

formation takes place (Fig. 11). In Fig. 14, the promycelium is 2-celled and from the apical cell two sterigmata are developed. At the tip of the sterigmata basidiospores are formed and the formation is not synchronous. The basidiospores germinate *in situ* or *in vitro* (Figs. 12, 13, 16 and 17). The nucleus in the basidiospore divides mitotically within the basidiospore itself to form 2 nuclei (Fig. 18), which occasionally form 4 nuclei (Fig. 20). Vary rarely bipolar germination is seen (Fig. 19), having two nuclei in long germ tube.

The authors are grateful to Dr. S. B. David, Head of Botany Department for facilities. Junior author is also thankful to CSIR authorities for financial help.

December 8, 1980.

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## STUDIES IN THE POLLEN GRAINS OF *JUNIPERUS* L.

(MRS.) MITHILESH CHATURVEDI

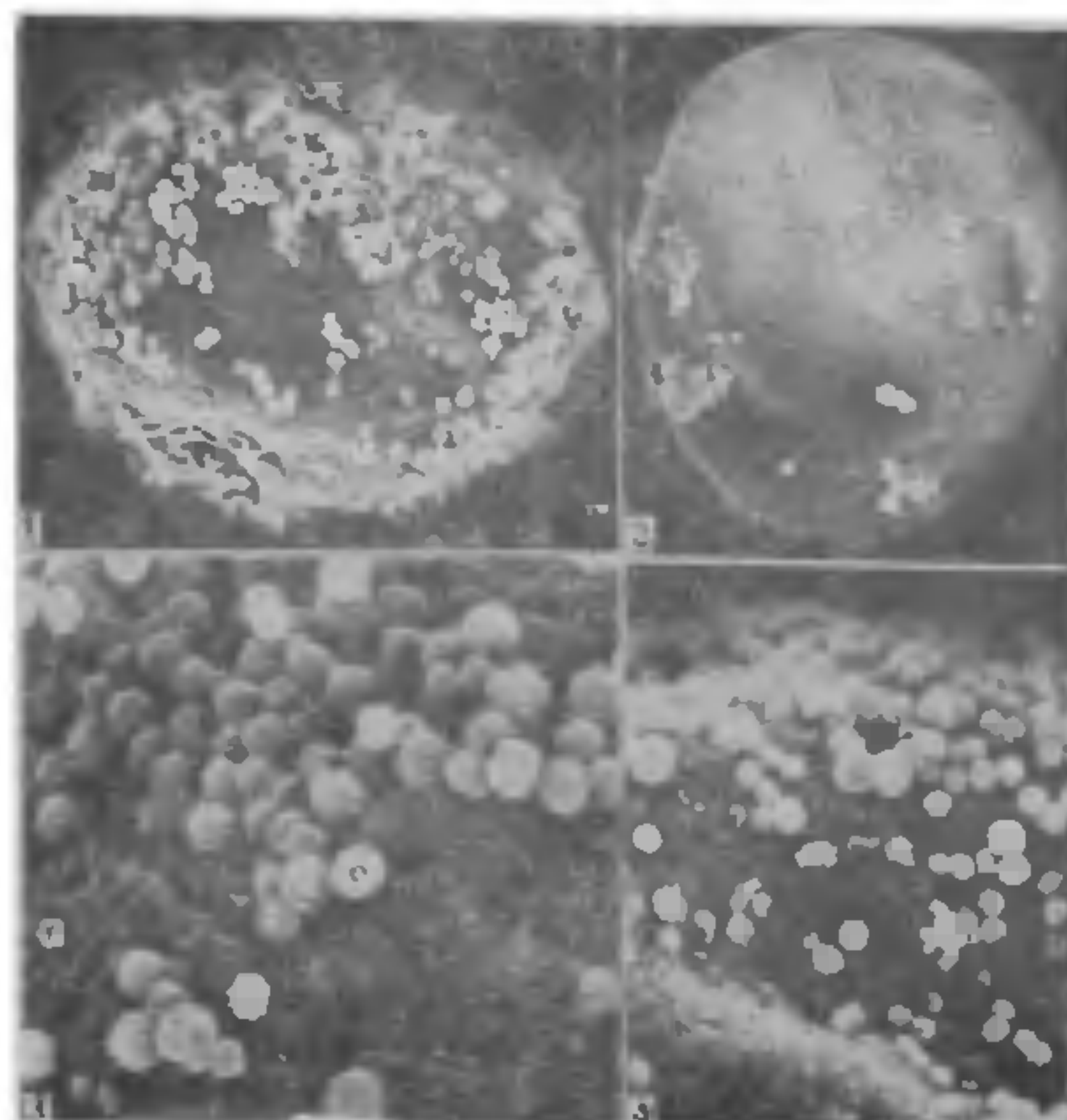
Palynology Laboratory  
National Botanical Research Institute  
Lucknow 226 001, India

ACCORDING to Mehra<sup>1</sup>, the genus *Juniperus* L. (Cupressaceae) contains nine species in the Himalayas. The present investigation relates to the pollen morphological studies of populations of 5 species namely, *J. excelsa* Bieb. (one population) *J. macropoda* Boiss. (two), *J. pseudosabina* Fisch. et Mey. (three), *J. squamata* Buch.-Ham. (one) and *J. wallichiana* Hook. f. (one).

The pollen morphological studies have been made both with light microscope (LM) and scanning electron microscope (SEM). For LM studies, unacetolysed, saffranin-stained pollen grains form the basis, and for SEM studies, natural air dried, unacetolysed pollen grains have been processed and photographed in the JEOL JSM 35c SEM.

The studies made under the light microscope are summarized in Table I. Pollen grains of *Juniperus* are inaperturate. As seen in the SEM, in pollen mass of each species there are two types of grains. In one type, the surface is profusely orbiculate (Fig. 1; cf. orbicules, Gulvag<sup>2</sup>) and in the other type either the surface is devoid of orbicules or scantily orbiculate (Fig. 2). Such types could be observed even under

LM. Orbicules have minute spinous excrescences (Figs. 3 and 4). The largest orbicules occur in *J. excelsa* (Fig. 3) and the smallest occur in *J. macropoda* (Fig. 4). In *J. excelsa*, one feature of exine surface which makes it distinct from other species, is the presence of reticulate folds at places in orbiculate grains forming lumina-like depressions (Fig. 3). The region between the orbicules is coarse, being finely granulate, in all the species. The exine thickness is 1.6  $\mu\text{m}$  in *J. excelsa* and 1.11  $\mu\text{m}$  in other species. Another feature which may be mentioned is the pollen size. Although in general pollen morphological investigations, pollen size is not given much credibility in demarcating various taxa, in the case of three populations of *J. pseudosabina* two populations found in the Western Himalayas have an average pollen size of 22  $\mu\text{m}$  (range 17–31  $\mu\text{m}$  and 17–24.4  $\mu\text{m}$ ), while the third population which occurs in the Eastern Himalayas (Sikkim) has bigger grains, size being 29.8  $\mu\text{m}$  (24.4–34  $\mu\text{m}$ ). Incidentally, in this population, the percentage of shrivelled grains is also nil, while in those of the Western Himalayas, it is 56 and 73 respectively. These percentages are higher than those of other species investigated (Table I) The highest percentage of shrivelled grains occurs in the pollen of a monoecious population of *J. pseudosabina*. In two populations of *J. macropoda*, the pollen size is almost stable being 24  $\mu\text{m}$  and 24.7  $\mu\text{m}$  and the percentages of shrivelled grains being nil and 3, respectively.



FIGS. 1–4. SEM photomicrographs of pollen grains of *Juniperus*. Figs. 1–3. *J. excelsa*. 1. Profusely orbiculate grain ( $\times 2,458$ ). 2. Grain almost devoid of orbicules ( $\times 2,458$ ). 3. A magnified pollen surface showing orbicules and reticulate folds of outer lamella ( $\times 8,600$ ). Fig. 4. *J. macropoda*: A magnified pollen surface showing orbicules ( $\times 8,600$ ). O. orbicule, r. reticulate folds,

TABLE I  
Studies in the pollen grains of *Juniperus L.*

Name of the species	Locality	Average grain size and range ( $\mu\text{m}$ )	Shrivelled grains %	Pollen wall thickness ( $\mu\text{m}$ )
<i>Juniperus excelsa</i> (Tree sp.)	Pooh, Kinnaur valley W. Himalayas	25.4 (17-39)	38	1.6
<i>J. macropoda</i> (Tree sp.)	Keylon Labul, Spiti valley, W. Himalayas	24 (19.5-29)	Nil	1.11
<i>J. macropoda</i>	Rarang Kanda Kalpa, W. Himalayas	24.7 (19.5-31.7)	3	1.11
<i>J. pseudosabina</i> (Shrub)	Pongi Khad, Simla, W. Himalayas	22 (17-31)	56	1.11
<i>J. pseudosabina</i> (Monoecious population)	Chini Kanda Kalpa, W. Himalayas	22 (17-24.4)	73	1.11
<i>J. pseudosabina</i>	Alukthung, Sikkim, E. Himalayas	29.8 (24.4-34)	Nil	1.11
<i>J. squamata</i> (Shrub)	Churpeak, Rajgarh, W. Himalayas	31 (24.4-41)	13	1.11
<i>J. wallichiana</i> (Tree sp.)	Gombathang, W. Sikkim, E. Himalayas	29 (24.4-31.7)	9	1.11

It has been noted that *J. wallichiana*, which is reported to be a tetraploid ( $2n = 44$ )<sup>1</sup>, is almost identical in the pollen morphology (including pollen size) with those of other species which are reported to be diploid.

The gymnosperm pollen wall, on the basis of transmission electron microscopic (TEM) studies has been found to be much simpler than the angiosperm pollen wall and consists of two layers, the inner laminated layer and the outer granular layer. In the case of *Juniperus*, the outer granules/orbicules are loosely set and sculptured having fine spinous pattern and the surface of the outermost lamella is coarsely granulate as seen in the SEM photomicrographs. Gulvag<sup>2</sup> raised a question regarding the pollen of *Larix decidua* "...whether the granules should be regarded as orbicules or a kind of sculptured layer is difficult to answer." The pollen surface of *Juniperus* reveals that the outermost granular layer may be termed as the sculptured layer, atleast for this genus. However, an explanation for the complete and partial absence of the orbicules/outer sculptured layer in some grains of the pollen mass of all the *Juniperus* populations presently studied, will be found perhaps in the TEM studies of pollen wall development. The possibility of the falling out of this layer is totally ruled out as the grains were unacetolysed and directly mounted on the stubs without any pretreatment.

The occurrence of two pollen types in the same pollen mass has been earlier reported in *Ephedra* species<sup>3,4</sup>. In *Ephedra* species, the most common feature is the presence of grains with smooth meridional crests and with wavy meridional crests in the same pollen mass. However, in *E. intermedia* var. *persica*, spheroidal grains with internal thickenings and elongated grains with external crests were observed. In the case of *Juniperus*, the size and density of the orbicules, and the pattern of the exine wall to which the orbicules are attached coupled with pollen size apparently may be considered to provide important information on the biosystematics of the taxon.

The author thanks Dr. T. N. Khoshoo, Director, National Botanical Research Institute, Lucknow, for encouragement and Dr. P. K. K. Nair for his valuable advice. Thanks are also due to Dr. M. Yunus for his help in taking SEM photomicrographs, and to Mr. P. S. Kaushal, Department of Botany, Punjab University, for providing the pollen material.

January 9, 1981.

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