

proximal end of the axis. The primary root gets separated from its surrounding mass of cells by schizogenous separation of cells. The radicle is encircled by the root cap which in turn is encased in the coleorhiza (Figs. 13-14). The coleorhiza differentiates from the cotyledonary mass of tissue on the lower side of the embryo and it is in continuation with the suspensor (Figs. 7-12).

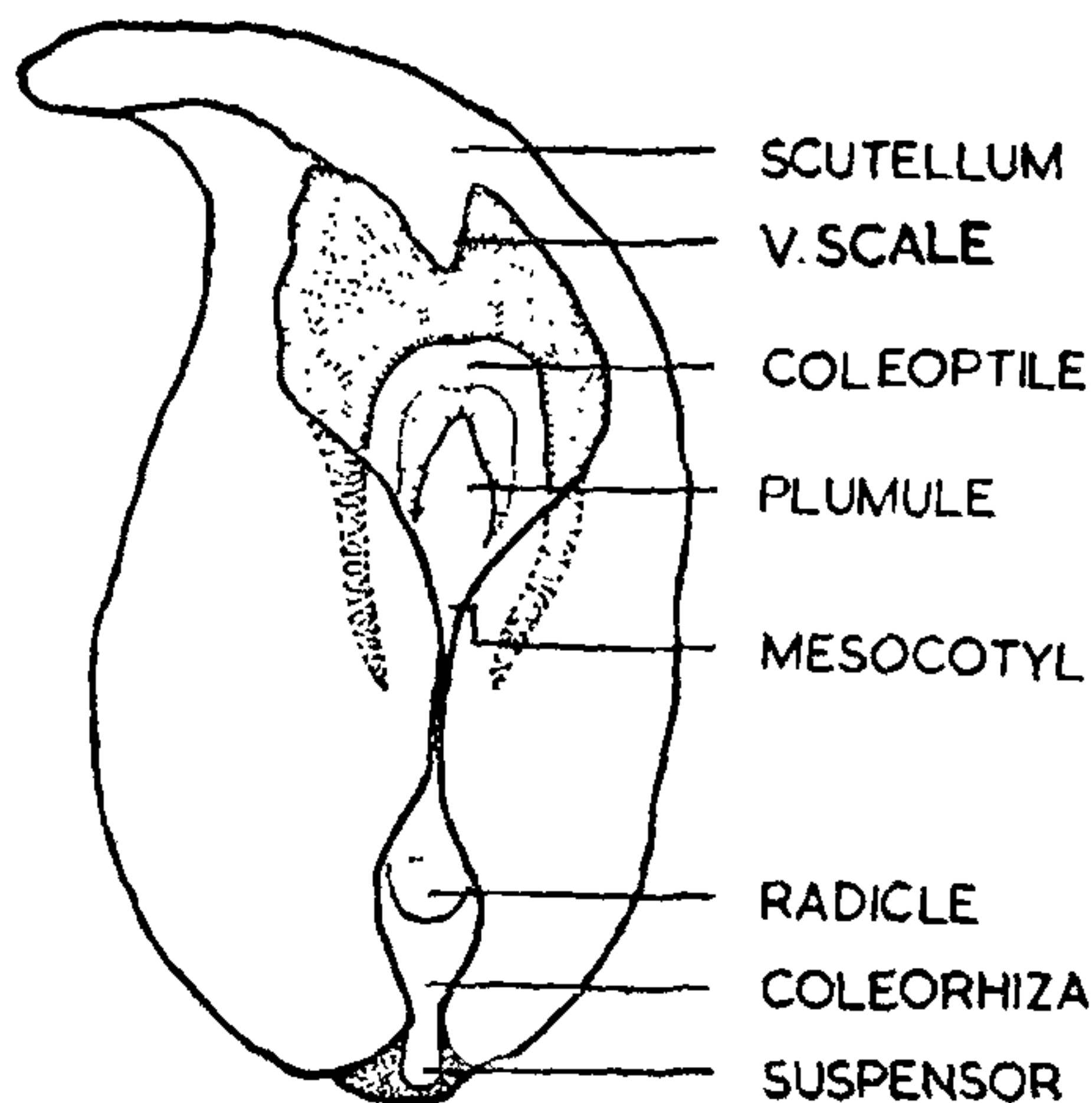


FIG. 14. Mature embryo of jowar; note the plumule radicle axis lying in the cavity of the shield-shaped cotyledon. (V. SCALE, ventral scale.)

Concurrent with the above, the ventral side of the scutellum flattens and its margins extend out. Its two lateral edges, the lateral scales (Figs. 11-12), extend over the plumule radicle axis from its sides while the ventral scale extends from the ventral side (Figs. 13-14). In certain cases, e.g., wheat and oat, the scutellar tissue on the dorsal side of the axis extends towards the dorsal surface of the plumule. This is the dorsal scale or epiblast (Fig. 13). Thus the scutellum with its ventral, lateral and the dorsal scales appears like a boat-shaped structure in the cavity of which lies the plumule radicle axis. The coleoptile and coleorhiza peep through the scutellar groove (Figs. 12-14). The axis above the scutellar node elongates and thus the mesocotyl becomes distinguishable (Figs. 11-14). The cortical portion of the mesocotyl is a continuation of the coleoptile and scutellum which are cotyledonary. Hence the coleoptile and mesocotyl are not the first leaf and internode respectively as it is interpreted.

Thus the formation of a mature grass embryo from its globular one passes through sequential events like (1) genesis of a germinal and abgerminal faces, (2) erection of a shoot root or embryonic axis (3), differentiation of shoot apex, root apex and different

regions of the single cotyledon. A mature grass embryo consists of a plumule radicle axis and a single cotyledon. The coleoptile, cortical portion of mesocotyl, coleorhiza and scutellum with its ventral, lateral and dorsal scales form the various elevations of the single cotyledon of grass embryo. The cotyledon forms a continuous structure from its base, coleoptile, to its tip, the scutellum through the mesocotyl surrounding the plumule radicle axis.

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1. Esau, K., *Anatomy of Seed Plants*, John Wiley and Sons, Inc., New York, London, 1960.
2. Guignard, J. L. and Mestre, J. Ch., *Phytomorphology*, 1970, 20, 190.
3. Mareshwari, P., *An Introduction to the Embryology of Angiosperms*, McGraw-Hill Co., Inc., New York.
4. O'Brien, T. P. and Thimann, K. V., *Am. J. Bot.*, 1965, 52, 910.

ADAPTATION OF *SCLEROTIUM ROLFII* TO SYSTEMIC FUNGICIDE

DEVELOPMENT of resistance in plant pathogens to fungicides has created a serious problem in the control of plant diseases. For effective control, application of fungicides has to be repeated several times during growth period of the crop and also from season to season. This continuous use of the same fungicide over the years leads to development of resistance in plant pathogens. Dharam Vir *et al.*³ reported development of resistance in *Helminthosporium avenae* to mercury in Denmark and consequently its failure to control the disease although fungicides based on mercury were being used in that country for years. Hexachlorobenzene used in Australia against bunt of wheat was rendered ineffective⁶. In recent years, a number of systemic fungicides have been introduced in the field of plant disease control and it has been observed that development of resistance in plant pathogens to this group has increased at an alarming rate^{2,5}. Acquired tolerance of fungi to fungicides has been obtained by exposing the pathogen to increasing concentrations of fungicides^{4,8}. Studies on the adaptation of *Sclerotium rolfsii* to higher concentrations of a systemic fungicide benomyl, are reported in this note.

Various concentrations of fungicides were obtained by adding weighed quantity of benomyl [Methyl-1 (butylcarbamoyl)-2 benzimidazole carbamate] to

measured amount of potato-dextrose-agar, when it was slightly warm. The mixture was shaken to obtain uniform distribution of fungicide in the medium. Twenty ml of the fungicide-amended medium was poured in each sterilised petri plate and inoculated at the centre with 5 mm disc of about three week old culture of *S. rolfii* containing mycelium and sclerotia. The studies were initiated with 100 ppm of benomyl and when the fungus had grown on this concentration for about three weeks, five mm disc containing mycelium and sclerotia was aseptically transferred to media containing the next higher concentration, viz., 500 ppm of benomyl. The process was continued by successive transfer of fungus culture from media containing lower doses of benomyl to media containing higher doses of fungicide. By this method the pathogen could be grown on medium containing 6,000 ppm of the fungicide. The parent culture failed to grow on this concentration showing thereby that the isolate growing on fungicide-amended medium had gradually adapted itself to grow on higher doses of benomyl. Sclerotial formation was absent in the adapted isolate and the type of mycelial growth was also different as compared to the parent isolate (Fig. 1). Adaptation of *S. rolfii* to copper fungicides have been reported⁷.

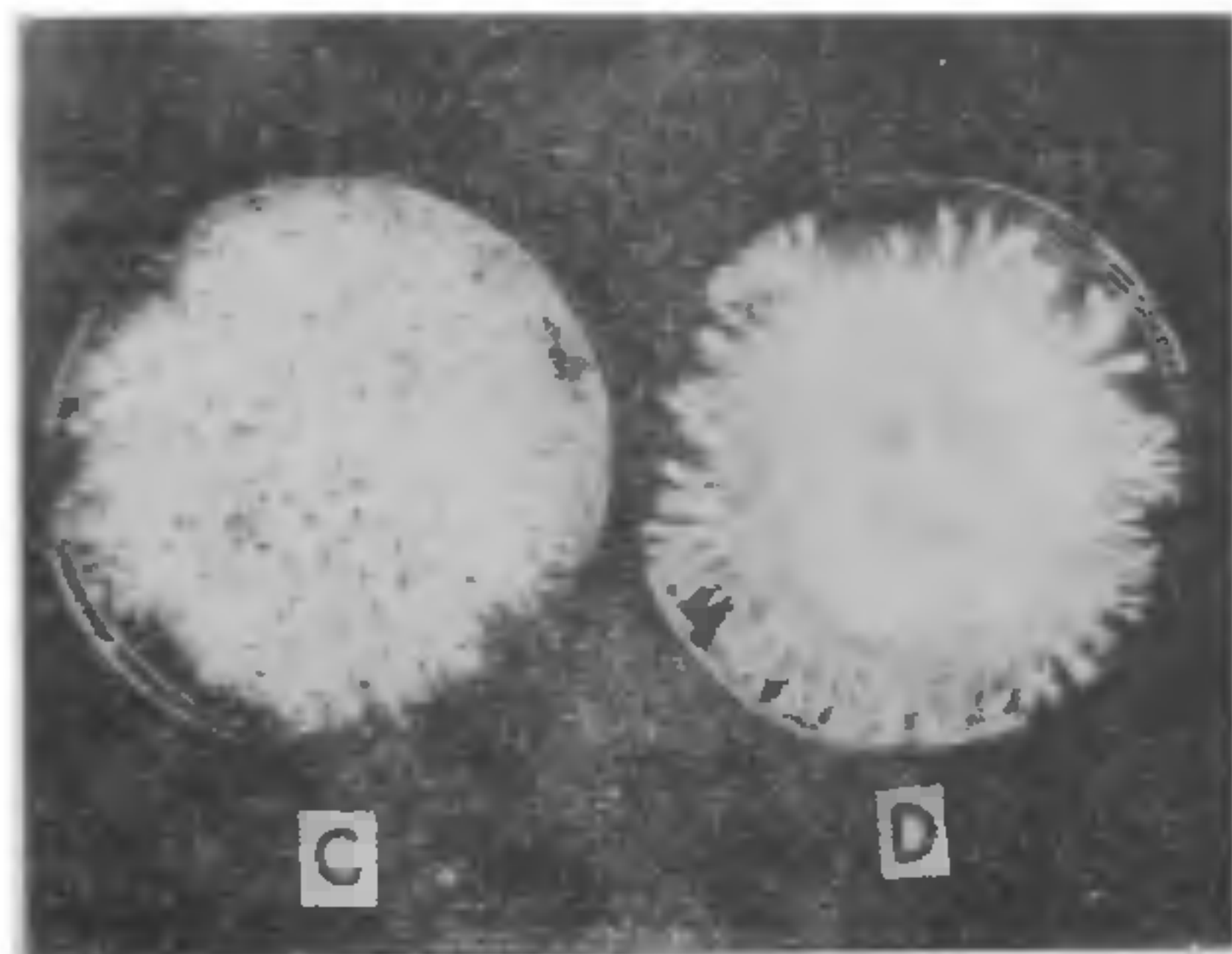


FIG. 1. Adaptation of *S. rolfii* to benomyl. C. Parent isolate. D. Adapted isolate.

The adapted isolate when transferred back to fungicide-free medium grew normally exhibiting typical characters of the parent isolate. It is therefore apparent that the resistance developed in the pathogen was of temporary nature which according to Buxton¹ occurs due to physiological changes in fungi with activation of adaptive enzymes. Conventional fungicides are multisite inhibitors and hence resistance to these fungicides is less frequent as compared to systemic fungicides which are site specific and where adaptation or resistance in pathogens develop quickly and frequently. The stable fungicide-resistant strains of fungi which seem to arise due to mutation, are much

more dangerous. Thus the use of same fungicide over the years for the control of a disease is fraught with danger. During formulation of plant protection schedules, it is advisable to substitute different fungicides after suitable intervals to avoid adaptation of pathogen to fungicide. There is a wide diversity in the mechanism of action of fungicides belonging to different groups which will reduce the chances of development of adapted or resistant strains in fungal pathogens.

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1. Buxton, E. W., in *Plant Pathology. An Advanced Treatise*, Academic Press, New York, 1960, p. 359.
2. Dharam Vir, *Proc. Natl. Acad. Sci. India*, 1976, 46, 127.
3. —, Mathur, S. B. and Neergaard, Paul., *Indian Phytopath.*, 1970, 23, 570.
4. Dutt, S. and Grover, R. K., *Indian J. Mycol. and Pl. Path.*, 1974, 4, 221.
5. Georgopoulos, S. G., in *Plant Diseases. An Advanced Treatise*, Academic Press, New York, 1977, p. 327.
6. Kuiper, J., *Nature*, 1965, 206, 1219.
7. Reddy, D. V. R. and Apparao, A., *Indian Phytopath.*, 1964, 17, 35.
8. Sen Gupta, P. K., Sayed, A. K. and Kaiser, K. M., *Phytopath. Z.*, 1971, 72, 315.

THE DIFFUSE STAGE IN THE MEIOSIS OF PMCs OF *CYMBOPOGON CAESIUS*

Cymbopogon caesius (Nees) Stapf (Poaceae), the Kachi grass is known to yield low quality aromatic oil compared to *Cymbopogon martinii* yielding palmarosa oil with which it is closely related¹. The analysis of meiosis in pollen mother-cells (PMCs) of this species revealed that the bivalents after pachytene enter an interphase-like stage wherein they lose stainability which is identified as the diffuse stage. The perusal of literature reveals that diffuse stage is widespread in plant and animal meiosis². This stage is mostly overlooked by plant cytologists in squash preparations, because of its interphase-like appearance. In the present communication, the occurrence of diffuse stage during meiosis in PMCs, with special reference to a 6B containing population of *Cymbopogon caesius* is reported. The occurrence of 6 B-chromosomes and the diffuse stage are new reports.