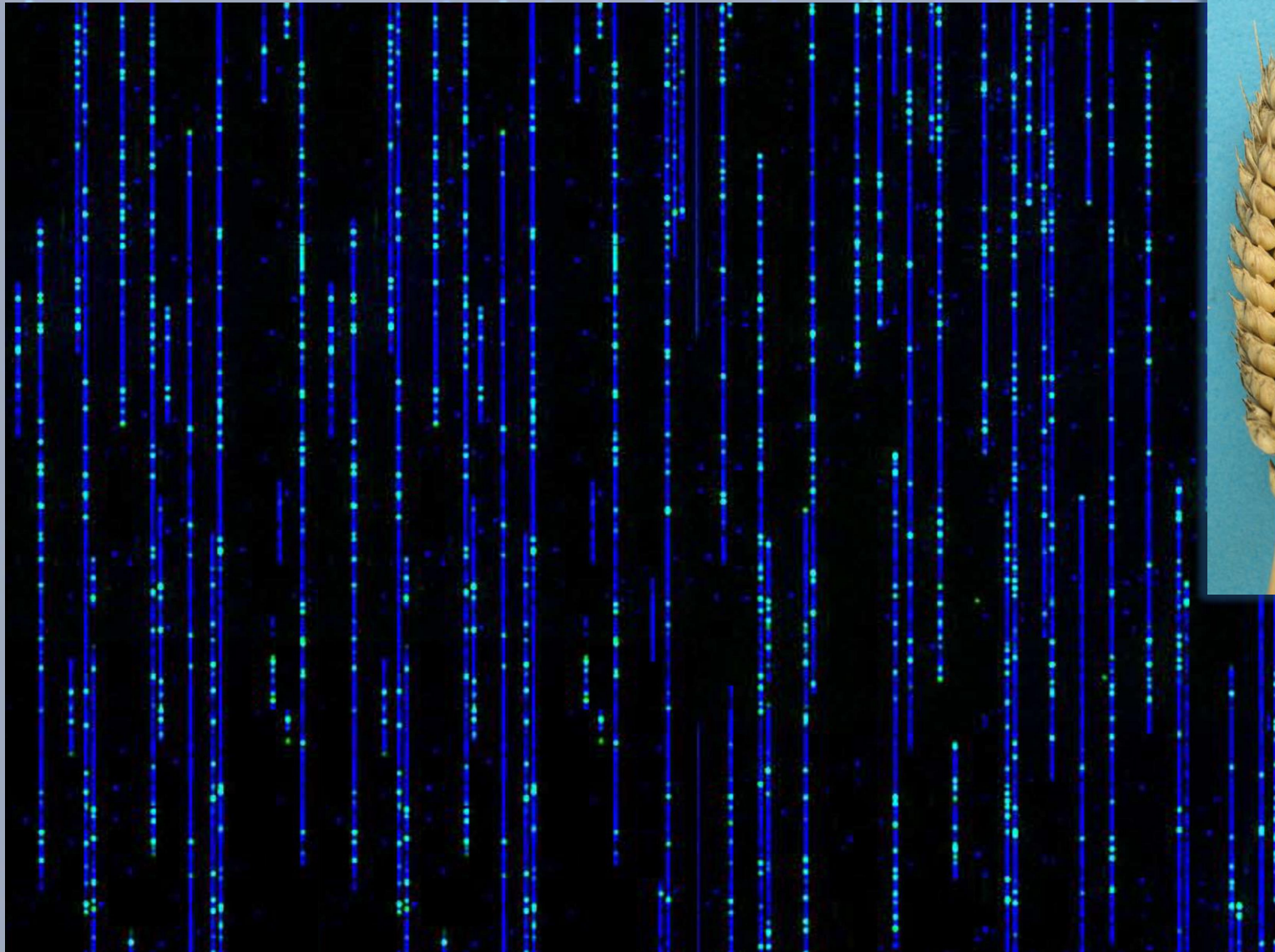


CHROMOSOME BIOLOGY 2022



5TH EDITION

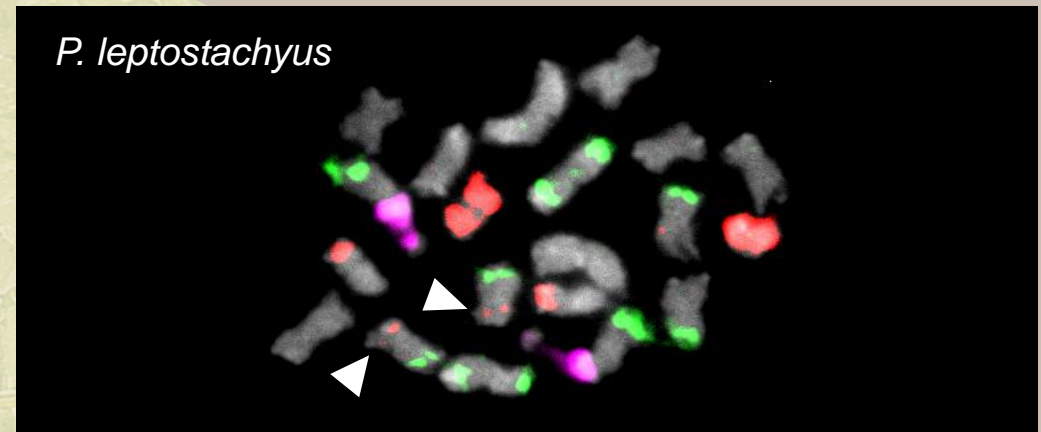
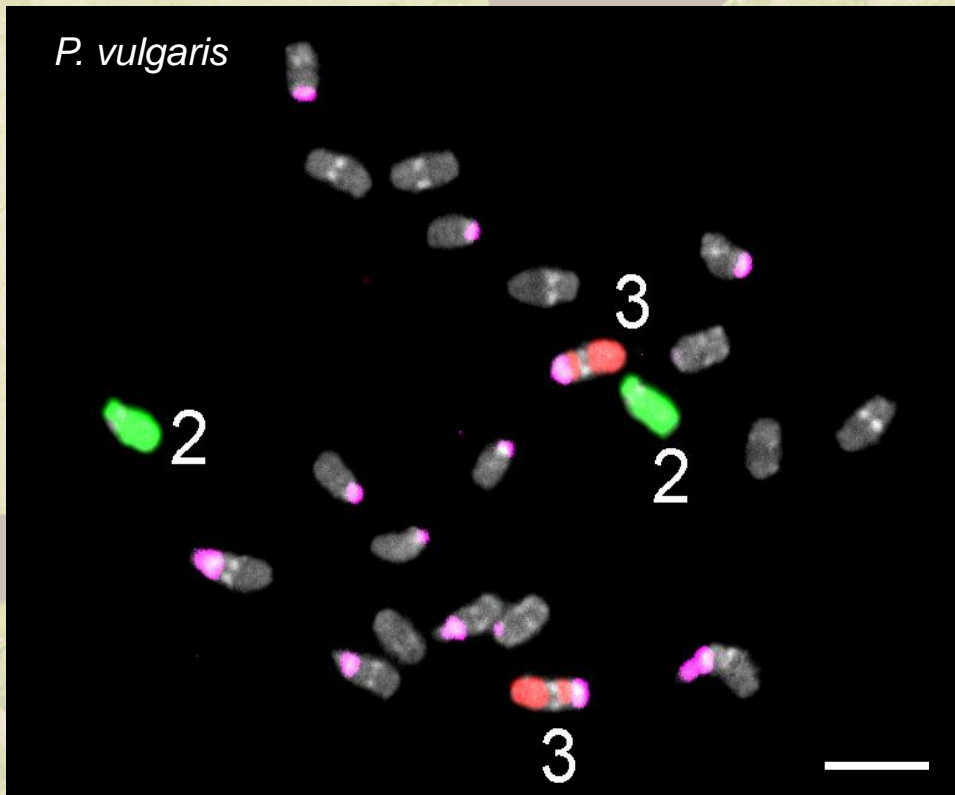
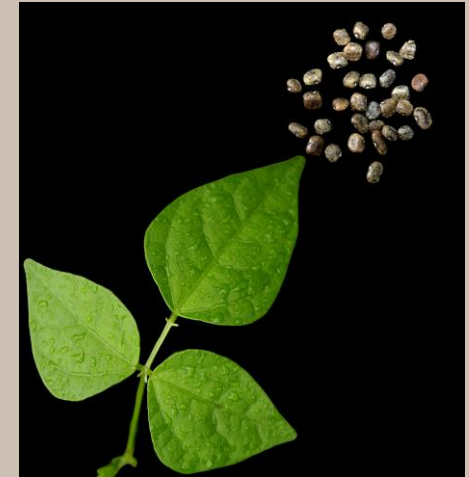
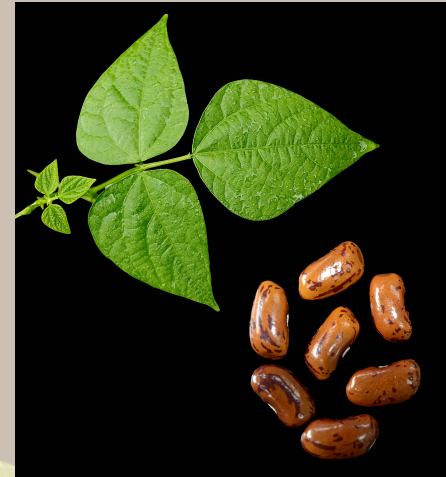
Leibniz
Association



Phaseolus vulgaris and *P. leptostachyus*

FABACEAE

► *Phaseolus vulgaris* is the second legume crop in importance to humans. As most of the genus, it has $2n = 22$, while three species from the *Leptostachyus* group have $2n = 20$ due to a descending dysploidy event. Although the dysploidy was caused by a nested chromosome fusion, *P. leptostachyus* underwent an intense genome re-structuring in a short period of time (~ 1.3 MyA), with multiple translocations observed after chromosome painting.



◀ ▲ Oligo-FISH painting probes for *P. vulgaris* (left) chromosomes 2 (in green) and 3 (in red) were hybridized to *P. leptostachyus* (right), evidencing how rearranged these two chromosome pairs are in this dysploid species. Chromosome 2 segments are distributed in at least four different chromosome pairs, while chromosome 3 segments are present in three different pairs. Arrowheads in *P. leptostachyus* karyotype points to small segments of chromosome 3 in a different pair. The difference in the distribution of the 35S rDNA loci (in purple) is also observed. Bar corresponds to 5 μ m.

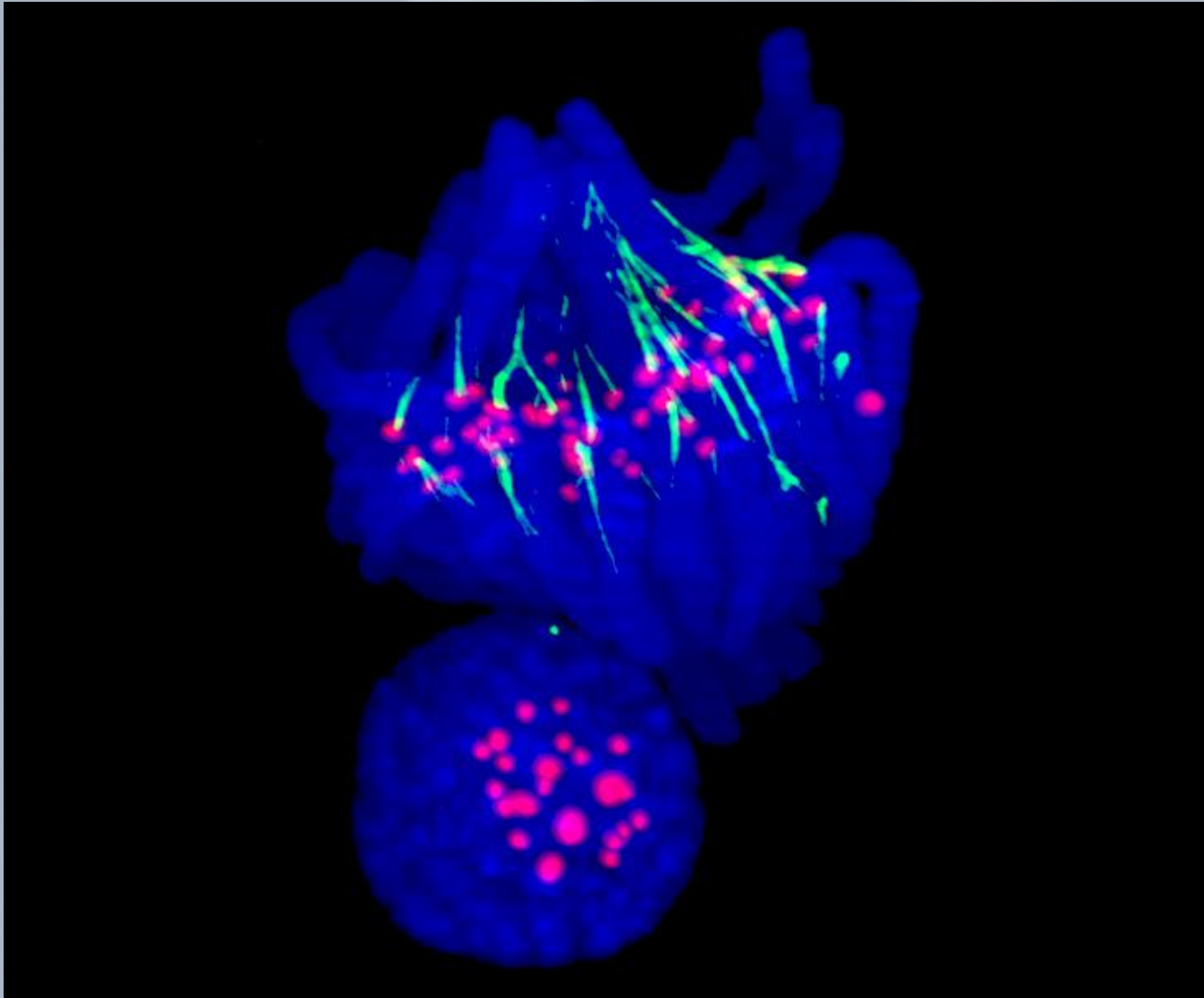
JANUARY



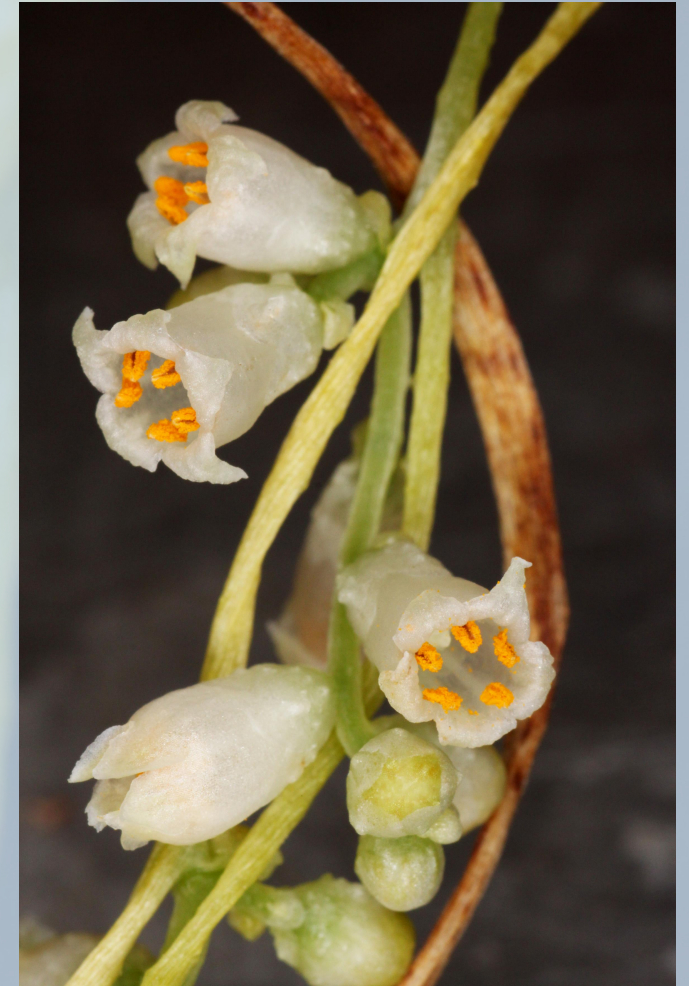
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					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Cuscuta reflexa
CONVOLVULACEAE

▼ *C. reflexa* ($2n=32$), also known as the giant dodder, is a parasitic leafless plant, common in the Indian subcontinent and the Greater Himalayas.



▲ Distribution of the outer kinetochore protein NDC80 (red) and microtubules (green) on chromosomes and interphase nucleus of the monocentric species *C. reflexa*.



FEBRUARY

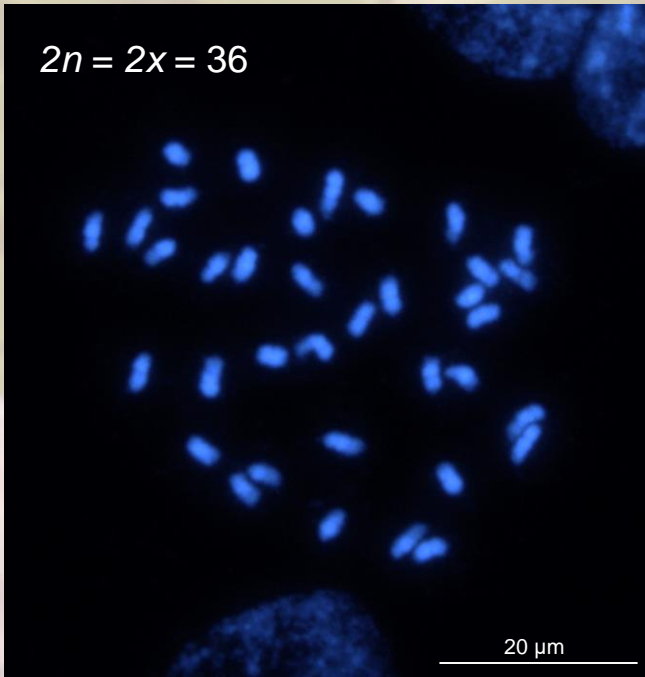
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

Hydrangea macrophylla HYDRANGACEAE

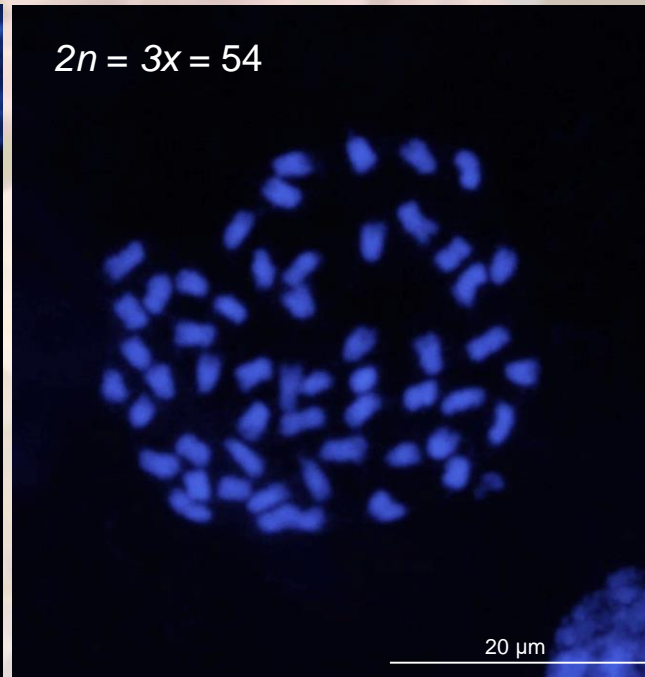
▼ *H. macrophylla* is an ornamental crop with impressively large flowers. Cultivars of *H. macrophylla* are used for landscaping, as potted plants for indoor cultivation or for production of fresh and dry cut flowers.



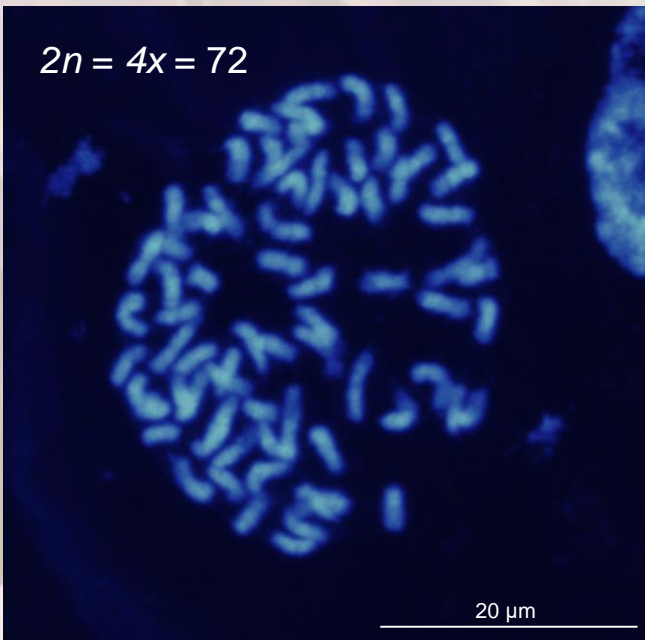
$2n = 2x = 36$



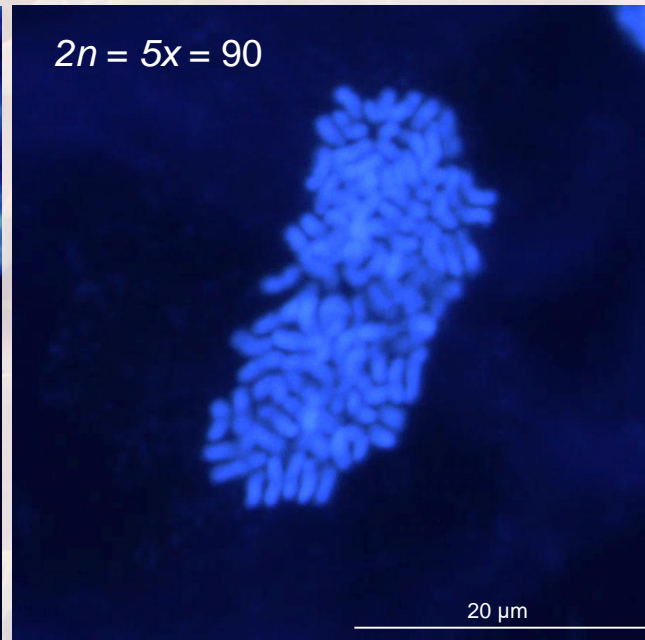
$2n = 3x = 54$



$2n = 4x = 72$



$2n = 5x = 90$



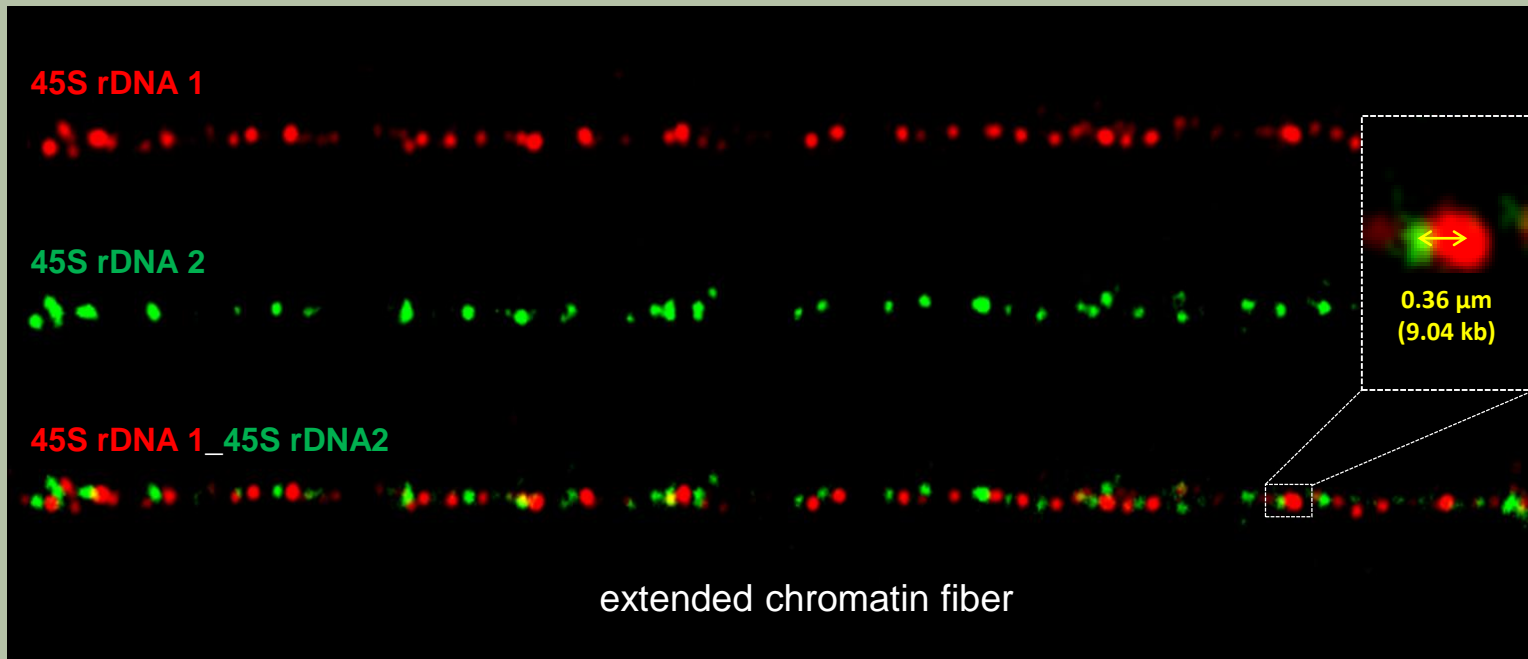
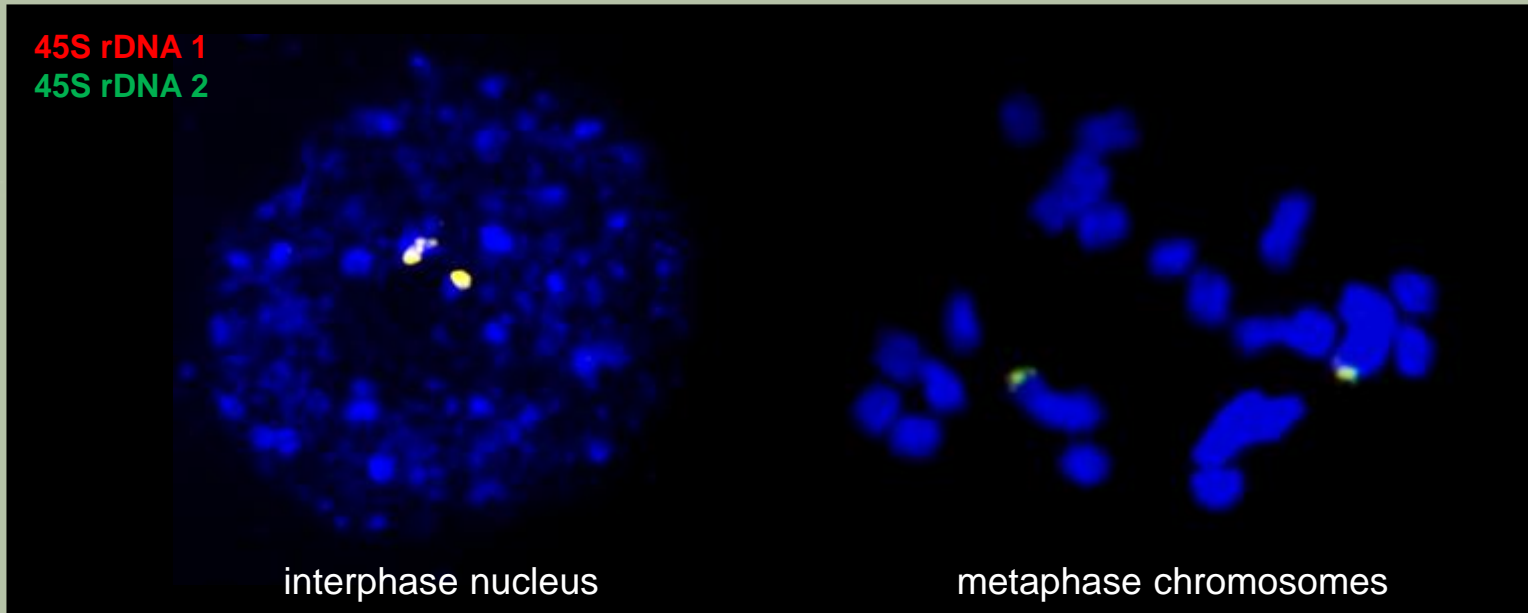
◀ *H. macrophylla* includes diploid ($2n = 2x = 36$) as well as polyploid varieties ($3x$, $4x$, $5x$). Presumably, most of them resulted from spontaneous polyploidization through unreduced pollen. The formation of high frequencies of unreduced pollen (>50%) is genetically controlled by a major locus in a dominant-recessive manner.

MARCH

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Chionographis japonica
MELANTHIACEAE

▼ *C. japonica* ($2n = 24$), distributed in north Asia, is the only genus with holokinetic chromosomes in this family.



◀ FISH probes, 45S rDNA 1 (red) and 45S rDNA 2 (green), covering a 45S rDNA unit show a pair of signals on both interphase nuclei and metaphase chromosomes of *C. japonica*. On the high-resolution chromatin fibers, their signals alternate and demonstrate the tandemly arrayed nature of the 45S rDNA.

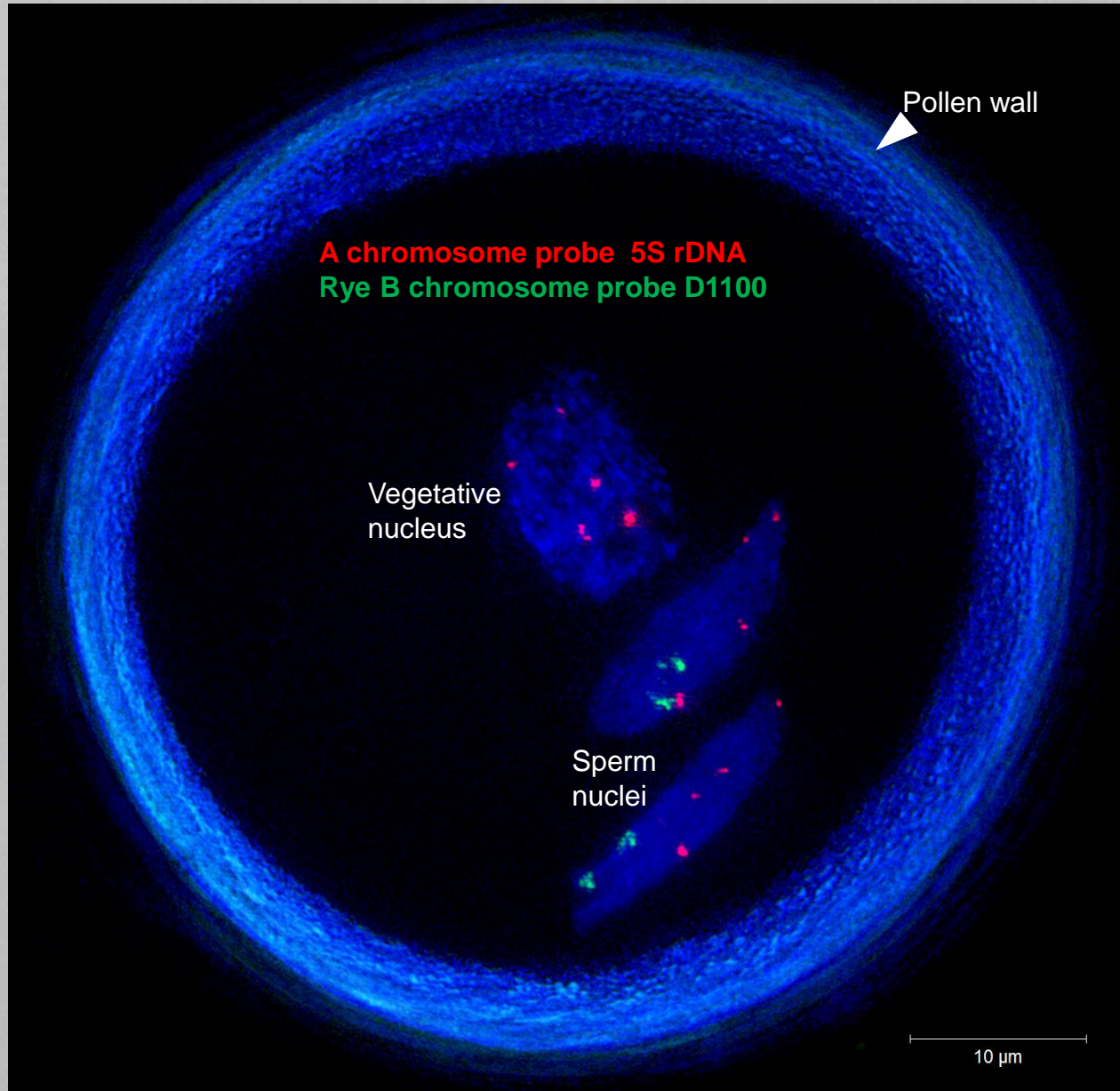
APRIL

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Wheat (*Triticum aestivum* L.)

POACEAE

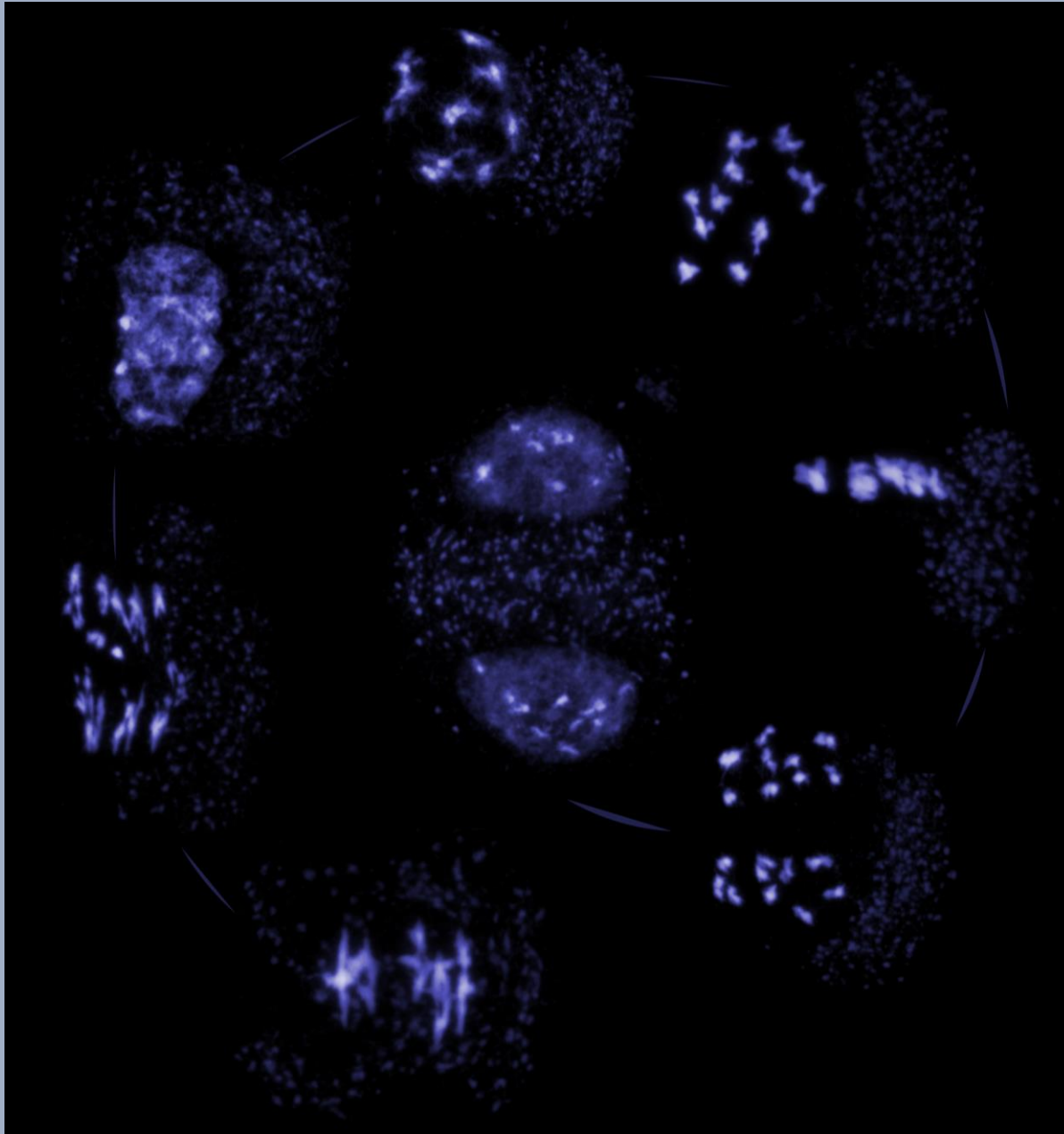
▼ Wheat lines possessing the B chromosome of rye as additional chromosome exist. Mature pollen of wheat analysed by scanning electron microscopy.



◀ The B chromosome is a dispensable element in the genome of many plants, animals, and fungi. B chromosomes in many species evolved a drive mechanism to transmit themselves at a higher frequency. Due to the drive process at the first pollen mitosis, rye Bs preferentially accumulate in sperm nuclei. Therefore after pollen FISH the rye B chromosome-specific repeat D1100 (green) only produces sperm nuclei-specific signals.

MAY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					



Arabidopsis thaliana BRASSICACEAE

▼ *A. thaliana* ($2n = 10$) constitutes a great model system for the study of biological processes. It was the first plant genome to be fully sequenced and there is a considerable number of mutant lines available that can be screened for phenotypes of interest.



◀ Structural maintenance of chromosome 5/6 (SMC5/6) complex is essential for preserving genome stability and plant fertility. Mutants defective for this complex produce triploid offspring because of the formation of unreduced male gametes. These gametes are generated as a consequence of the production of dyads instead of tetrads, as can be seen in this spiral meiosis sequence.

Nadia Fernández-Jiménez and Mónica Pradillo (Universidad Complutense de Madrid, Spain)
Fen Yang and Ales Pecinka (Institute of Experimental Botany, Olomouc, Czech Republic)

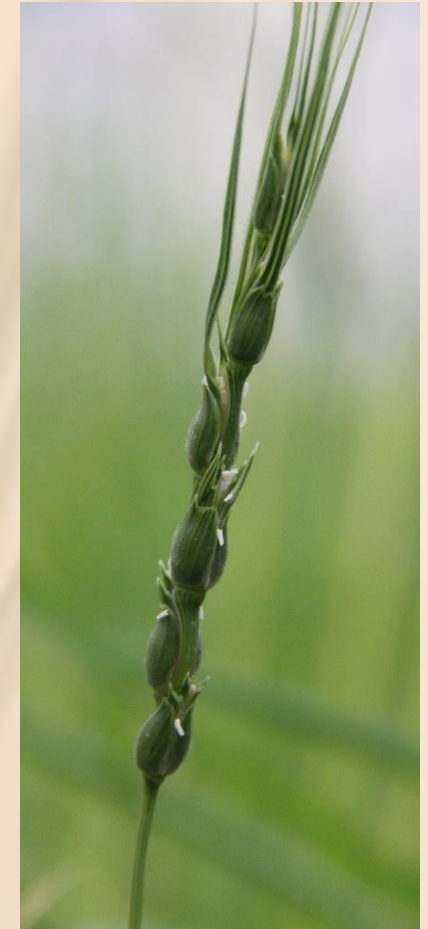
JUNE

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	27
27	28	29	30			

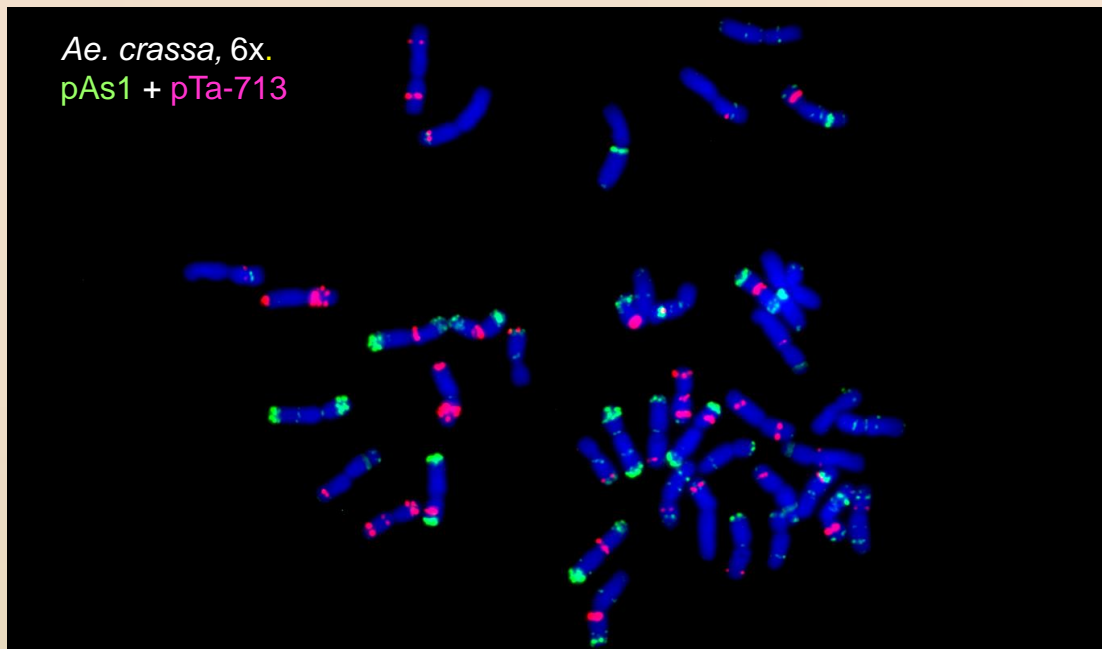
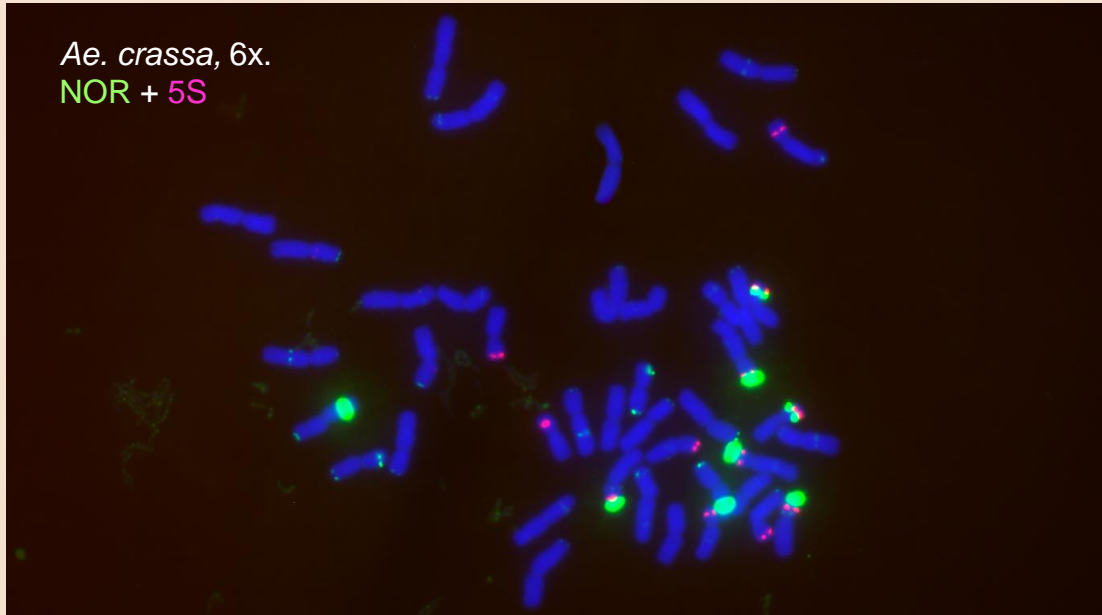
***Aegilops crassa* Boiss.**

Persian goatgrass
POACEAE

► Polyploid species, growing in the eastern part of the distribution area of the genus *Aegilops*. Two biotypes are discriminated within *Ae. crassa*: tetraploid ($2n=28$) and hexaploid ($2n=42$).



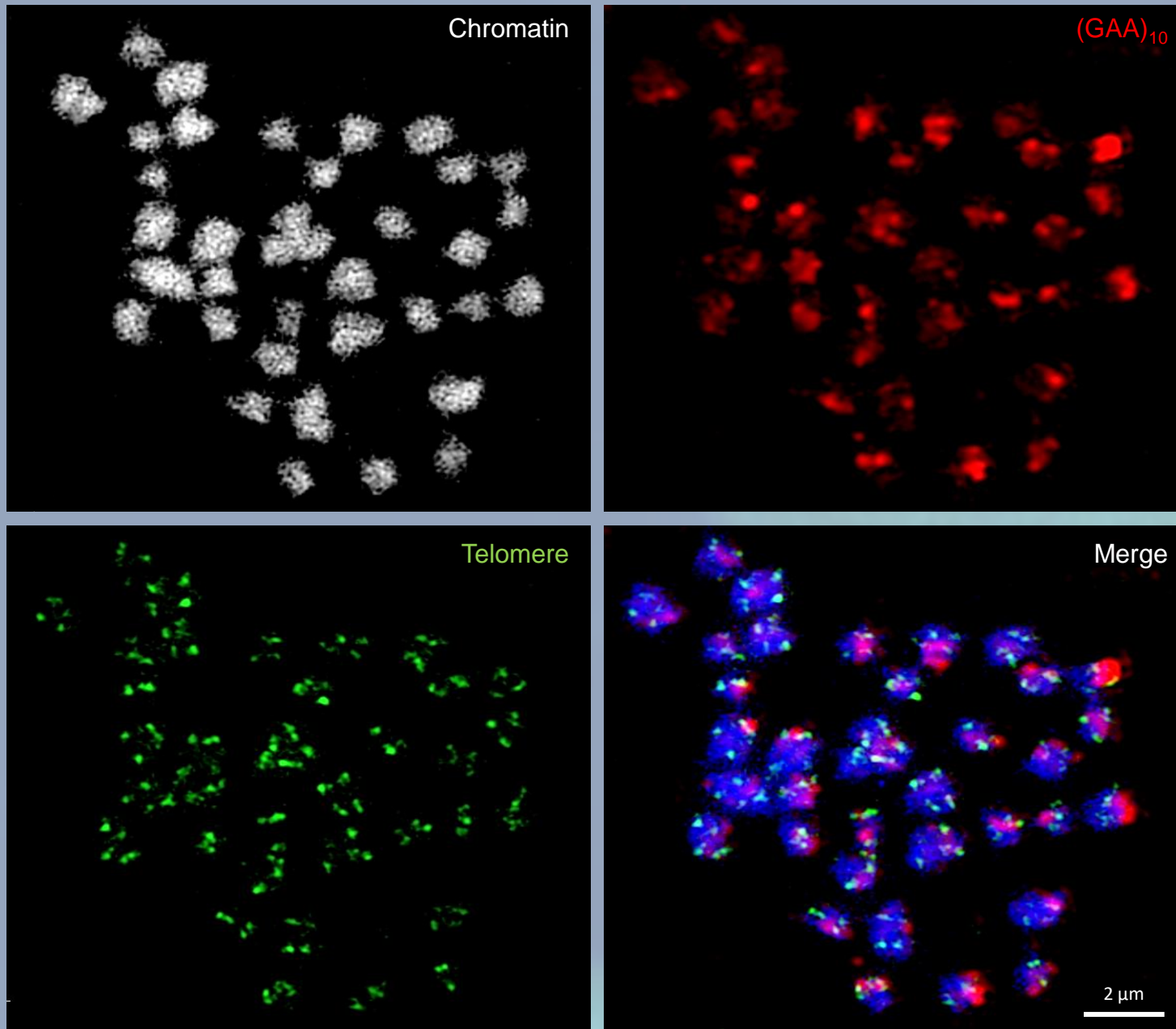
◄ Evidence from molecular and cytogenetic analyses suggest that *Ae. crassa* is probably the oldest polyploid species in the genus *Aegilops*, which origin is still not clear. One genome is thought to originate from ancient *Ae. tauschii*, whereas the second genome was probably contributed by the progenitor of the Sitopsis section. Both genomes were substantially modified during speciation. Hexaploid *Ae. crassa* originated from hybridization of tetraploid form with *Ae. tauschii*.



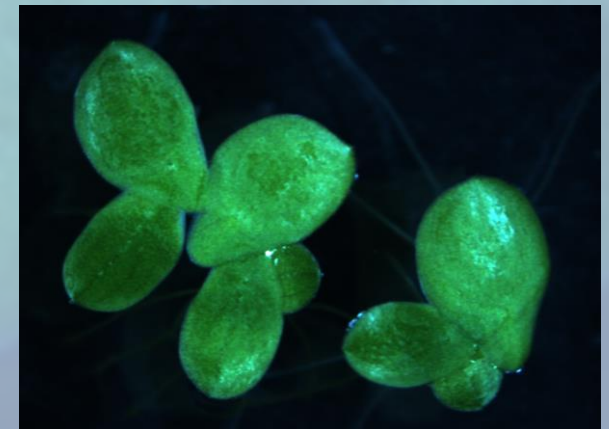
JULY

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Landoltia punctata
LEMNACEAE



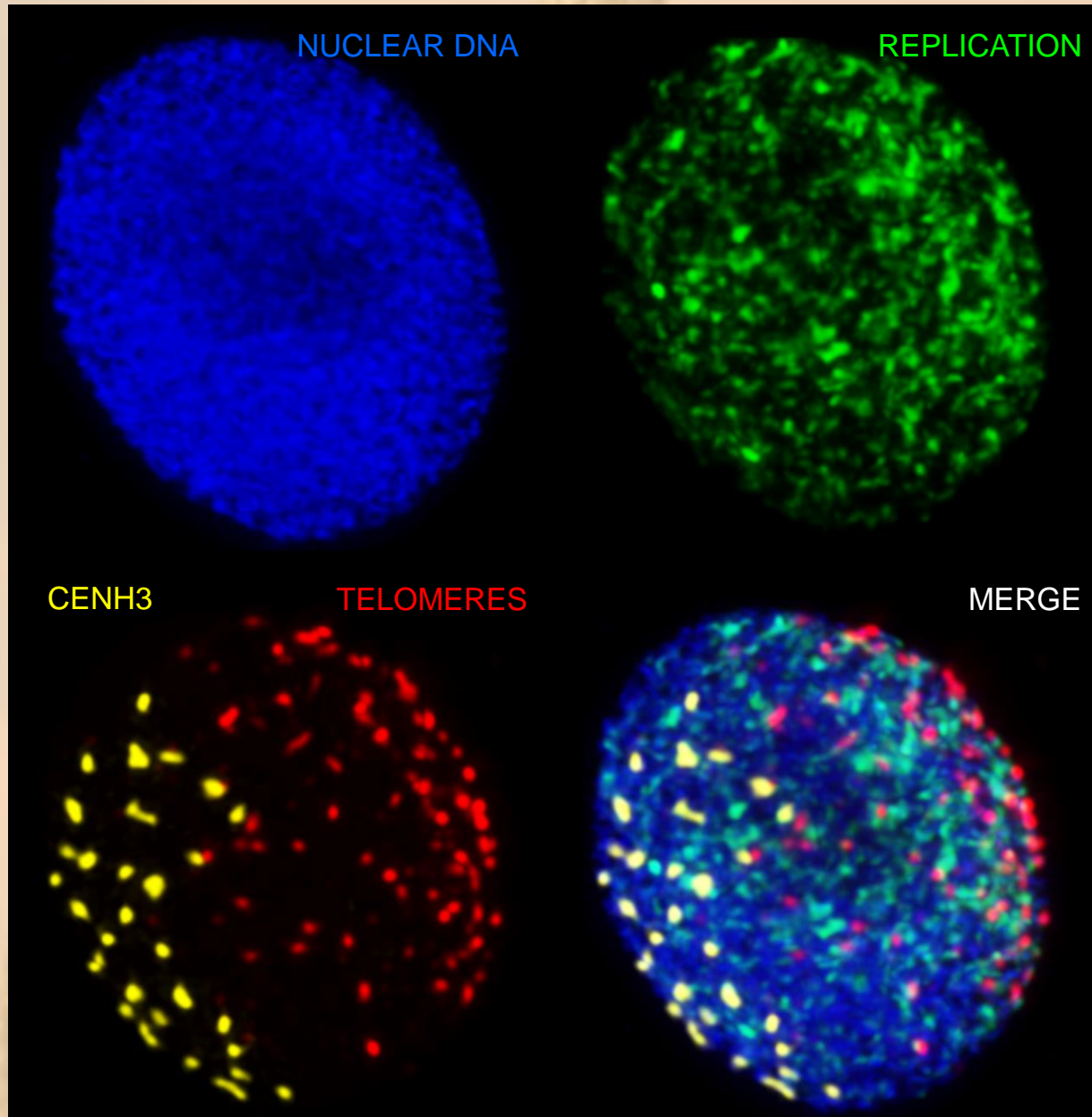
▼ Belongs to the monospecific duckweed genus *Landoltia*



◀ Distribution of GAA microsatellite signals on *La. punctata* chromosomes ($2n = 46$). GAA microsatellite probe and telomere repeats (TTTAGGG); imaged by 3D-SIM.

AUGUST

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				



Triticum aestivum

POACEAE

▼ Bread wheat (*T. Aestivum*) is a staple food for a significant part of the world's population. Wheat is an allohexaploid species ($2n = 6x = 42$), comprising three homoeologous genomes A, B, and D.

We used flow-sorted nuclei from root meristem to explore replication timing and 3D organization of 5 different stages of interphase (Němečková *et al.*, 2020).

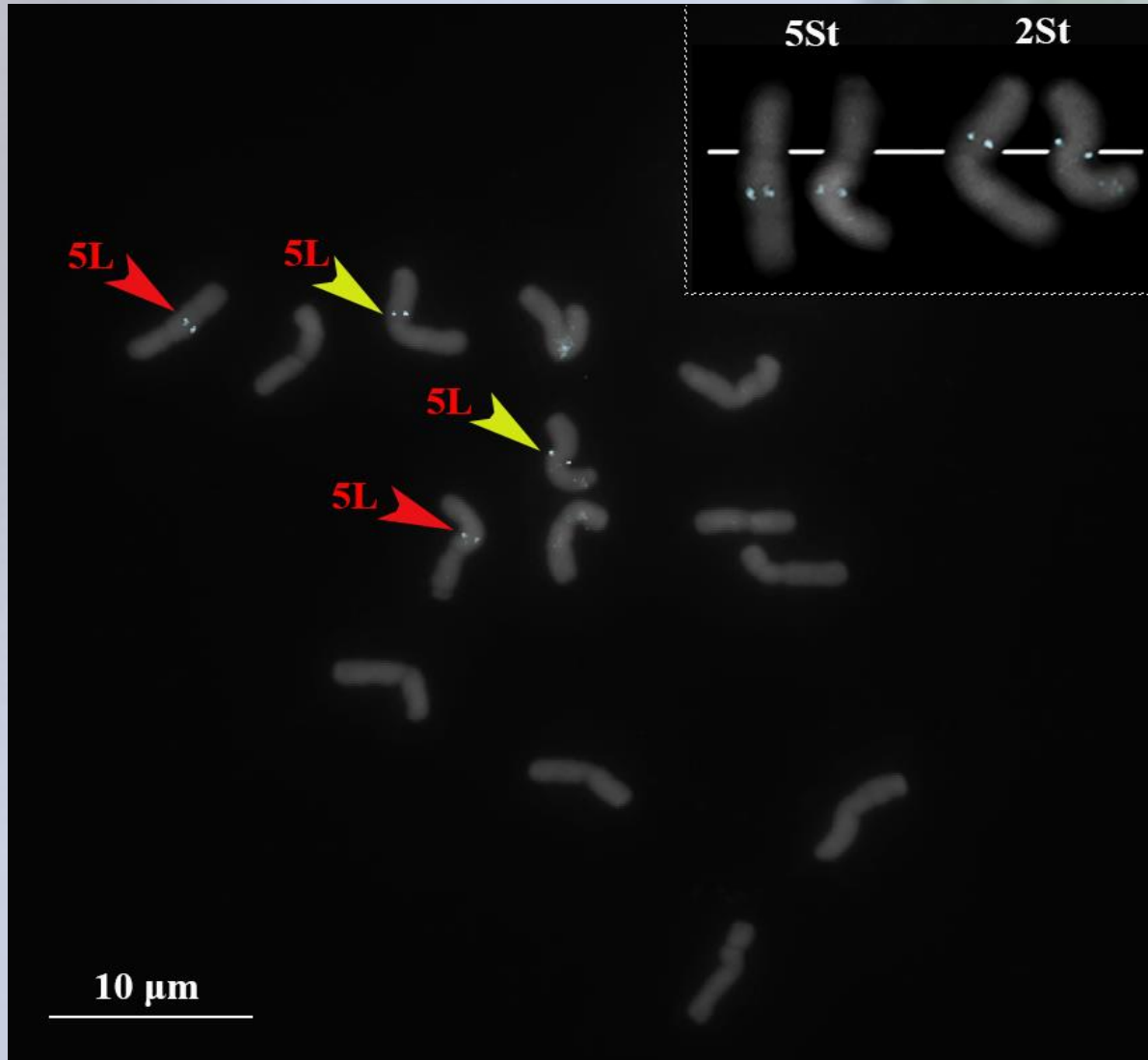


◀ Cell nucleus of bread wheat at the middle stage of S phase. Replicating DNA was labeled by EdU (green), centromeres were visualized using immunolabeling of CenH3 (yellow), and telomeres were visualized by FISH (red). Nuclear DNA was stained with DAPI (blue).

SEPTEMBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Pseudorogneria libanotica
TRITICEAE, POACEAE



▼ *Pse. libanotica* ($2n = 14$), wild diploid Triticeae species with StSt genome, is one of the most critical basic species, which participate to more than 65% perennial polyploid speciation in Triticeae.

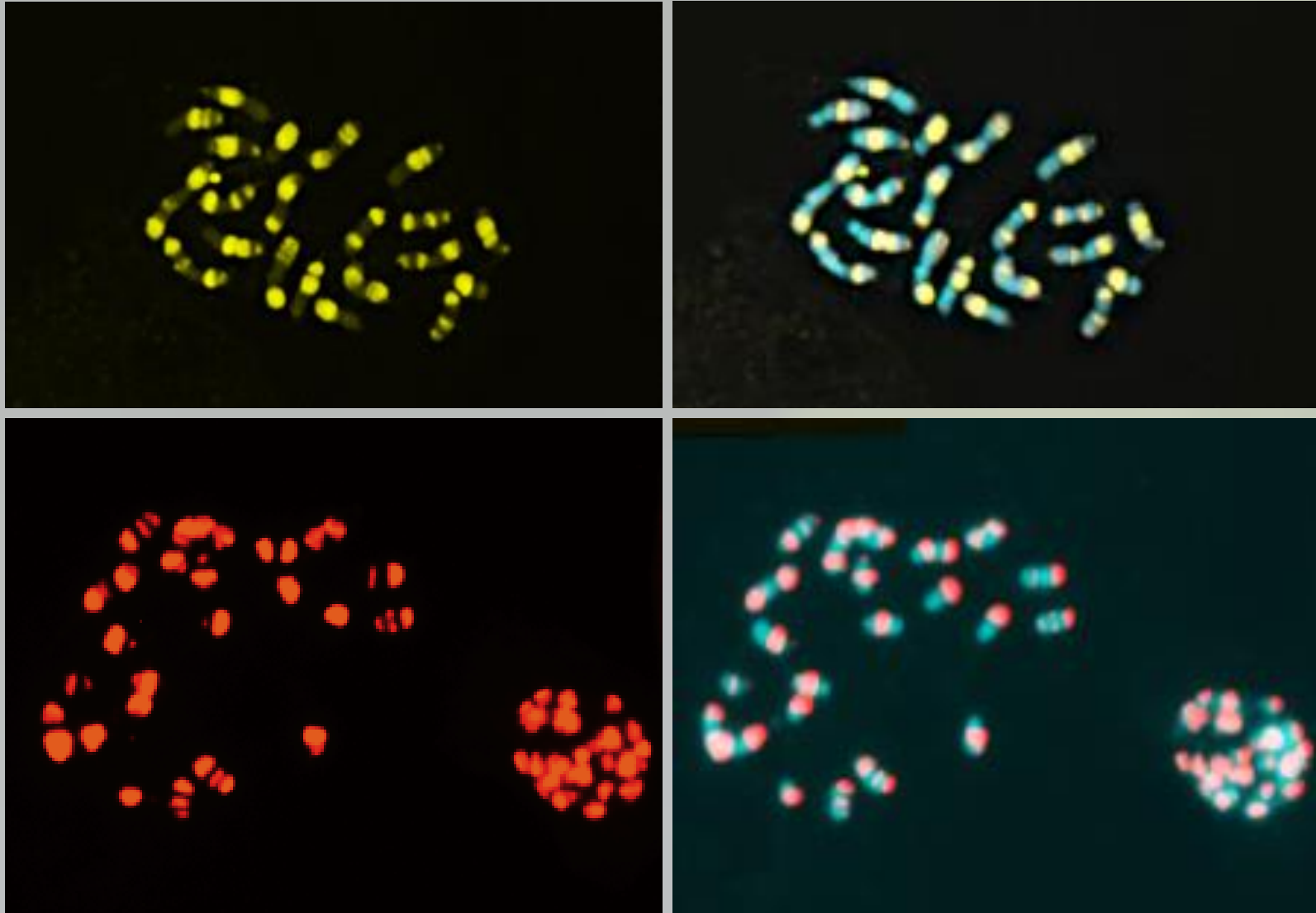


▲ Single-copy FISH barcode on mitotic metaphase chromosomes of *Pse. libanotica*. Common wheat 5-homoeologous group single-gene FISH marker (5L) was applied to identify the homoeologous 5St chromosomes (red arrow) in *Pse. libanotica*. Interestingly, a duplication was observed on chromosome 2St (yellow arrow).

OCTOBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Genipa americana
RUBIACEAE



▲ *G. americana* is a large tree widespread in the Neotropics. Its fruit is used in sweets, juice, liqueur, syrup and as a source of quinine in folk medicine. The native tribes use the juice of unripe fruits to paint their bodies.

▲ Almost half of its 22 chromosomes are positively stained with chromomycin A3 (yellow bands) and it is probably the tree species with the highest heterochromatin content. *In situ* hybridization of a telomeric probe (red signals) revealed that all CMA+ bands are enriched in TTTAGGG, except for two small 35S rDNA sites.

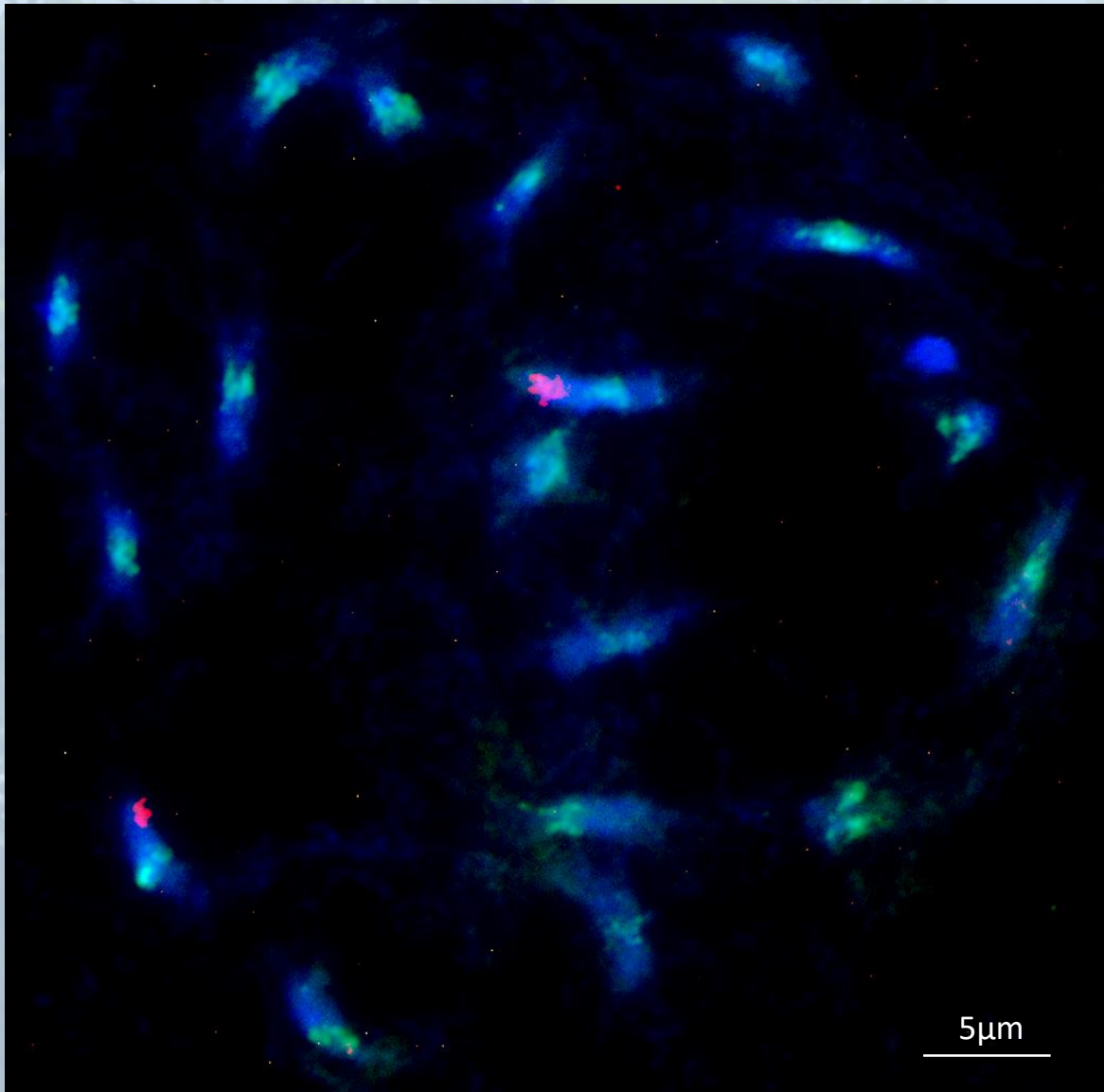
Lidiane Feitoza, Jéssica Nascimento and Marcelo Guerra (Federal University of Pernambuco, Recife, Brazil)

NOVEMBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Ensete glaucum
MUSACEAE

▼ A 3 m tall *Ensete glaucum* plant with a large green hanging inflorescence collected from Yunnan province, China, growing in the South China Botanical Garden. *Ensete* is a sister genus to *Musa*. *E. glaucum* is widely distributed in Asia. As a cold resistant and drought species it is a potential gene and germplasm resource for abiotic stress tolerance in banana breeding.



▲ Oligonucleotide fluorescent *in situ* hybridization to a metaphase of *E. glaucum* ($2n=18$) with 5S rDNA probe (red) showing one dispersed site on one pair of chromosomes and Egcn, a 134bp repeat (green), found at the centromeres of all chromosomes.



DECEMBER

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

CENH3.1

CENH3.2

DNA

Merge

5 μ m

Vigna unguiculata FABACEAE

▼ *V. unguiculata* ($2n = 22$), originated from sub-Saharan Africa, is one of the most important legume crops at dryland farming in Africa due to the tolerant to drought and heat.



◀ Immunostaining of two functional centromere specific histone H3 (CENH3) variants on cowpea pachytene chromosomes. Both CENH3s are localized in functional centromeres of cowpea.

2023

JANUARY

Wk	Mo	Tu	We	Th	Fr	Sa	Su
							1
1	2	3	4	5	6	7	8
2	9	10	11	12	13	14	15
3	16	17	18	19	20	21	22
4	23	24	25	26	27	28	29
5	30	31					

FEBRUARY

Wk	Mo	Tu	We	Th	Fr	Sa	Su
5			1	2	3	4	5
6	6	7	8	9	10	11	12
7	13	14	15	16	17	18	19
8	20	21	22	23	24	25	26
9	27	28					

MARCH

Wk	Mo	Tu	We	Th	Fr	Sa	Su
9			1	2	3	4	5
10	6	7	8	9	10	11	12
11	13	14	15	16	17	18	19
12	20	21	22	23	24	25	26
13	27	28	29	30	31		

APRIL

Wk	Mo	Tu	We	Th	Fr	Sa	Su
13						1	2
14	3	4	5	6	7	8	9
15	10	11	12	13	14	15	16
16	17	18	19	20	21	22	23
17	24	25	26	27	28	29	30

MAY

Wk	Mo	Tu	We	Th	Fr	Sa	Su
18	1	2	3	4	5	6	1
19	8	9	10	11	12	13	8
20	15	16	17	18	19	20	15
21	22	23	24	25	26	27	22
22	29	30	31				

JUNE

Wk	Mo	Tu	We	Th	Fr	Sa	Su
22				1	2	3	4
23	5	6	7	8	9	10	11
24	12	13	14	15	16	17	18
25	19	20	21	22	23	24	25
26	26	27	28	29	30		

JULY

Wk	Mo	Tu	We	Th	Fr	Sa	Su
26						1	2
27	3	4	5	6	7	8	9
28	10	11	12	13	14	15	16
29	17	18	19	20	21	22	23
30	24	25	26	27	28	29	30
31	31						

AUGUST

Wk	Mo	Tu	We	Th	Fr	Sa	Su
31		1	2	3	4	5	6
32	7	8	9	10	11	12	13
33	14	15	16	17	18	19	20
34	21	22	23	24	25	26	27
35	28	29	30	31			

SEPTEMBER

Wk	Mo	Tu	We	Th	Fr	Sa	Su
35					1	2	3
36	4	5	6	7	8	9	10
37	11	12	13	14	15	16	17
38	18	19	20	21	22	23	24
39	25	26	27	28	29	30	

OCTOBER

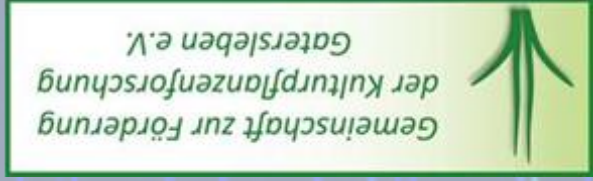
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41	9	10	11	12	13	14	15
42	16	17	18	19	20	21	22
43	23	24	25	26	27	28	29
44	30	31					

NOVEMBER

Wk	Mo	Tu	We	Th	Fr	Sa	Su
44		1	2	3	4	5	
45	6	7	8	9	10	11	12
46	13	14	15	16	17	18	19
47	20	21	22	23	24	25	26
48	27	28	29	30			

DECEMBER

Wk	Mo	Tu	We	Th	Fr	Sa	Su
48					1	2	3
49	4	5	6	7	8	9	10
50	11	12	13	14	15	16	17
51	18	19	20	21	22	23	24
52	25	26	27	28	29	30	31



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Cover picture

Genome optical mapping of wheat. Saki Chan (Bionano) and Hana Šimková (Institute of Experimental Botany, Olomouc, Czech Republic)

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Jörg Fuchs and Andreas Houben (IPK, Gatersleben, Germany)

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