# Spatiotemporal features of microsporogenesis in the cycad species *Macrozamia communis*

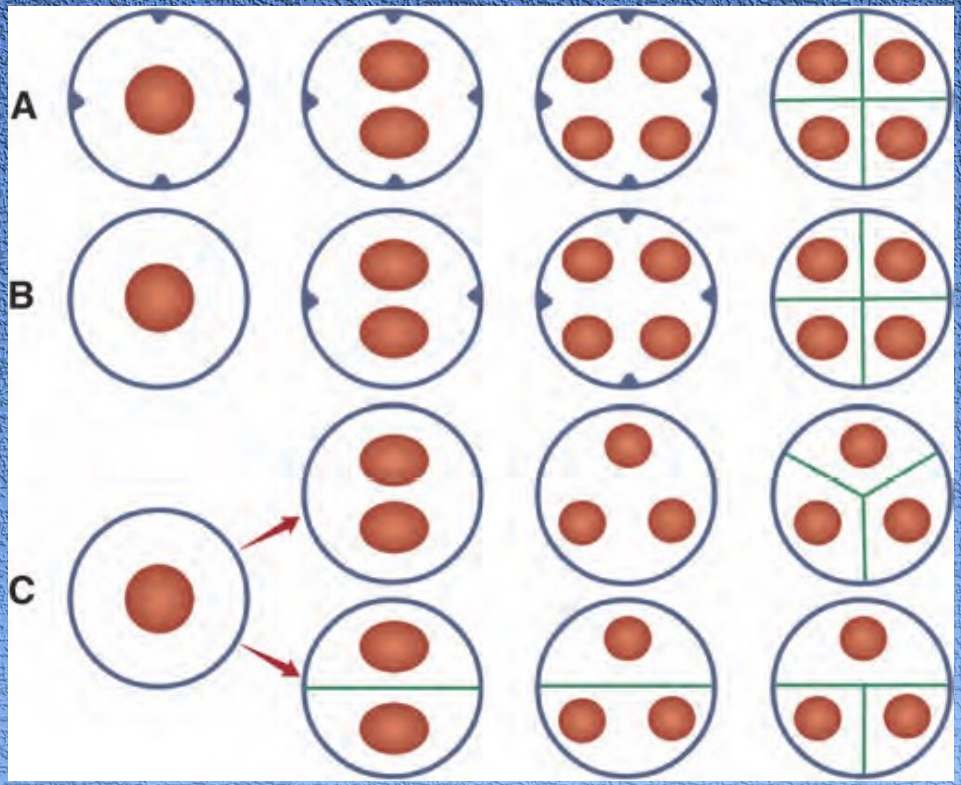
Xiaodong Yan, Mei Bai, Xiping Ning, Haibo Ouyang, Shouzhou Zhang, Ming Yang, and Hong Wu

# Cytokinesis types in microsporogenesis in seed plants and in sporogenesis in non-seed plants

Non-seed plants

Few seed plants
- *Magnolia*
- Cycads

Most of seed plants




Intermediate

Simultaneous

Successive

Even though AWCIs have been reported in microsporogenesis in some cycads, there are still important unanswered questions about the AWCIs:

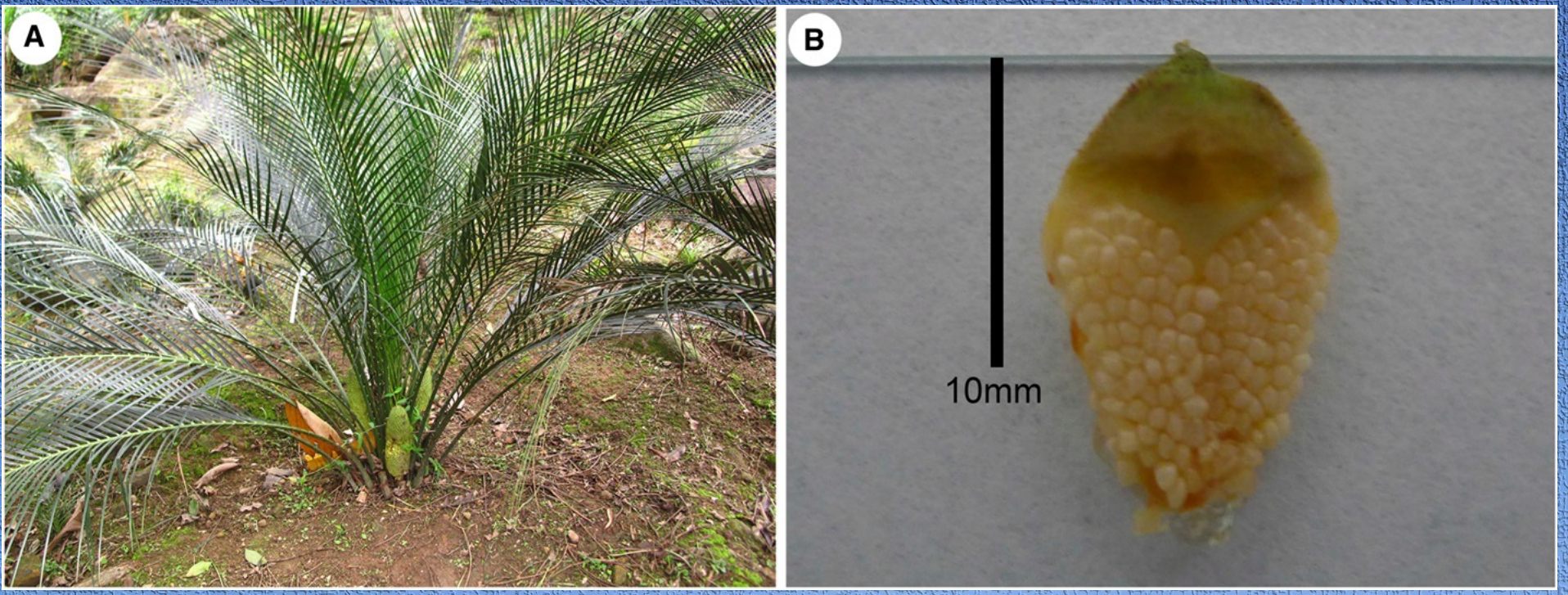
- When the AWCIs are formed during meiosis?
- Are phragmoplasts involved in the formation of the AWCIs?
- Do two rounds of AWCIs follow the two rounds of nuclear divisions, respectively?

## Material and methods in the study

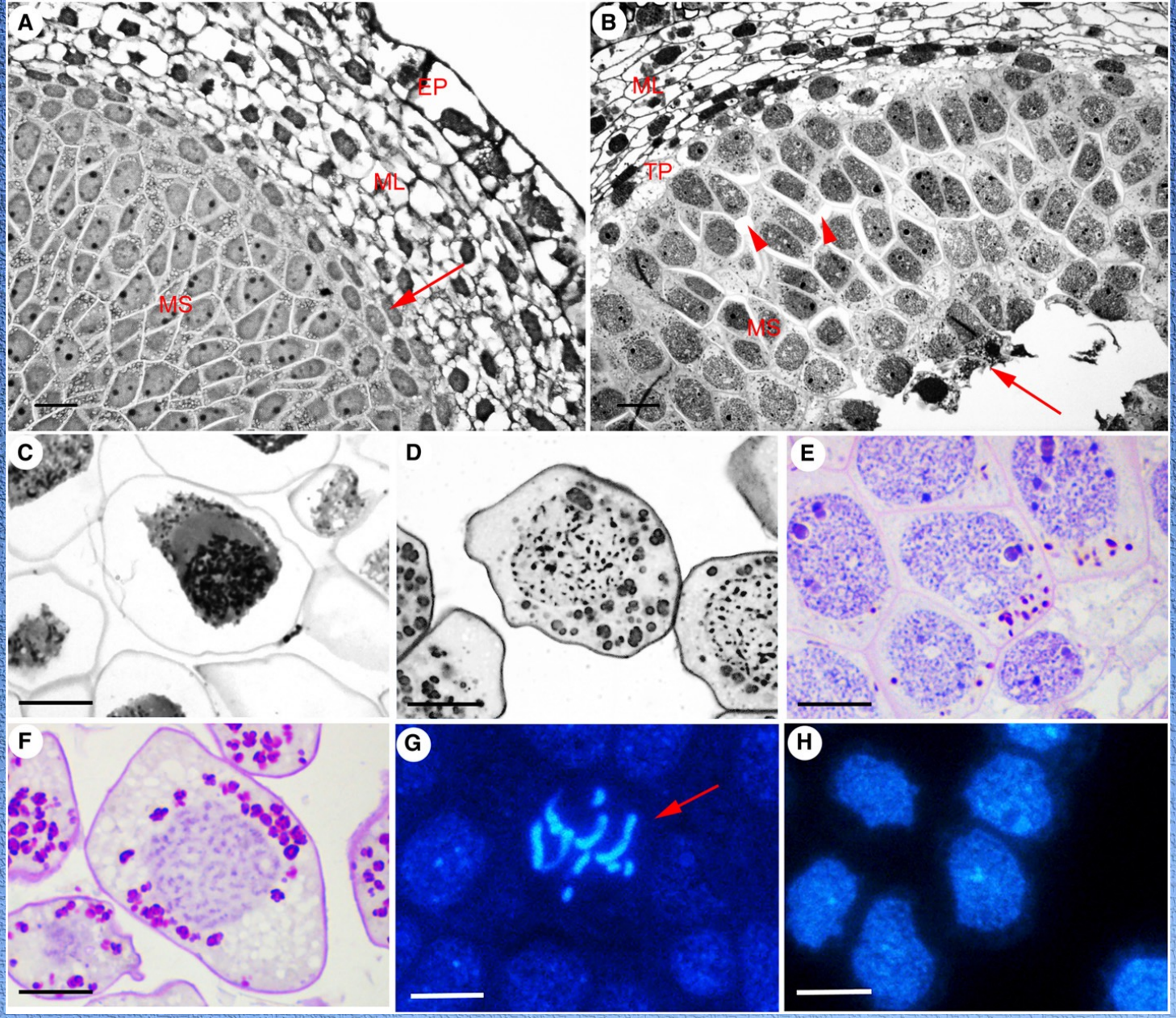
Bright-field and epifluorescence microscopy, confocal laser scanning microscopy, and transmission electron microscopy were used to investigate the microsporogenic process in *Macrozamia communis* , a species in the Zamiaceae family of cycads.

## Significance of the study

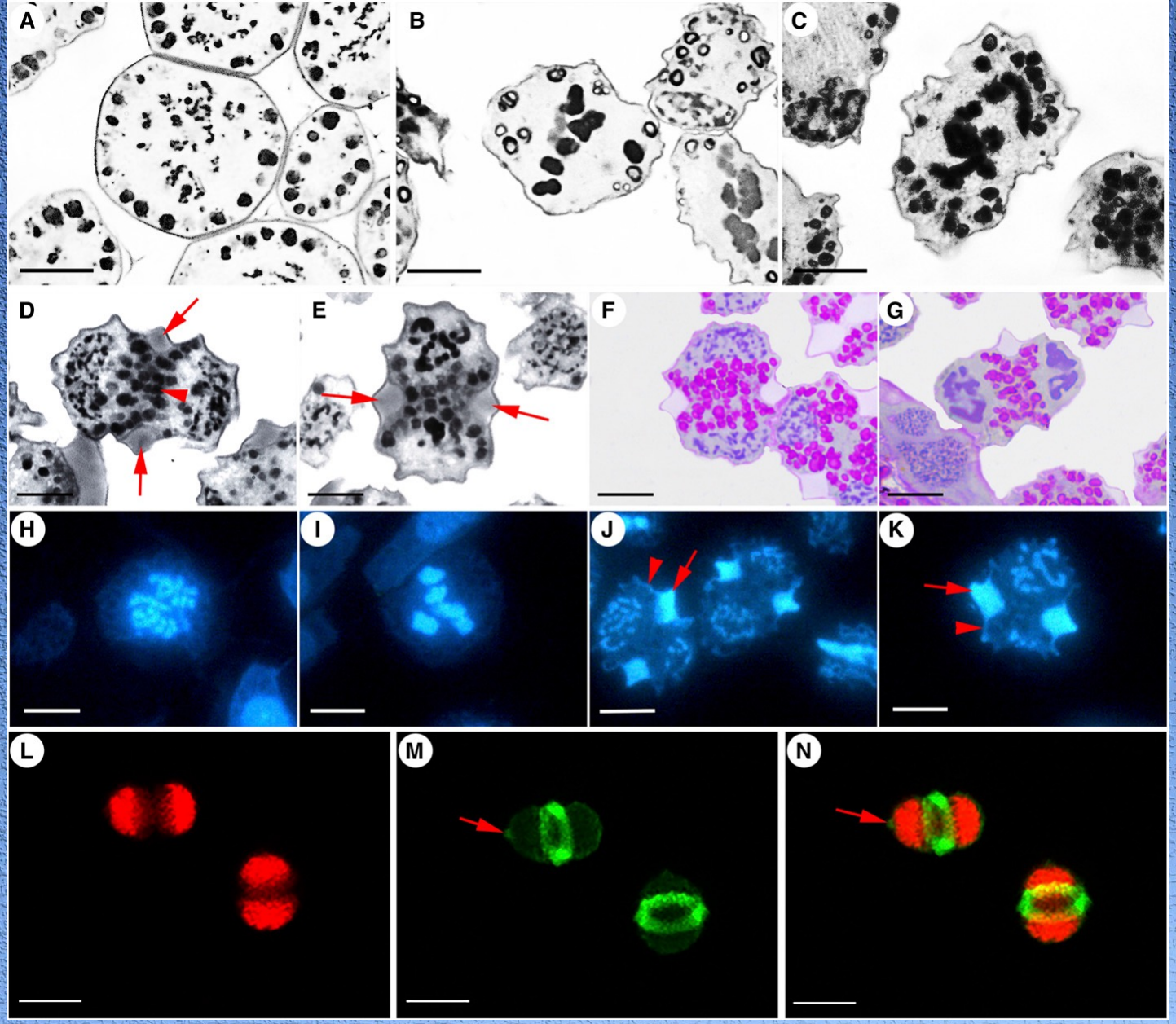
The cellular features uncovered in *M. communis* may serve as useful reference features for comparative studies of microsporogenesis/sprorogenesis in plants.



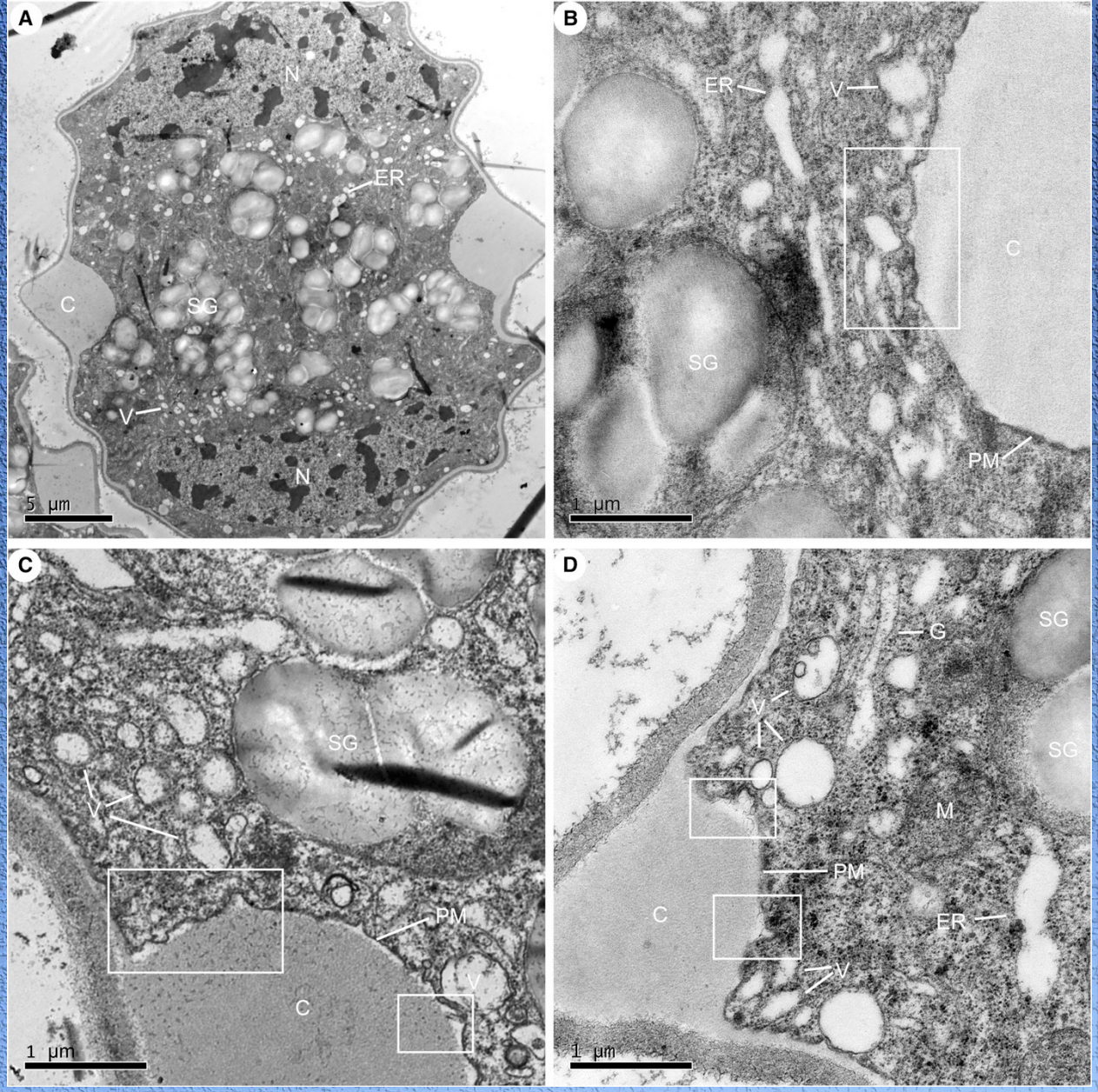

**Plant and microsporophyll of *Macrozamia communis* . (A) Plant with male cones. (B) Microsporophyll with microsporangia on its abaxial side.**



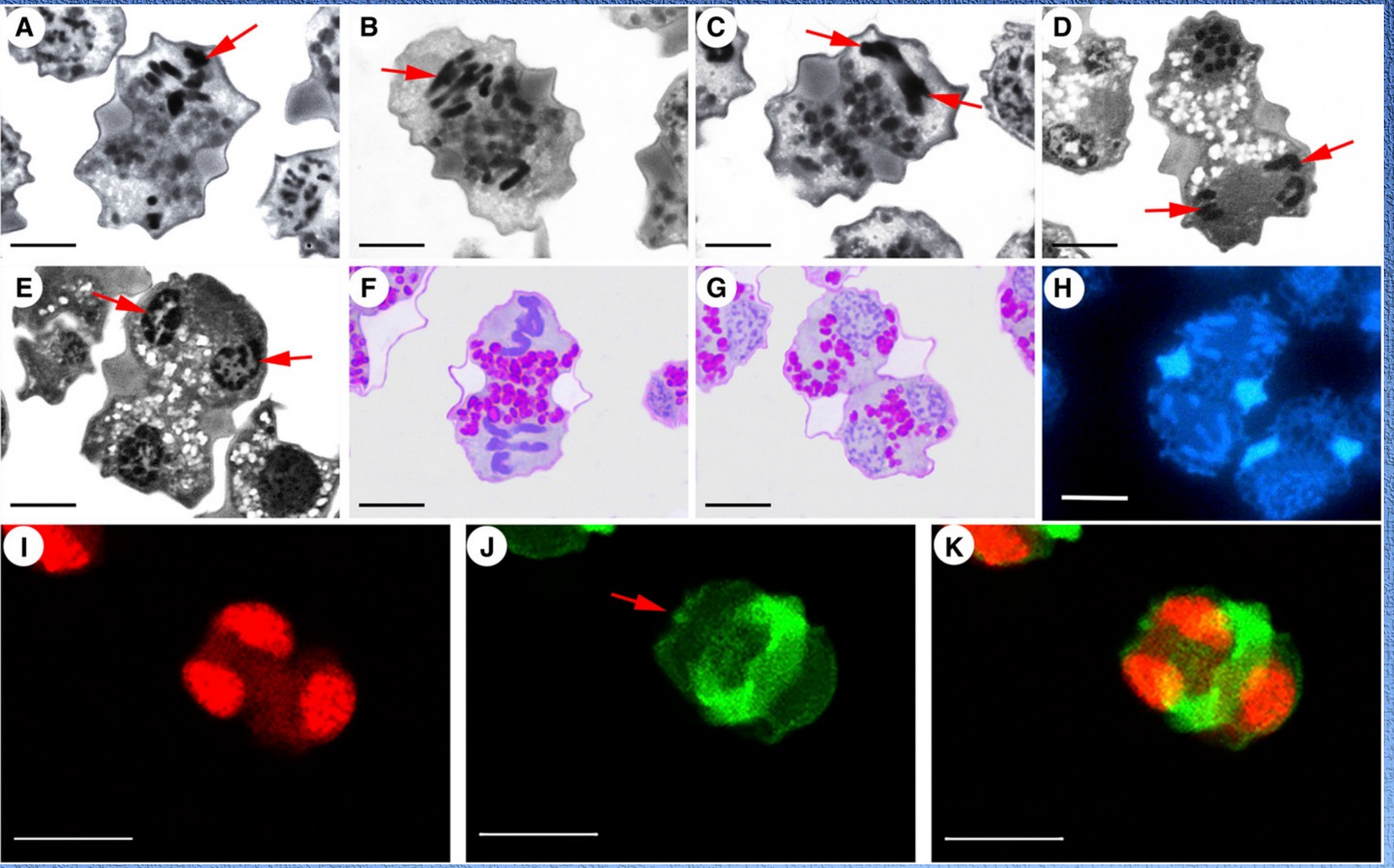

Microsporangia and microsporocytes before and during prophase I.



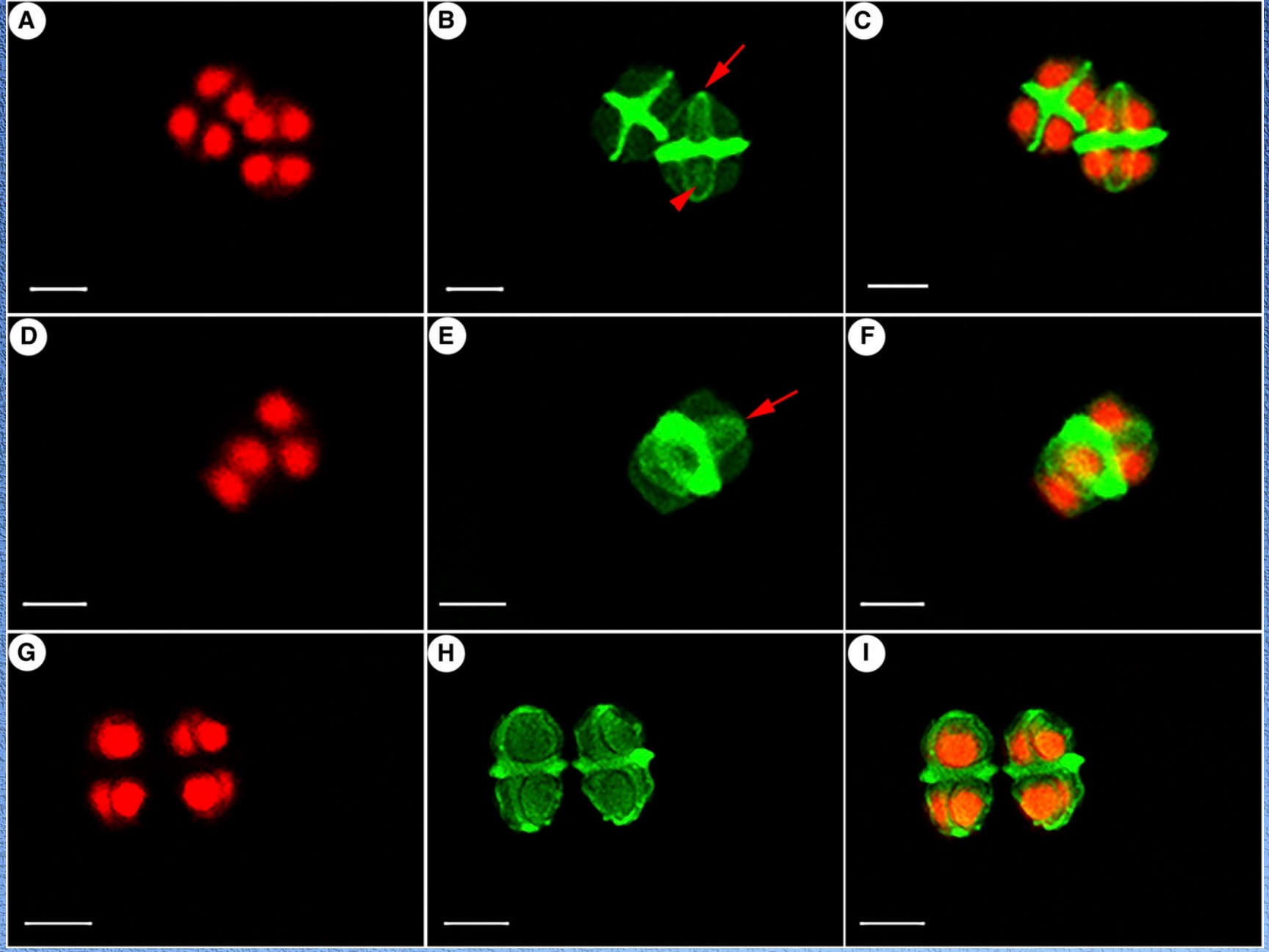

Microsporocytes at stages from prophase I to prophase II.



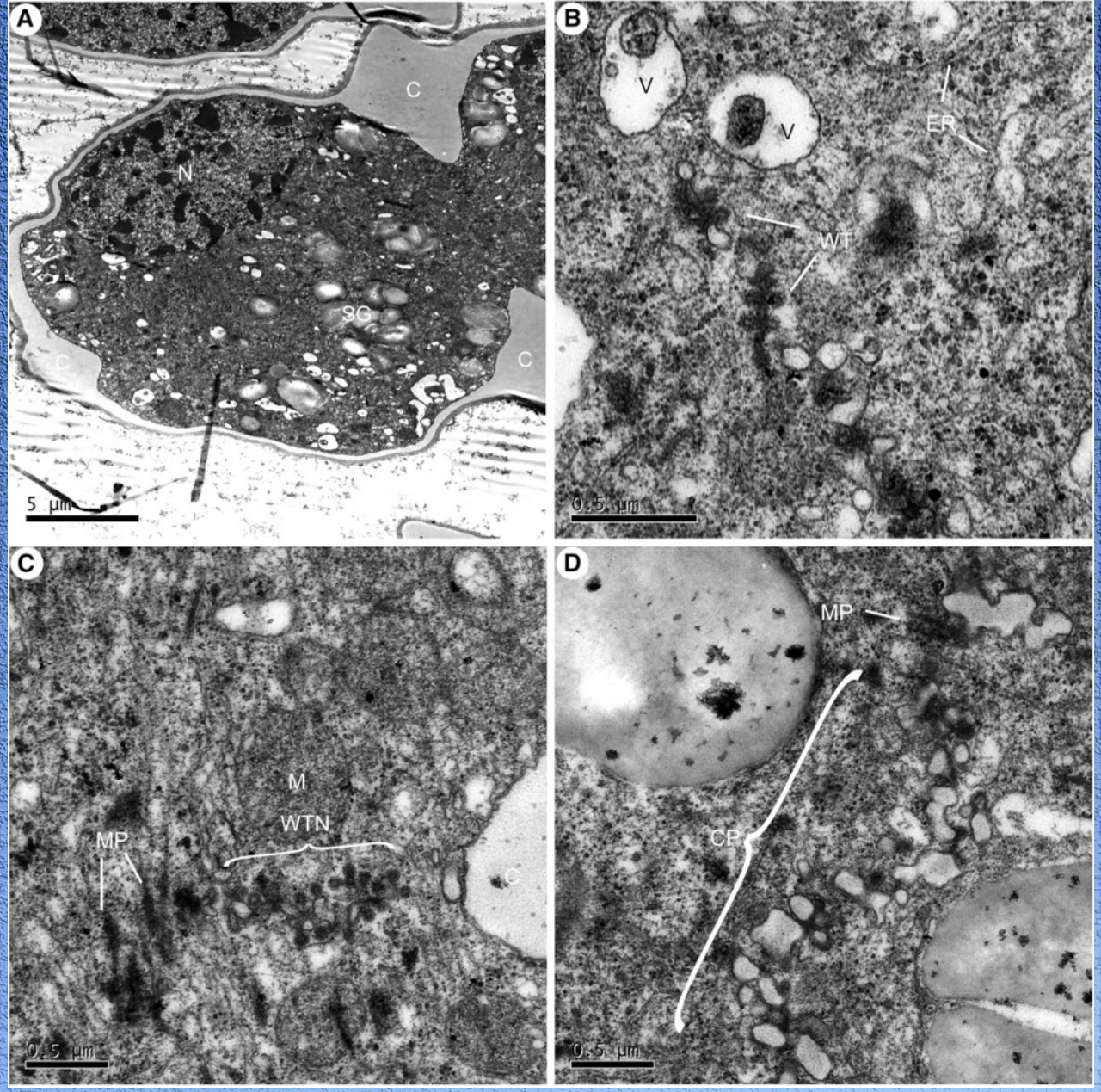

**Electron micrographs of microsporocytes at prophase II.**



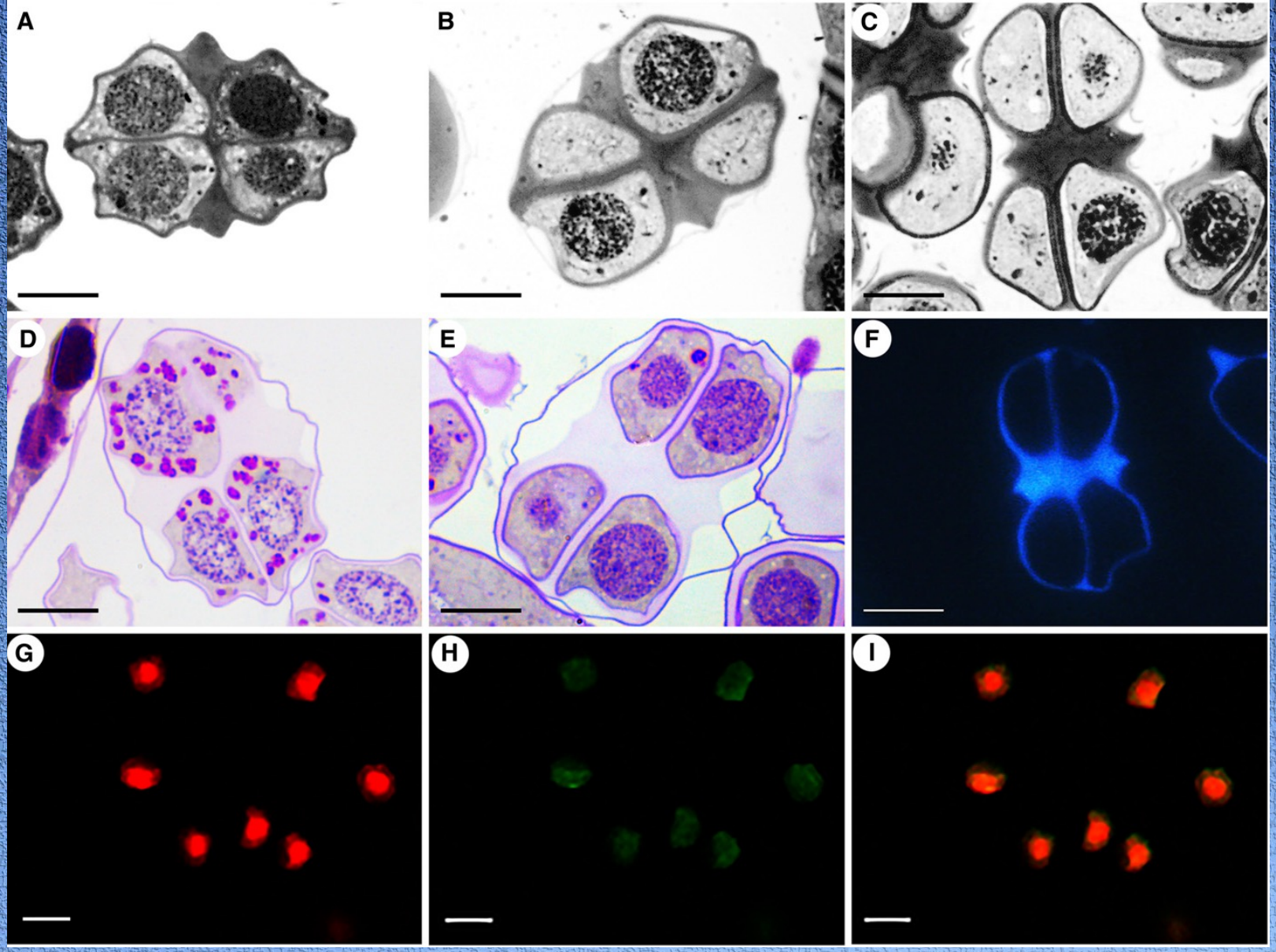

Microsporocytes at stages from metaphase II to telophase II.




Completion of cytokinesis for tetrad formation.




**Transmission electron micrographs of developing and mature tetrads.**




Thicknesses of callose walls of mature tetrads and free uninucleate microspores.

## Key findings

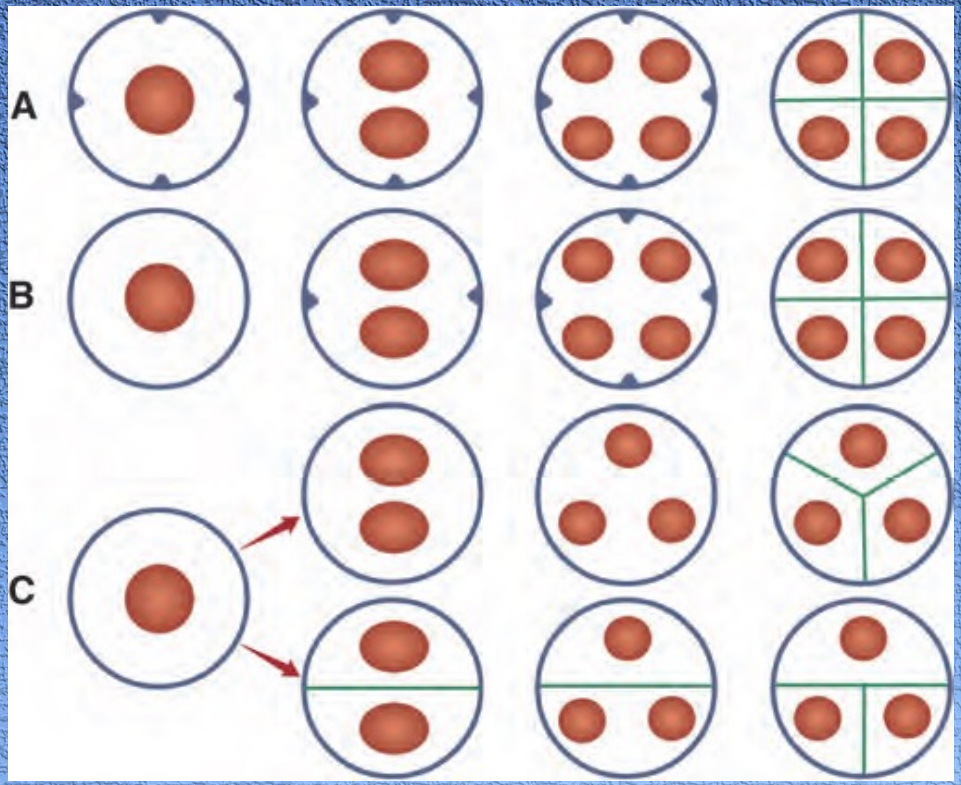
- First round of ACWIs occurs in prophase-II as a callose ring between the newly formed nuclei.
- Formation of ACWIs is independent of cytokinetic apparatuses such as mini-phragmoplasts, wide tubules, or wide tubular networks.
- Second round of ACWIs occurs shortly after telophase II between the newly formed nuclei.
- Cell plates subsequently form via phragmoplasts in the planes of the ACWIs.

# Evolution of cytokinesis in microsporogenesis/sporogenesis: ACWIs are of an ancient feature of cytokinesis

Non-seed plants

Few seed plants

Most of seed plants




Intermediate

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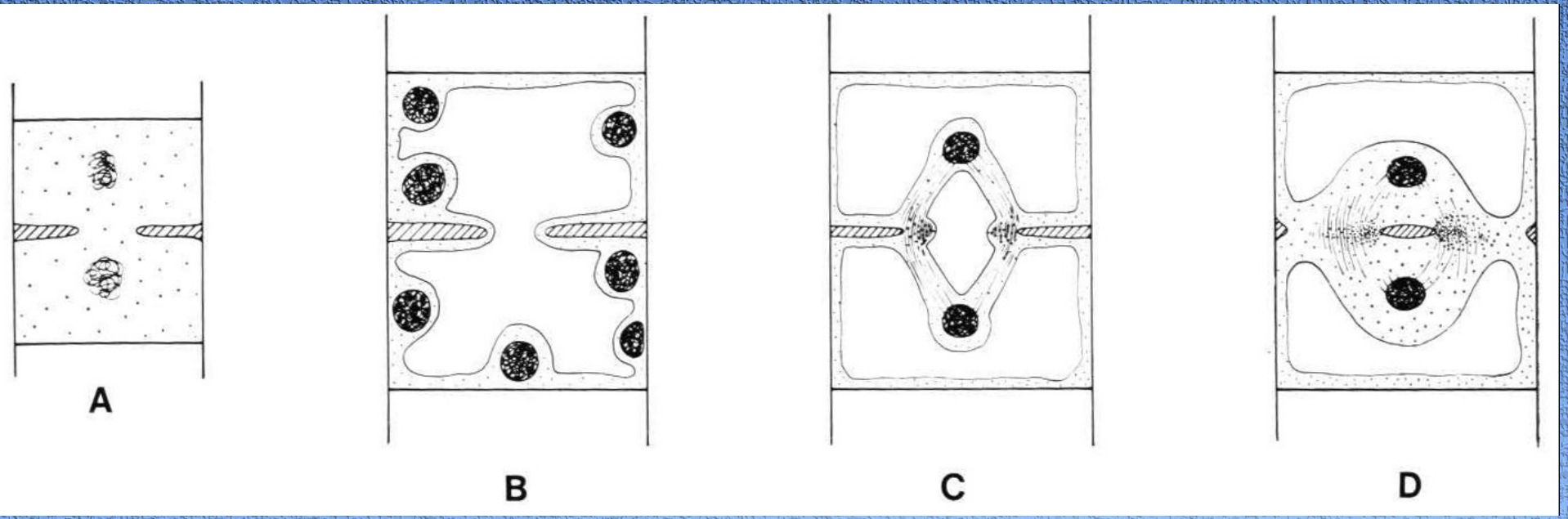
# A general hypothesis: cytokinesis in plants evolved from a mechanism of sole ACWIs to that of concurrent diminishing CWIs and phragmoplast-dependent cell plate formation




A: prokaryotic blue-green algae; B: algae; C: algae; and D: algae and higher plants. Figure from Pickett-Heaps, 1969, Cytobios 3: 257-280.

# Acknowledgements


## Contributing authors and affiliations

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## Technical assistance

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Xuan Lun, Chuanhe Liu, South China Agricultural University—TEM

## Funding

Natural Science Foundation of China
Public Subject Foundation, Chinese Academy of Sciences