth of dikaryotic cells, x 450.
5. Extended vegetative growth in palisade layer, x 450.
6. Division of sporiferous cells in the telial head showing complete organisation of a telial head, x 1600.
7. Section showing the nuclei coming very close, x 1600.
8. Fusion of conjugate nuclei in teliospores but not in the cysts, x 1600.
9. Mature teliospores with diploid nuclei, x 720.
10. Mature teliospore, x 450.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