

# Chromosome Biology

## 2023



6th Edition

○

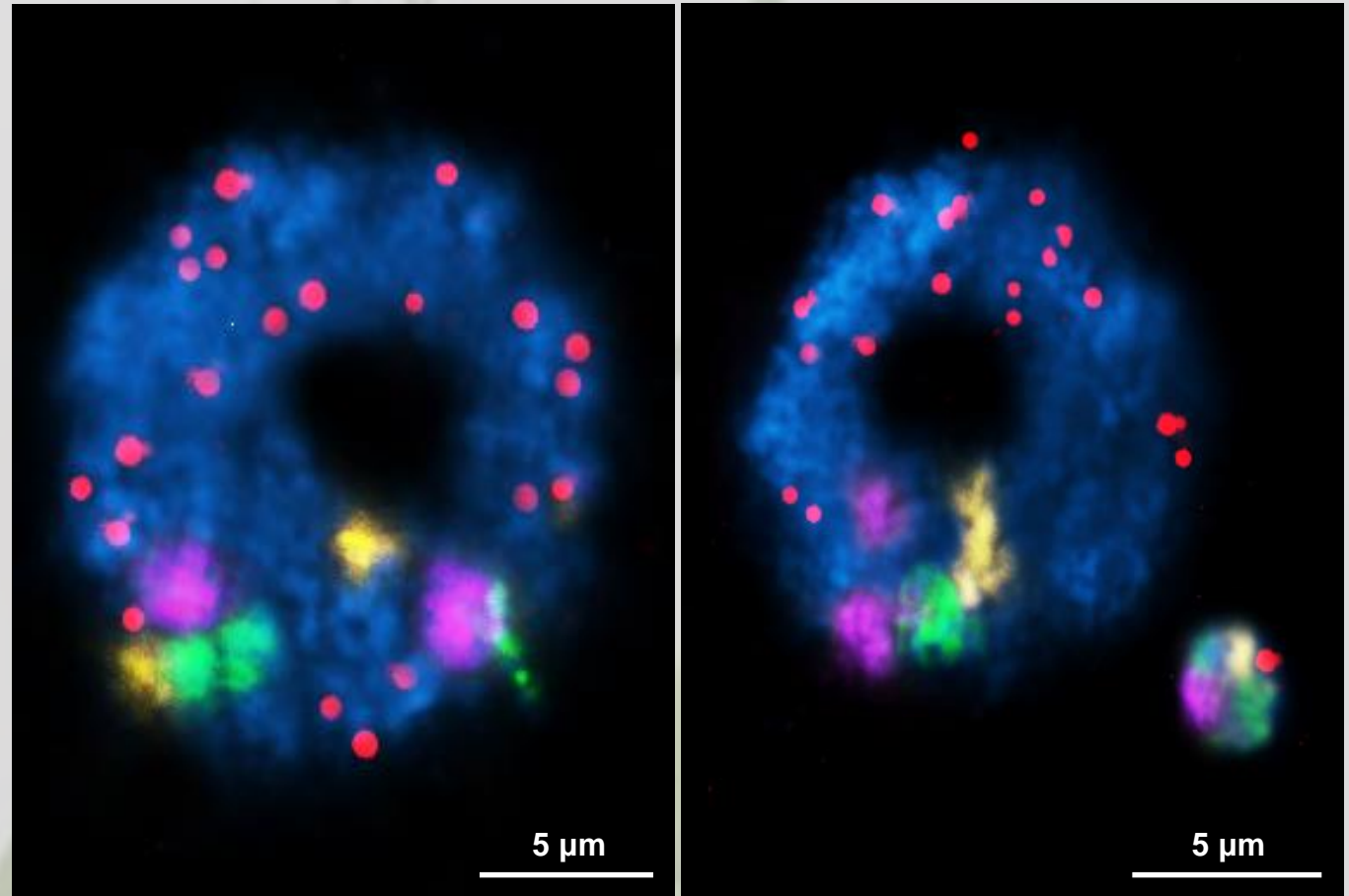
## ***Brachypodium distachyon***

POACEAE



◀ *B. distachyon* ( $2n=10$ ) is a small-genome annual grass originated from the Mediterranean region. It has been used to study various aspects of the plant genome organisation for more than twenty years. It is also a model organism for economically important temperate zone cereals and forage grasses.

▶ *Brachypodium distachyon* interphase nucleus without and with a micronucleus induced by X-radiation. Chromosome-specific (green, purple and yellow) and telomere-specific (red) FISH signals are visible.



# JANUARY

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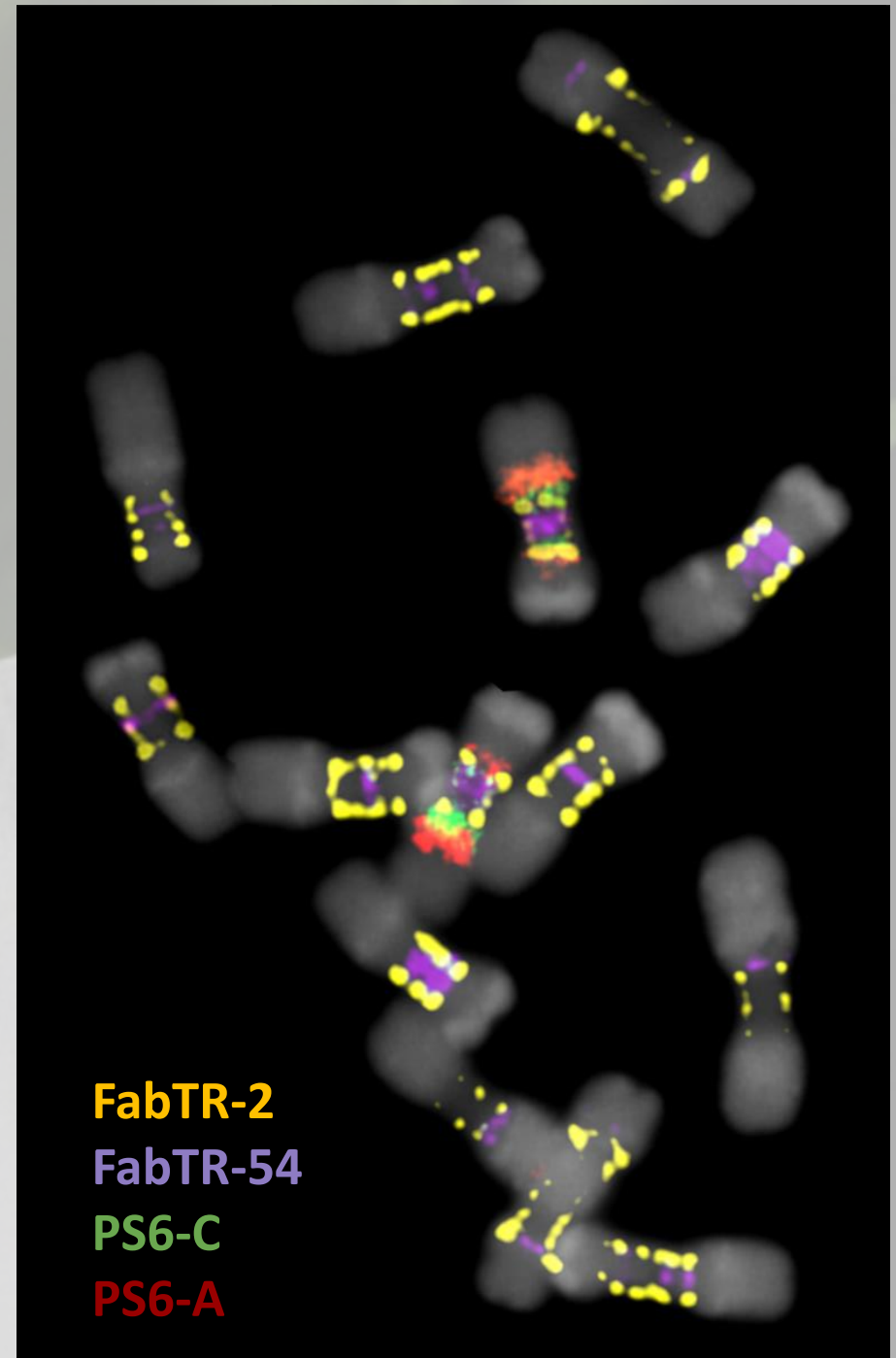
***Lathyrus sativus***  
FABACEAE

▼ The grass pea, *L. sativus*, is a legume with a large genome (6.52 Gbp/C) and low chromosome number ( $2n = 14$ ). The chromosomes possess extended primary constrictions (meta-polycentric chromosomes) with multiple domains of centromeric chromatin.



► A single satDNA family labels the extended primary constrictions of all chromosomes. Painting probes designed for the *Pisum sativum* centromere 6 (PS6-C/PS6-A) label orthologous centromere in *L. sativus*, revealing its expansion compared to *P. sativum*. Part of this centromeric extension is due to the accumulation of the satDNA family FabTR-54.

Laura Ávila Robledillo and Jiří Macas (Biology Centre, CAS, Czech Republic)



# FEBRUARY

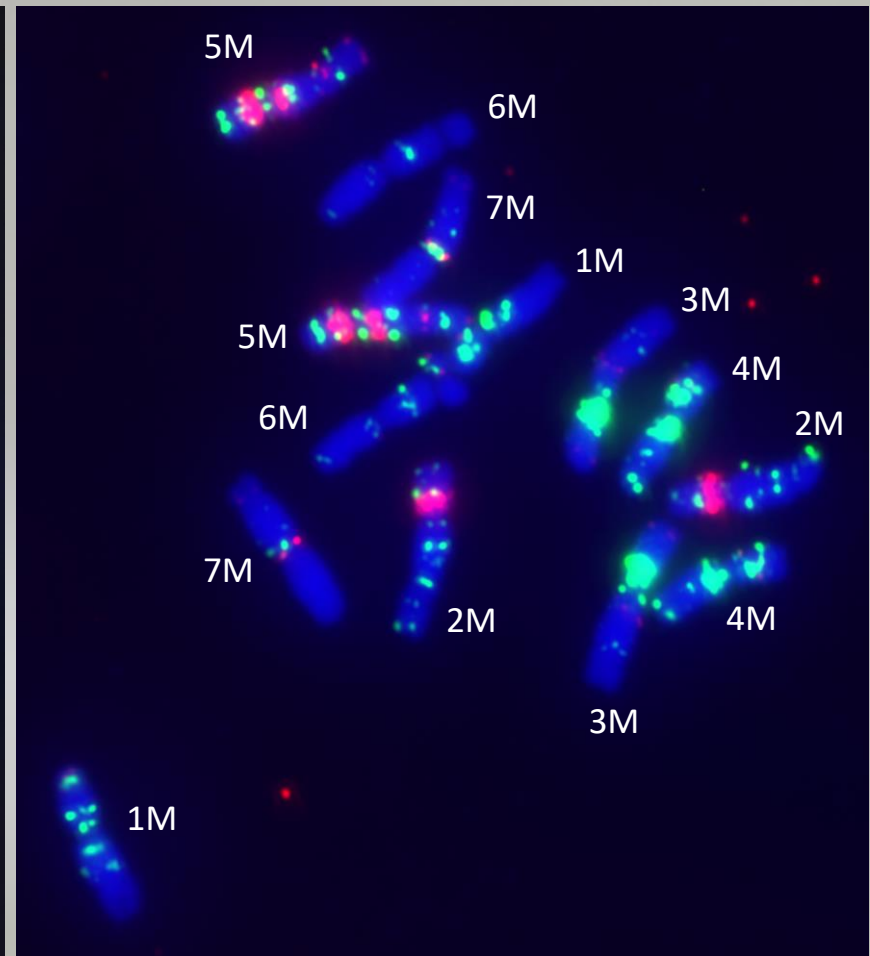
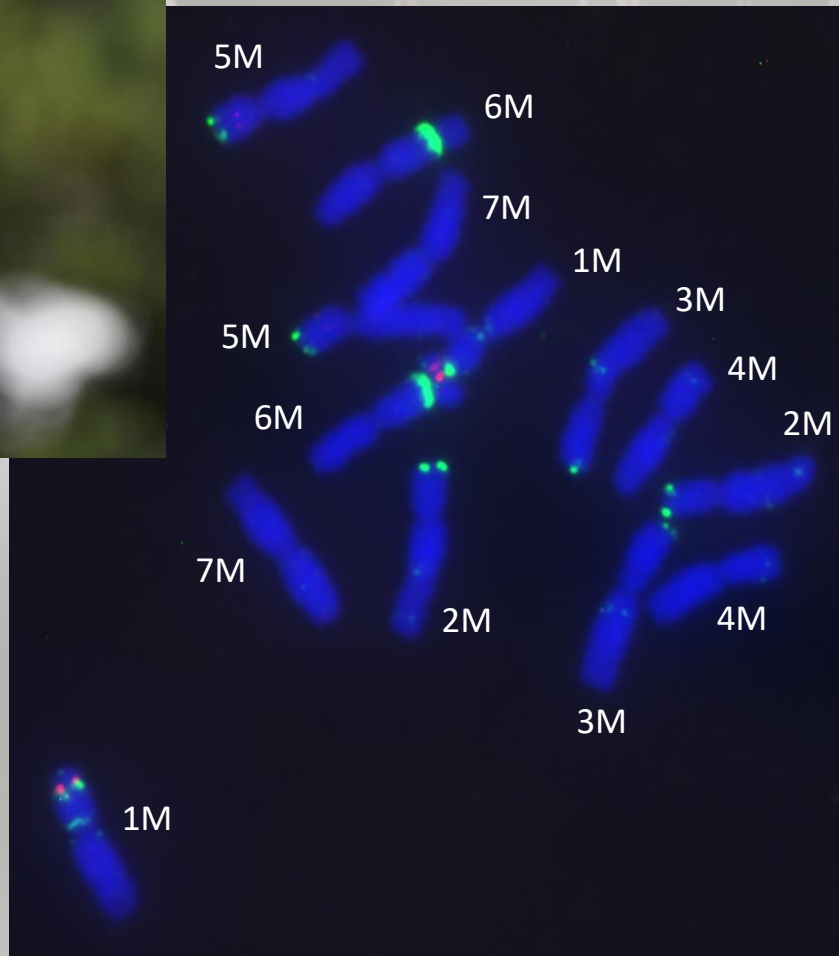
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## *Aegilops comosa* POACEAE

◀ *Ae. comosa* ( $2n = 2x = 14$ , MM), a mediterranean species with a main distribution area in coastal and inland Greece, but also occurring in Albania, former Yugoslavia and Turkey. Recently it was also found in Northern Cyprus. The photo was taken on the roadside near Troodos (h-1800 m), Cyprus by Mr. Roland Tsandekidis.

► FISH with 5S (red) and 45S (green) rDNA probes (left image) followed by hybridization with  $GAA_n$  (green) and pTa-713 (red) satellite sequences (right image) allowed the precise identification of all seven chromosome pairs. Chromosomes are designated according to genetic nomenclature.



# MARCH

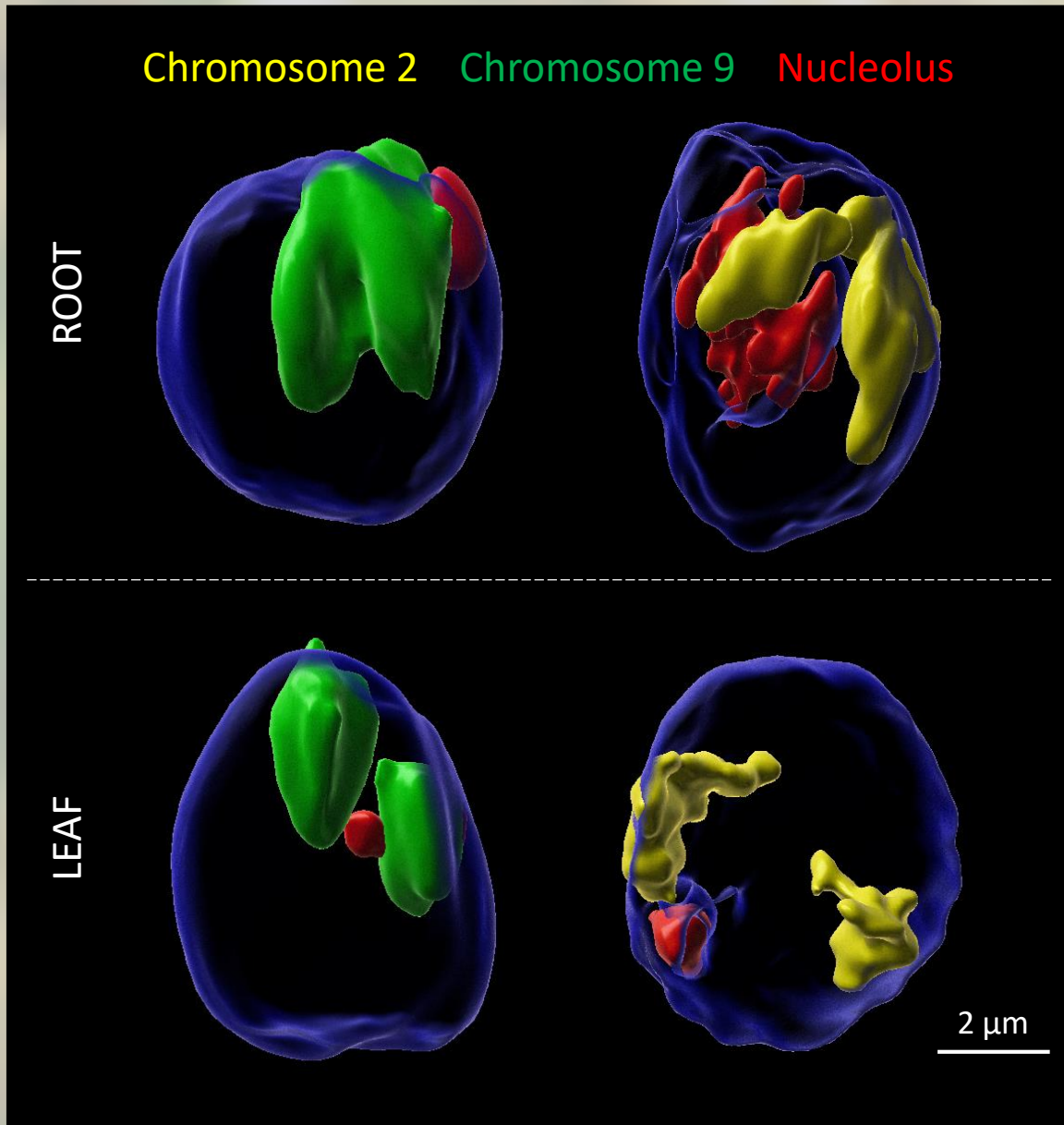


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## *Oryza sativa*

POACEAE

▼ Rice is one of the most important cereal crops worldwide. Its 389 Mb genome is one of the smallest of monocots which makes rice an important experimental system for genome research.



◀ Positioning of chromosomes 2 and 9, and nucleoli in interphase nuclei of rice. In the root meristem, both chromosomes were preferentially associated (in 90% of the nuclei) compared to leaf nuclei (only in 35% of the nuclei). Chromosome 2 and chromosome 9 containing NOR region were visualized using oligo-painting FISH. Nucleoli were visualized by anti-fibrillarin using immunolabeling. 3D-models were created using the software Imaris.

Alžběta Doležalová and Eva Hřibová  
(Institute of Experimental Botany, Olomouc, Czech Republic)



# APRIL

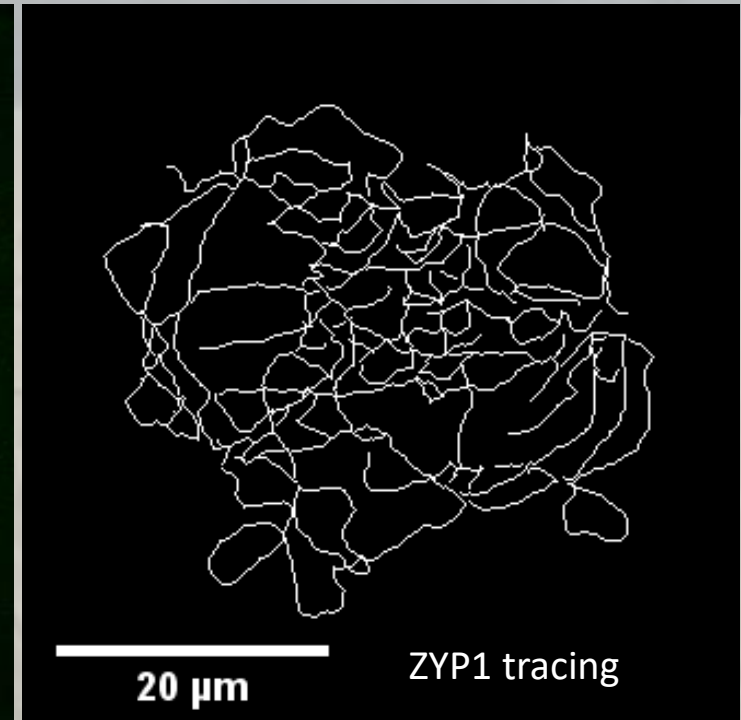
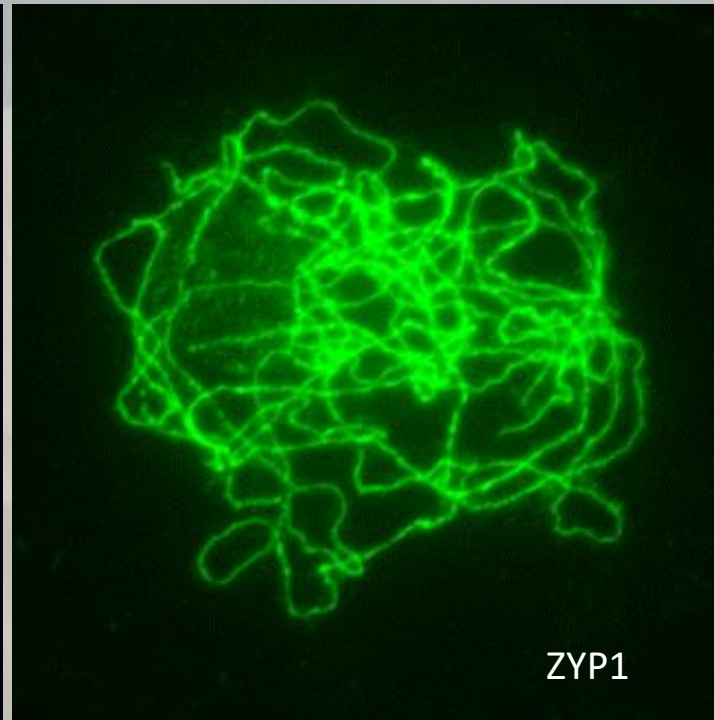
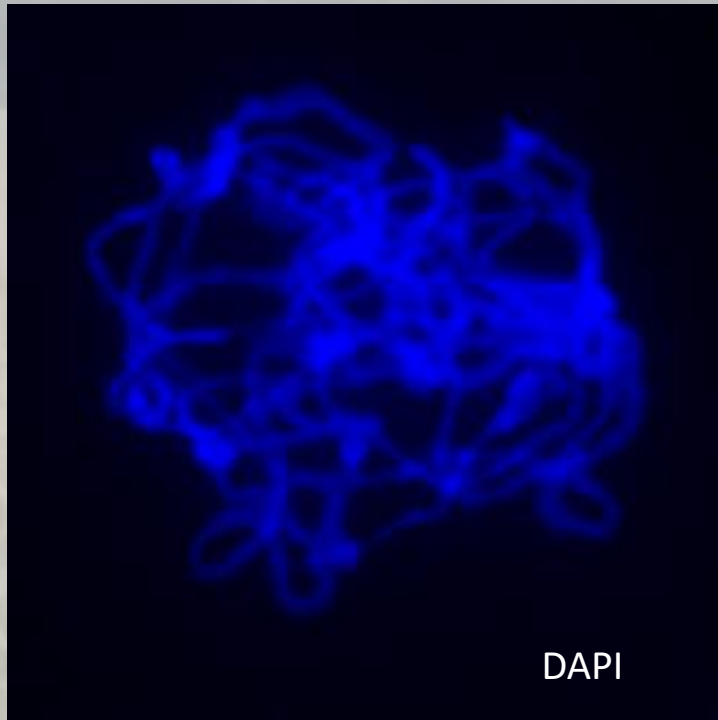
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## Rye (*Secale cereale*)

POACEAE

► Rye is a self-incompatible, wind-pollinating species belonging to the Poaceae (Monocotyledons). Rye was domesticated from weeds outside its region of origin, the Fertile Crescent, which was first hypothesized by Nikolai Ivanovič Vavilov (1887–1943).

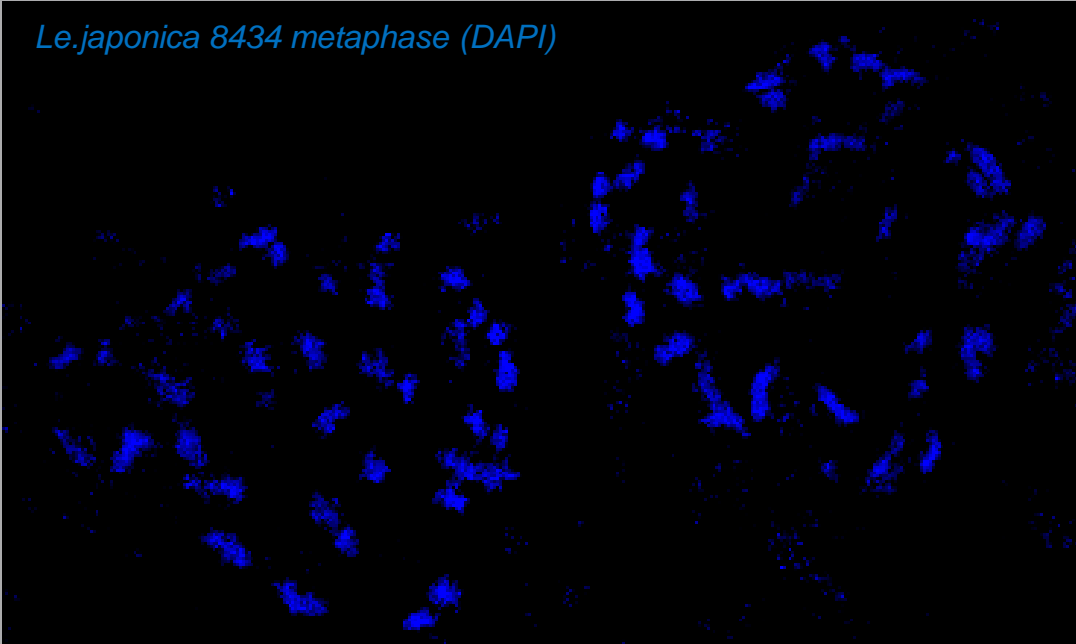
▼ Meiotic pachytene chromosomes of a feral rye accession collected in Afghanistan (*Secale cereale* subsp. *afghanicum*). Pachytene chromosomes were immuno-labeled for ZYP1 (green) and stained with DAPI (blue). The total length of all pachytene chromosomes was measured using SingleNeuriteTracer (approx. length = 793.27  $\mu\text{m}$ ).



# MAY

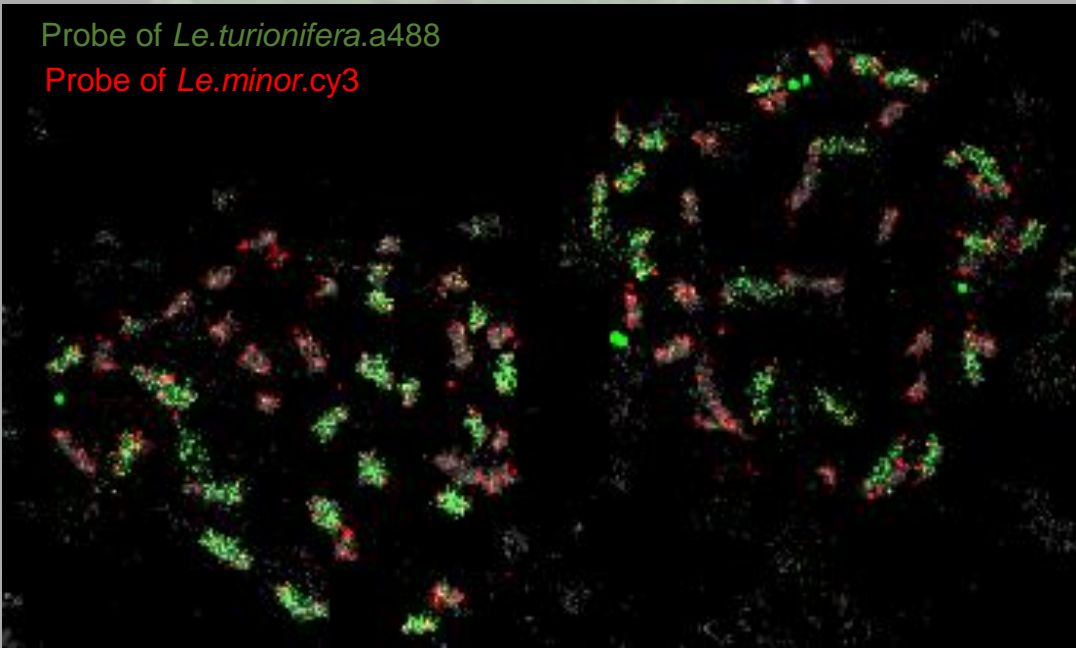
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*Le.japonica* 8434 metaphase (DAPI)



Probe of *Le.turionifera*.a488

Probe of *Le.minor*.cy3



## *Lemna japonica*

### LEMNACEAE

▼ *Le. japonica* ( $2n = 42$ , 453 Mbp/1C) is an interspecific hybrid between *Le. minor* and *Le. turionifera* according to tubulin gene polymorphism fingerprinting (Braglia et al., 2021) and GISH.

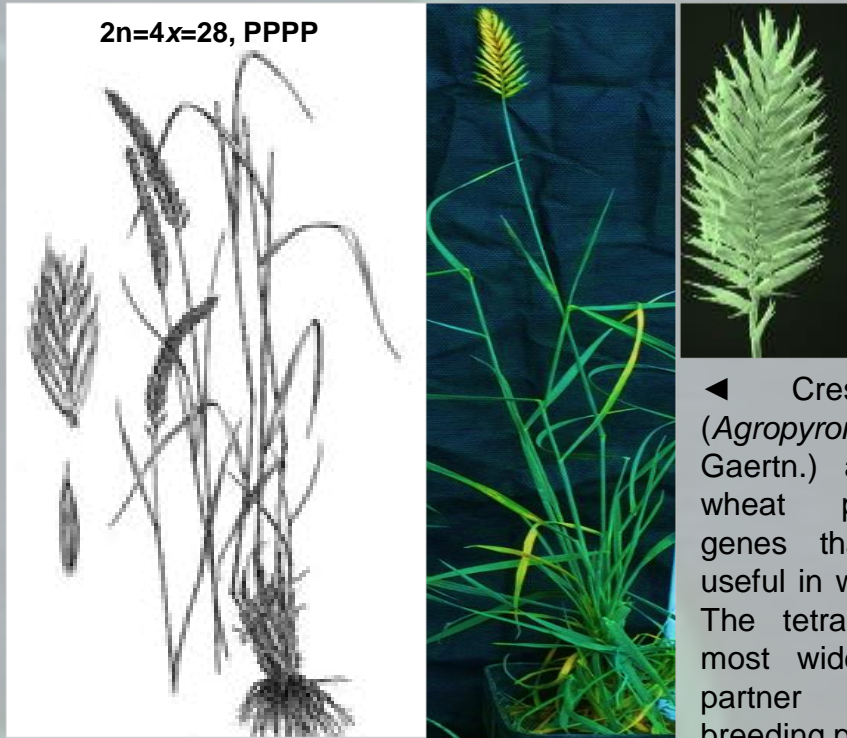


◀ GISH with genomic probes of *Le. minor* (red) and *Le. turionifera* (green) of mitotic chromosome of *Le. japonica* (clone 8434) confirms that this clone is a dihaploid hybrid between *Le. minor* and *Le. turionifera*.

# JUNE

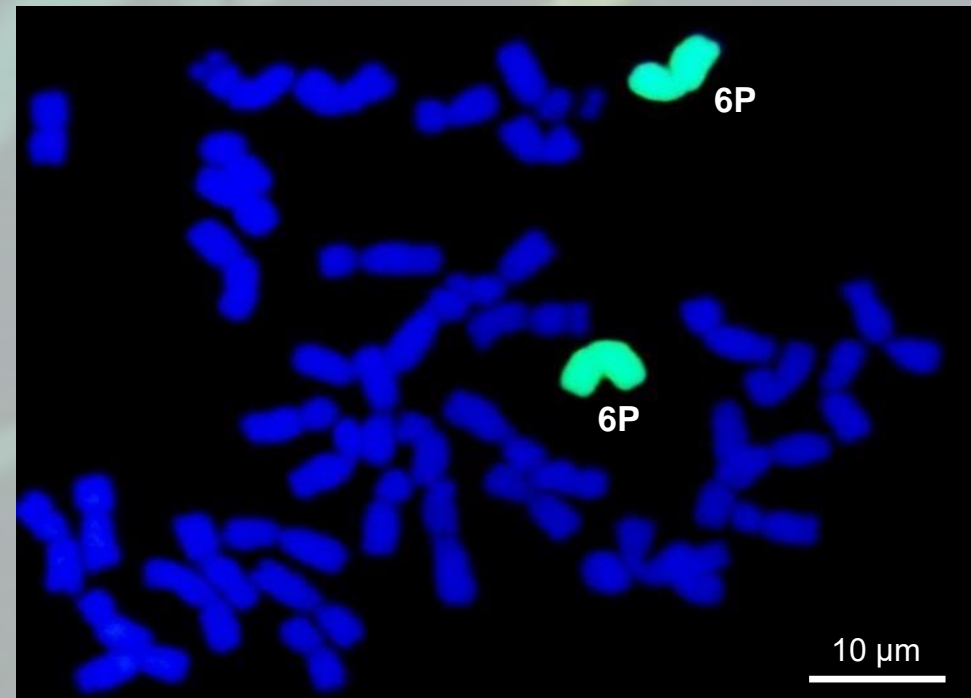
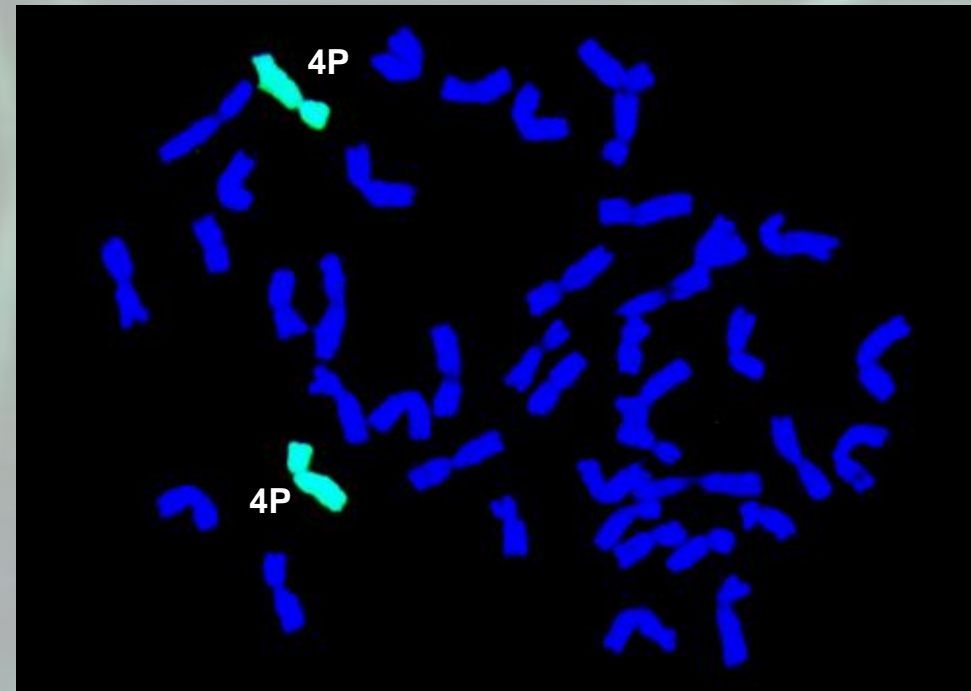
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***Agropyron cristatum***  
POACEAE



◀ Crested wheatgrass (*Agropyron cristatum* L. Gaertn.) a wild relative of wheat possesses many genes that are potentially useful in wheat improvement. The tetraploid form is the most widely used crossing partner in introgression breeding programs.

▶ GISH of mitotic metaphase chromosomes of wheat-*A. cristatum* lines using labeled genomic DNA from tetraploid *A. cristatum* (green). Chromosome 4P (top) and 6P (bottom) disomic addition.

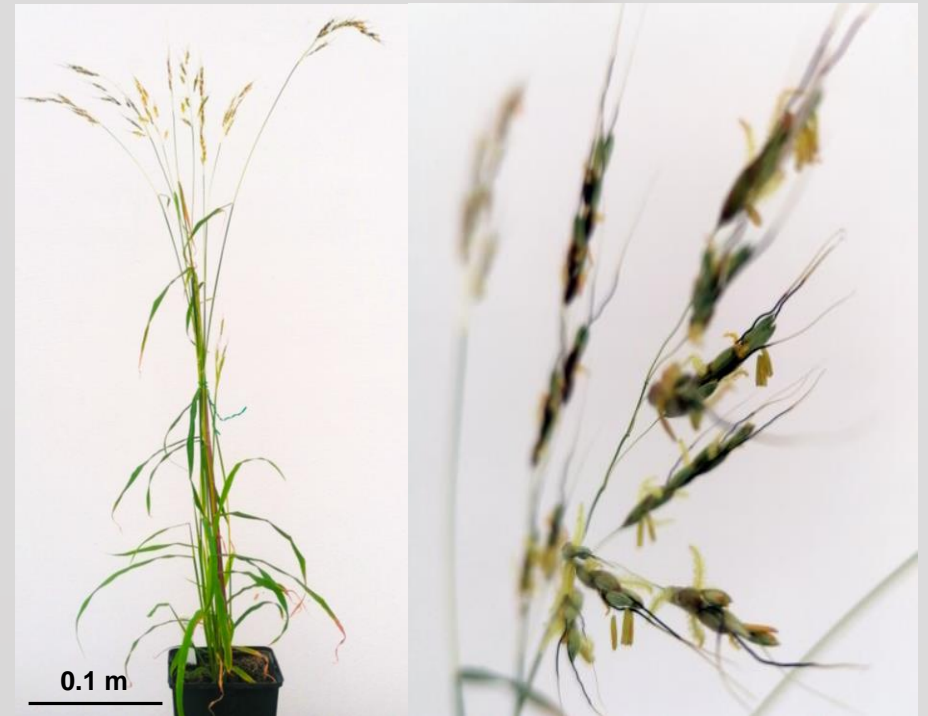
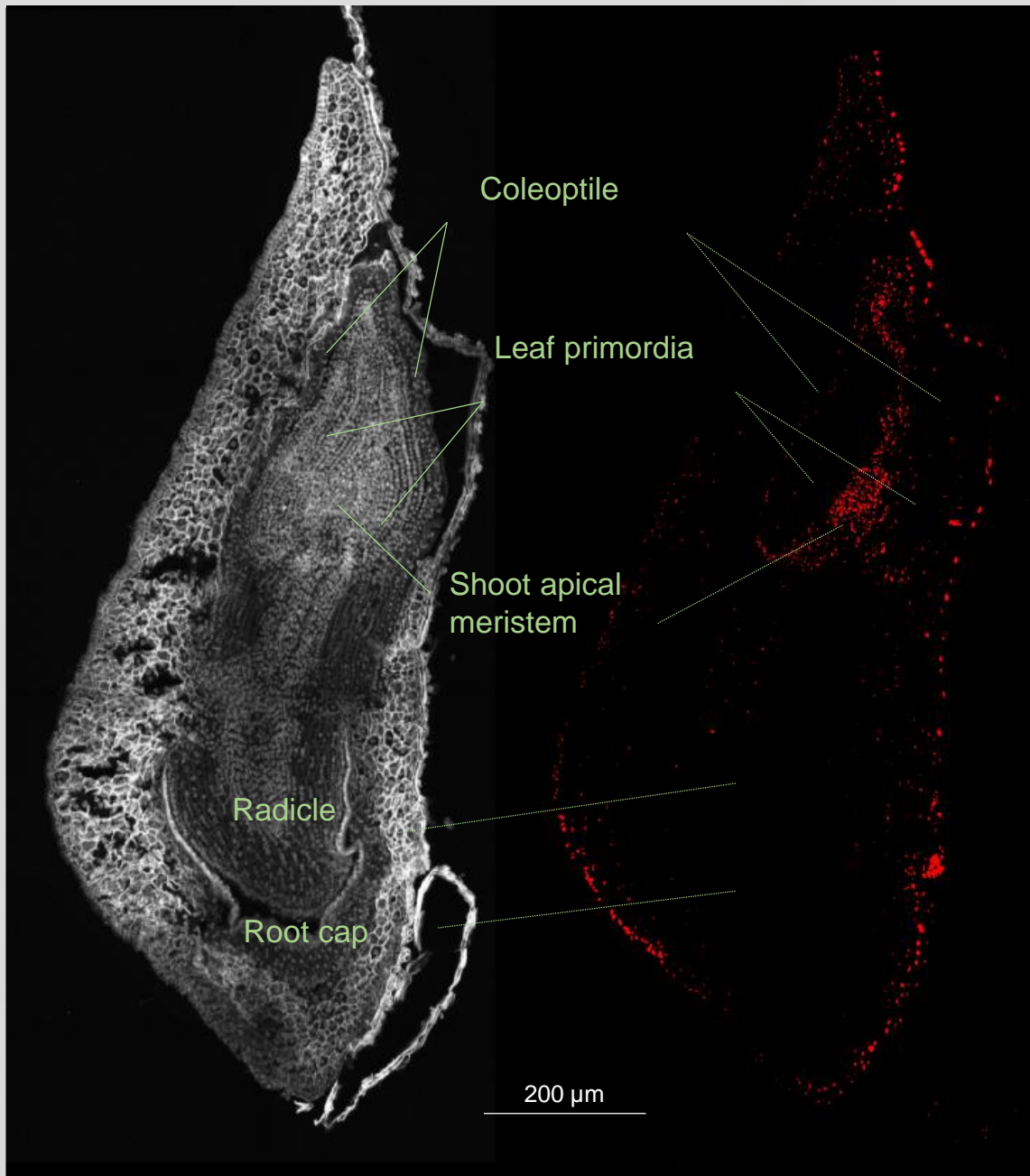


# JULY

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## *Sorghum purpureoericeum* POACEAE

▼ Wild sorghum (*S. purpureoericeum*) is a tropical, often cross-pollinating species with loose and open panicles. Its genome ( $2n=2x=10$ ) occasionally carries supernumerary B chromosomes.



◀ B chromosome distribution in a sorghum embryo. Cross section of a mature embryo after FISH with a B chromosome-specific probe (red). The B chromosome is absent in proto-root cells and leaf primordia. Only in very few groups of cells predetermined to form meristems and reproductive organs the B chromosome exists.

Miroslava Karafiátová, Alzbeta Doležalová, Tereza Bojdová and Jan Bartoš  
(Institute of Experimental Botany of the Czech Academy of Sciences, Olomouc, Czech Republic)



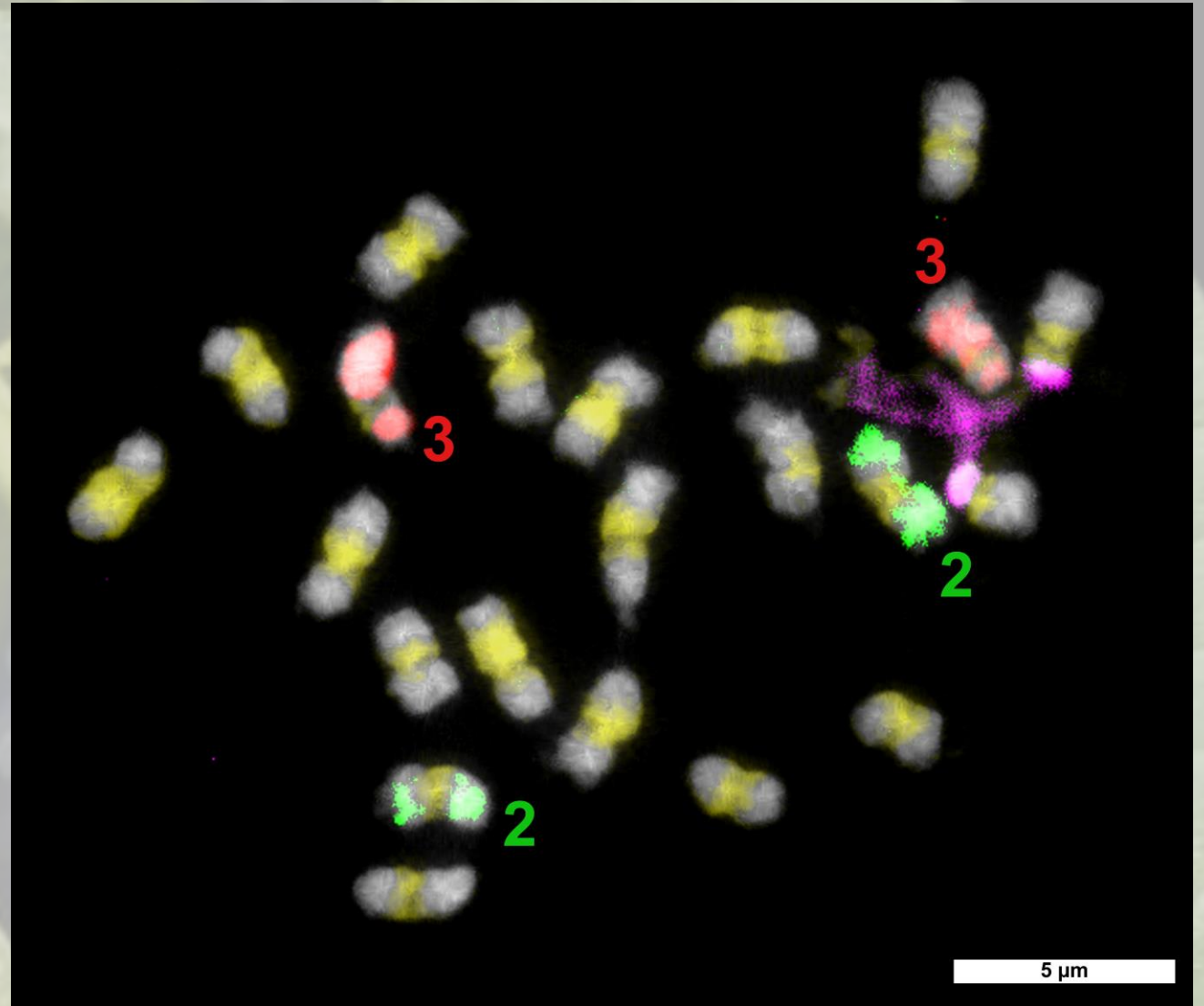
# AUGUST

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## *Phaseolus lunatus*

FABACEAE

▼ *Phaseolus* L. beans are one of the most important legume crops. *Phaseolus lunatus* ( $2n = 22$ ), also known as Lima bean, was domesticated twice, in Mesoamerica and in the Andes. It is worldwide consumed for its high level of fibers and proteins.



► Oligo-FISH painting probes for *P. vulgaris* chromosomes 2 (green) and 3 (red) were hybridized to *P. lunatus* chromosomes, evidencing a conserved synteny of these two chromosome pairs. Chromomycin A3 (yellow) marks pericentromeric heterochromatin. Chromosome 6 carries 35S rDNA repeats (purple).

Thiago Nascimento and Andrea Pedrosa-Harand (Federal University of Pernambuco, Recife, Brazil)

# SEPTEMBER

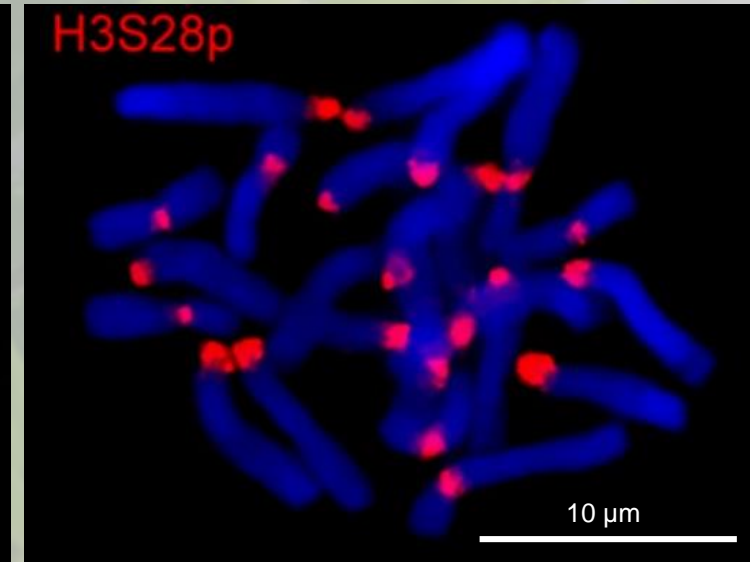
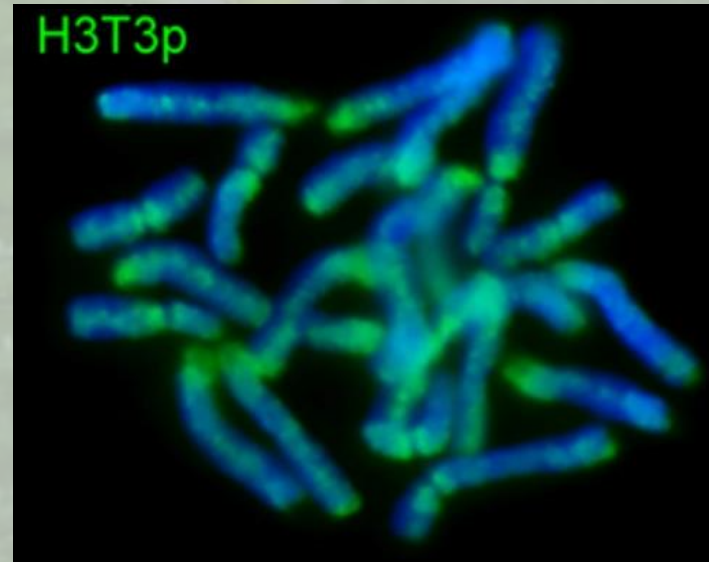
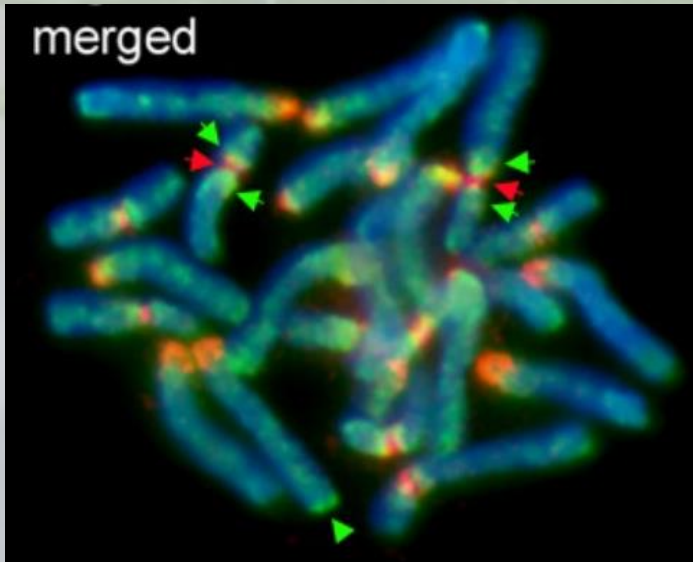
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## *Cycas revoluta* CYCADACEAE

◀ “Cycads are to the vegetable kingdom what Dinosaurs are to the animal, each representing the culmination in Mesozoic times of the ruling Dynasties in the life of their age.” Lester Ward, 1900. The members of the *Cycadaceae* family exhibit several interesting genomic features: stable chromosome number  $x=11$ ; there are only diploid species, their karyotypes are asymmetrical and they contain abundant telomeric repeat variants in both telomeres and centromeres.

▼ Immunostaining of *C. revoluta* ( $2n=2x=22$ ) mitotic chromosomes with antibodies recognizing phosphorylated histone H3 at threonine 3 (green) and phosphorylated histone H3 at serine 28 (red). Histone H3 phosphorylation is enriched in pericentromeric regions (green arrows). Diffuse anti-H3T3p signals are also observed along the chromosome axis between the chromatids and some chromosome ends (green arrowhead).



# OCTOBER

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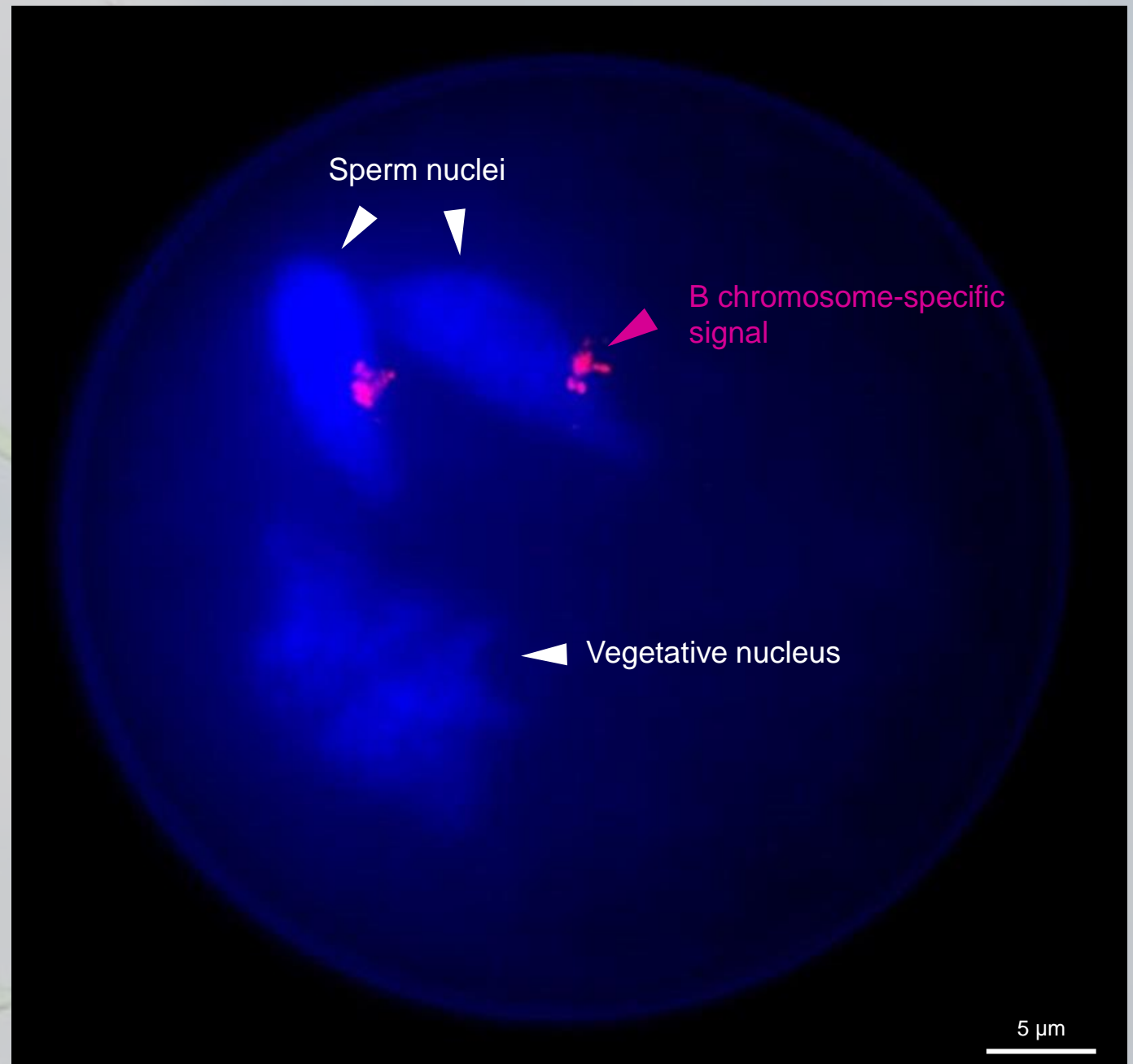
# *Festuca pratensis*

## POACEAE

▼ *Festuca* species have a diverse distribution and are considered important components of grass ecosystems of the temperate zones. In *F. pratensis* in addition to the essential A chromosomes, one to five supernumerary B chromosomes have been reported.

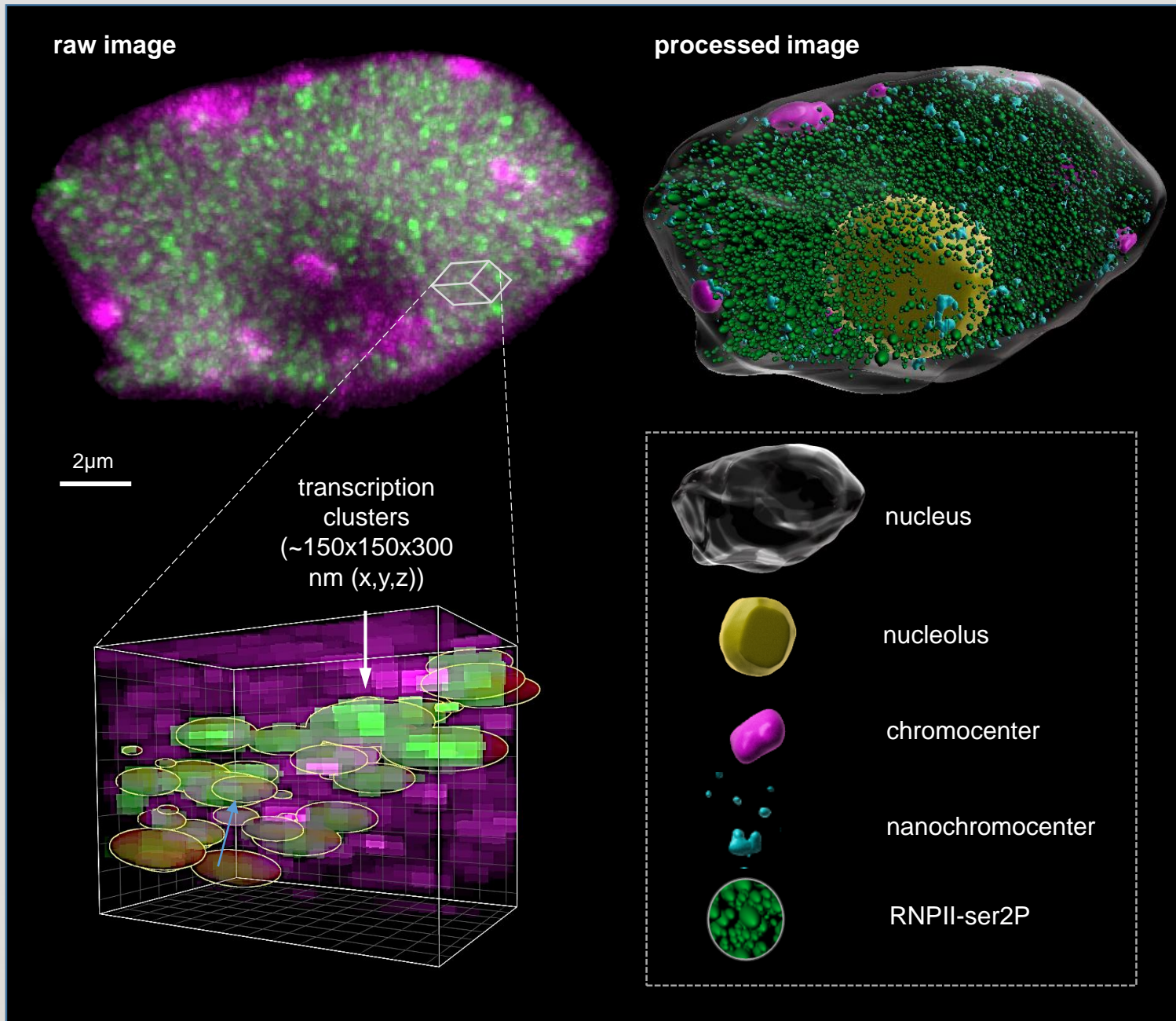


► FISH of an intact pollen grain of *F. pratensis* using the B-specific probe Fp\_Sat 253. Only sperm nuclei display B-specific signals indicating that the drive of Bs occurs in the first pollen mitosis.



# NOVEMBER

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## *Arabidopsis thaliana* BRASSICACEAE

▼ *A. thaliana* ( $2n = 10$ ) serves as one of the model systems to understand the 3D organising principles of the genome, in eukaryotes.



◀ 3D imaging using Stimulated Emission Depletion (STED) of *Arabidopsis* nuclei allows to gain insight into the 3D genome organization at nanoscale resolution. Here, isolated leaf nuclei were immunostained for RNA Pol II ser2P (green) and counter-stained for DNA using Live 560 (Abberior, magenta). The image was segmented to produce a digital representation of the nucleus, heterochromatin (chromocenters and nanochromocenters) and transcription clusters. This step enables a quantitative analysis, in 3D, of the distribution of transcriptional clusters.



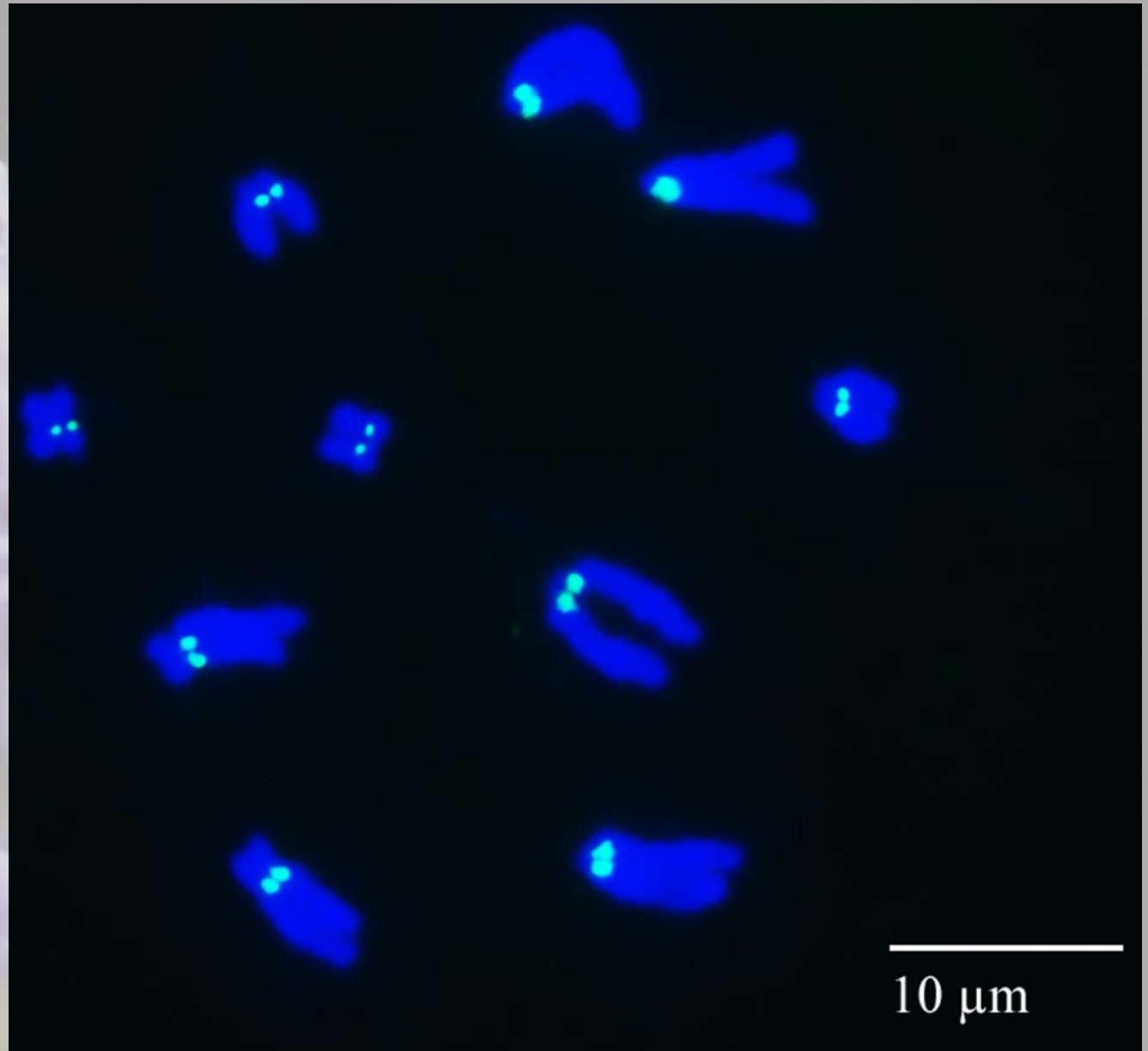
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## ***Cephalaria syriaca* (Pelemir)**

DIPSACACEAE

▼ *C. syriaca* ( $2n=2x=10$ ) is a member of the Dipsacaceae family, which is generally distributed in Europe, West and Central Asia, Northern and Southern Africa, and Mediterranean regions. The genus *Cephalaria* is extremely rich in macromolecules and chemical compounds, and has a significant biological and morphological diversity in Turkey.



▲ FISH revealed the centromere-specificity of the Cs150 satellite repeat on chromosomes of *C. syriaca*.

# 2024

## JANUARY

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## FEBRUARY

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## MARCH

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## APRIL

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## MAY

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## JUNE

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## JULY

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## AUGUST

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## SEPTEMBER

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## OCTOBER

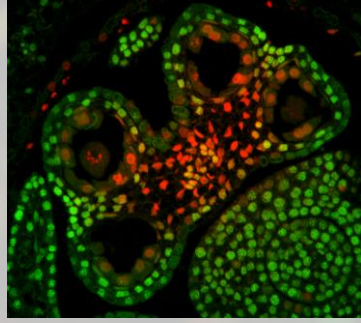
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## NOVEMBER

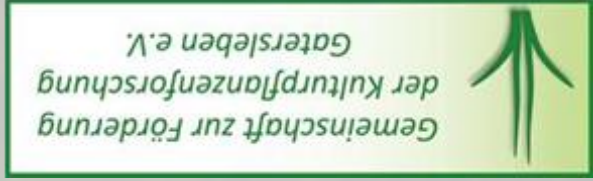
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## DECEMBER

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**Cover picture**  
Immunodetection of histone H4 acetylation (green) in a tissue section of a *Fagopyrum tataricum* (*Polygonaceae*) anther.  
Agnieszka Braszewska, Artur Piński and Alexander Betekhtin (University of Silesia in Katowice, Poland)



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Most of all, we would like to thank all colleagues who provided the beautiful contributions.

**Compilation and Design:** Jörg Fuchs and Andreas Houben (IPK, Gatersleben, Germany)

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