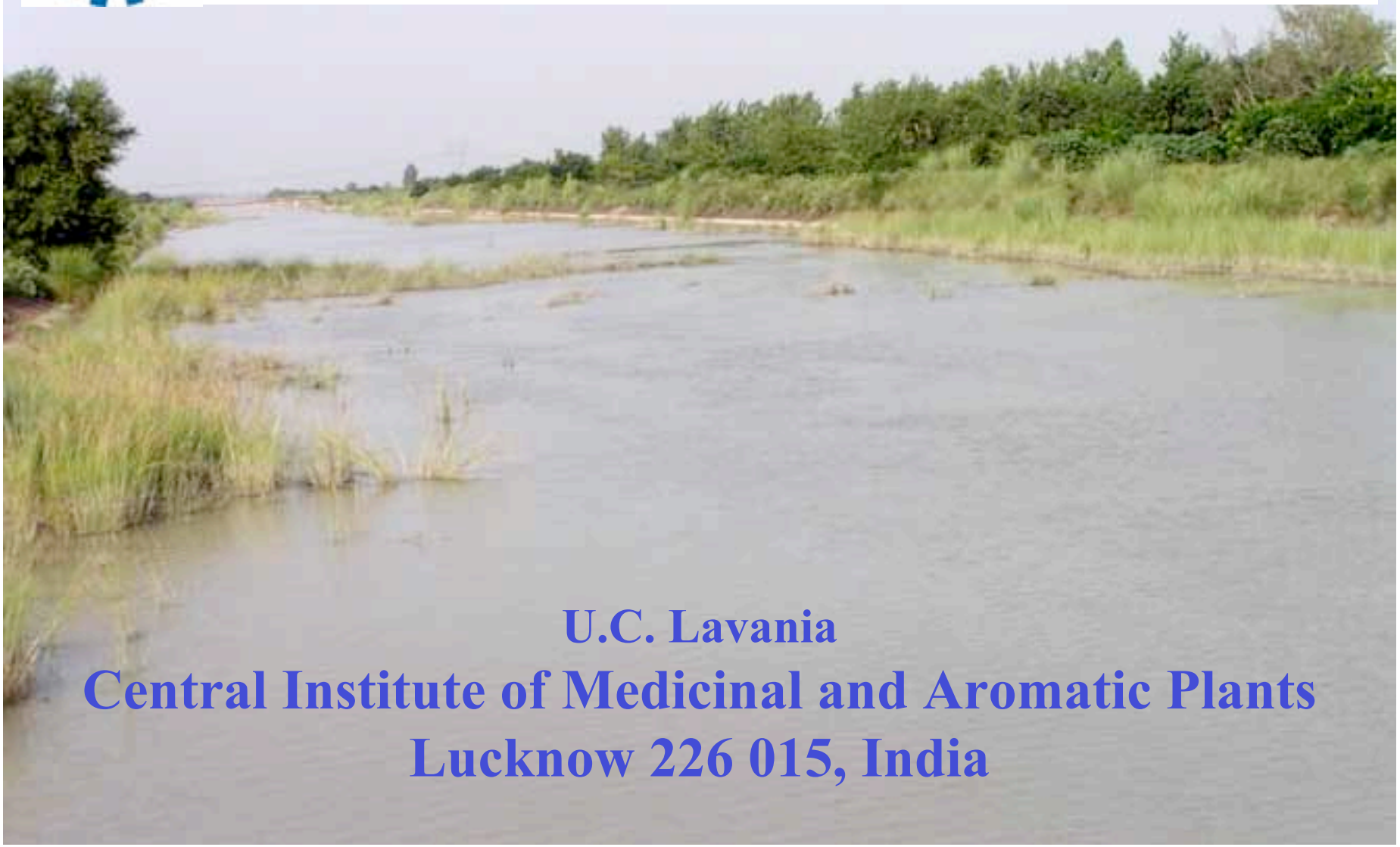
Towards bio-efficient and non-invasive Vetiver



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Towards bio-efficient and non-invasive Vetiver

Vetiver is traditionally used for extraction of essential oil from roots

We need genotypes that produce high concentration and superior quality of essential oil in their roots

Vetiver is now extensively utilized for its multifarious environmental applications

We need plant types that produce (i) low oil / virtually no oil in its roots that works as a deterrent to local root diggers, (ii) ideal root physiography suiting to desired application

Promises and bottlenecks

Seed forming vetiver is the valuable genetic resource to realize ideal plant type for specific applications, but poses a potential threat of becoming weedy invading the non-target areas on account of seed dispersal by air and / or water

Safeguards

Therefore, if we have to realize the full potential of vetiver diversity, it is imperative that while identifying a desired genotype from amongst the natural diversity, we should also provide safeguards to mitigate indiscriminate spread of vetiver

This could be suitably pursued by minimizing seed formation in an ideal genotype isolated from seed forming wild types

Towards bio-efficient and non-invasive Vetiver

Centre of Origin holds repertoire of natural diversity for identification of ideal plant type

- **Diversity in reproductive biology : nonflowering –to-profuse seed forming**
- **Diversity in root physiography for diverse applications (root oil, environmental applications for soil – water conservation, pollution mitigation and soil-water detoxification**
- **Inherent heterozygosity expressed through segregating seed progenies promises genetic diversity**

Strategic Objectives

The study envisages two objectives vis-à-vis eco-friendly utilization of vetiver

Realization of non-invasiveness in seed forming vetiver

Enhancement of biological potential in given genotype

The above have been duly addressed by

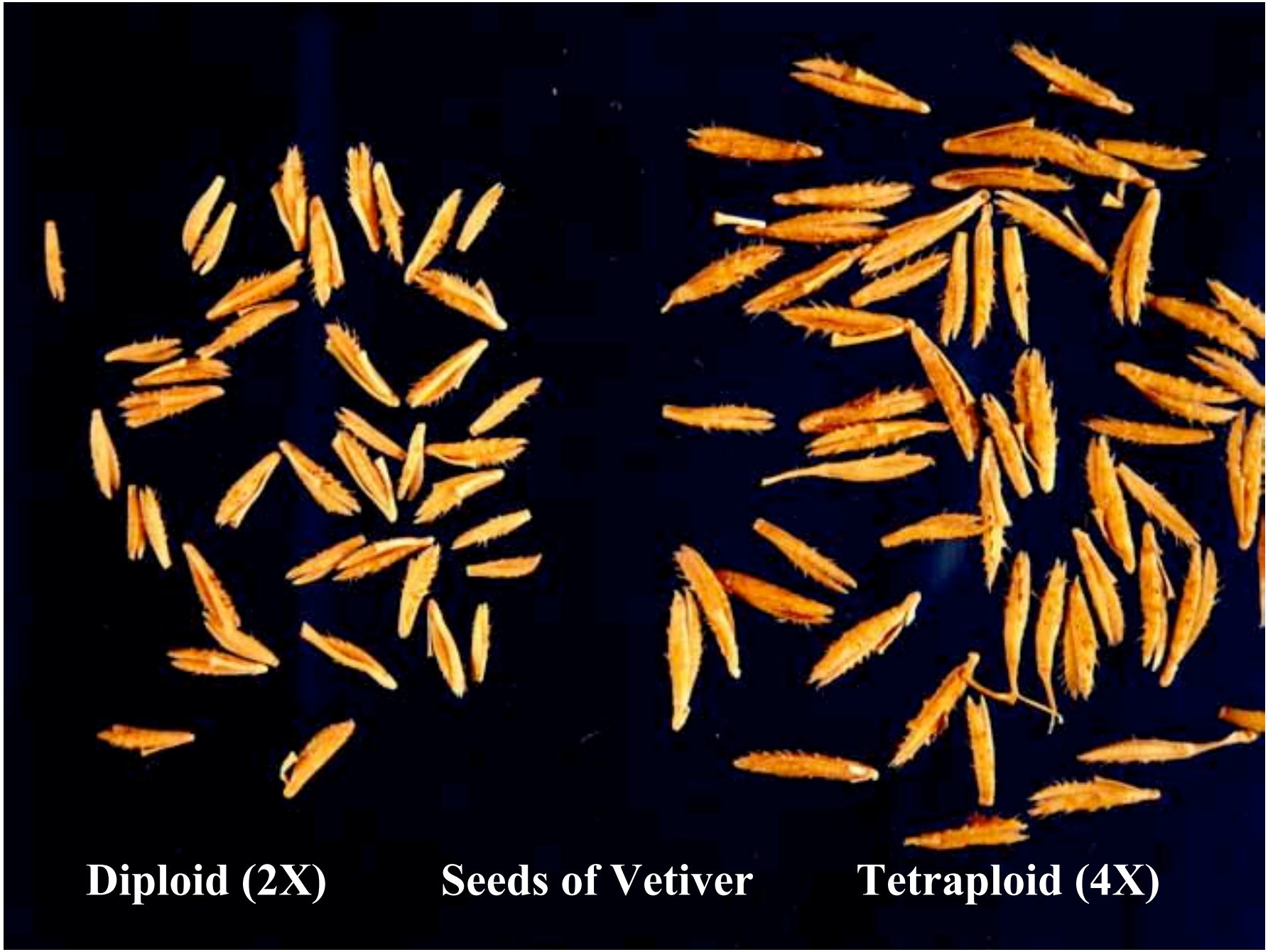
Polyploid mediated realization of low seed / non-seediness features on account of disturbances in meiotic behaviour

Enhanced metabolic potential on account of enhanced chlorophyll content / photosynthetic efficiency

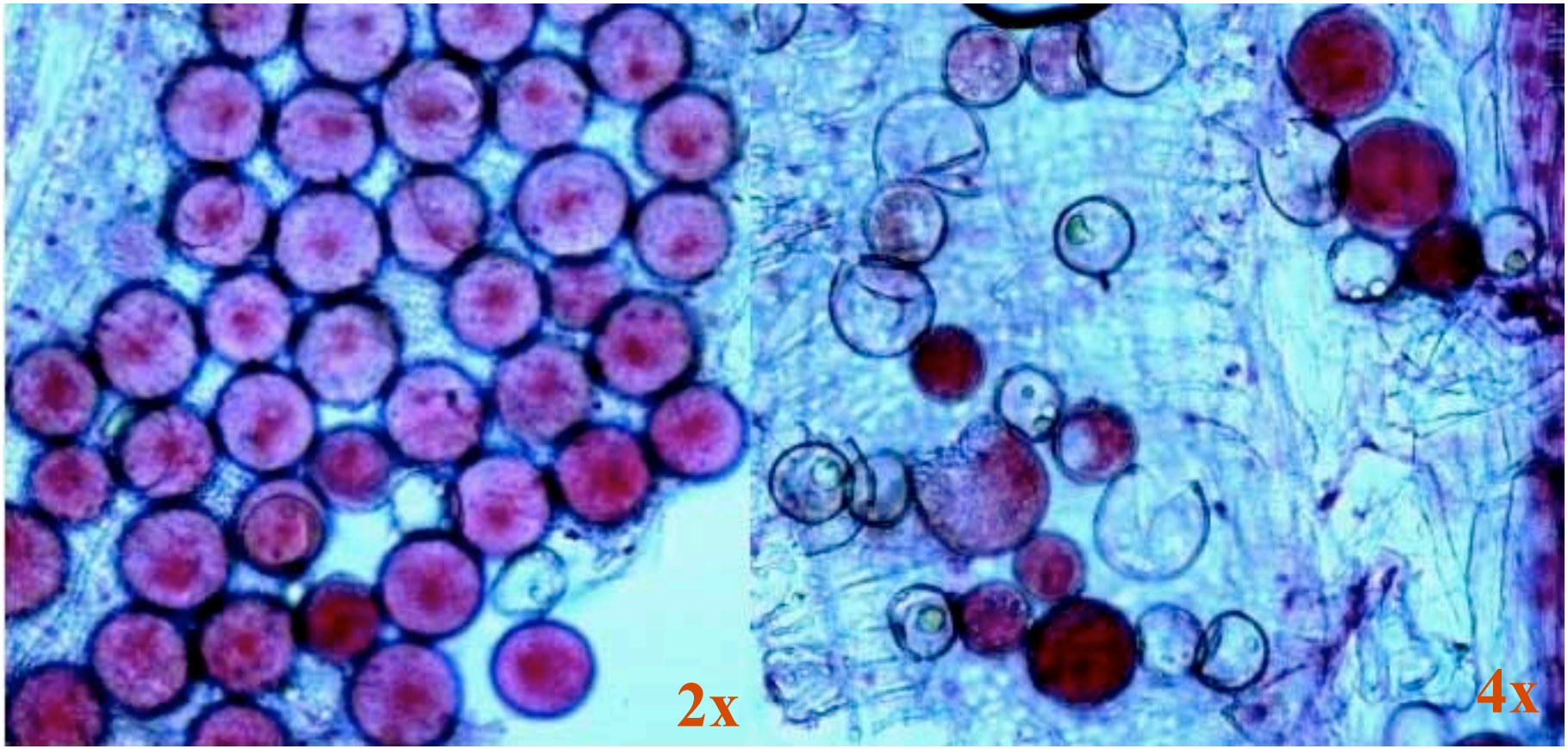
Increased cell size for enhanced essential oil and increased stellar region for enhanced tensile strength.

Root exo-morphology and somatic chromosomes in diploid (2x) vs. Tetraploid (4x) in Vetiver

Relative comparison of inflorescence spike in 2x vs 4x

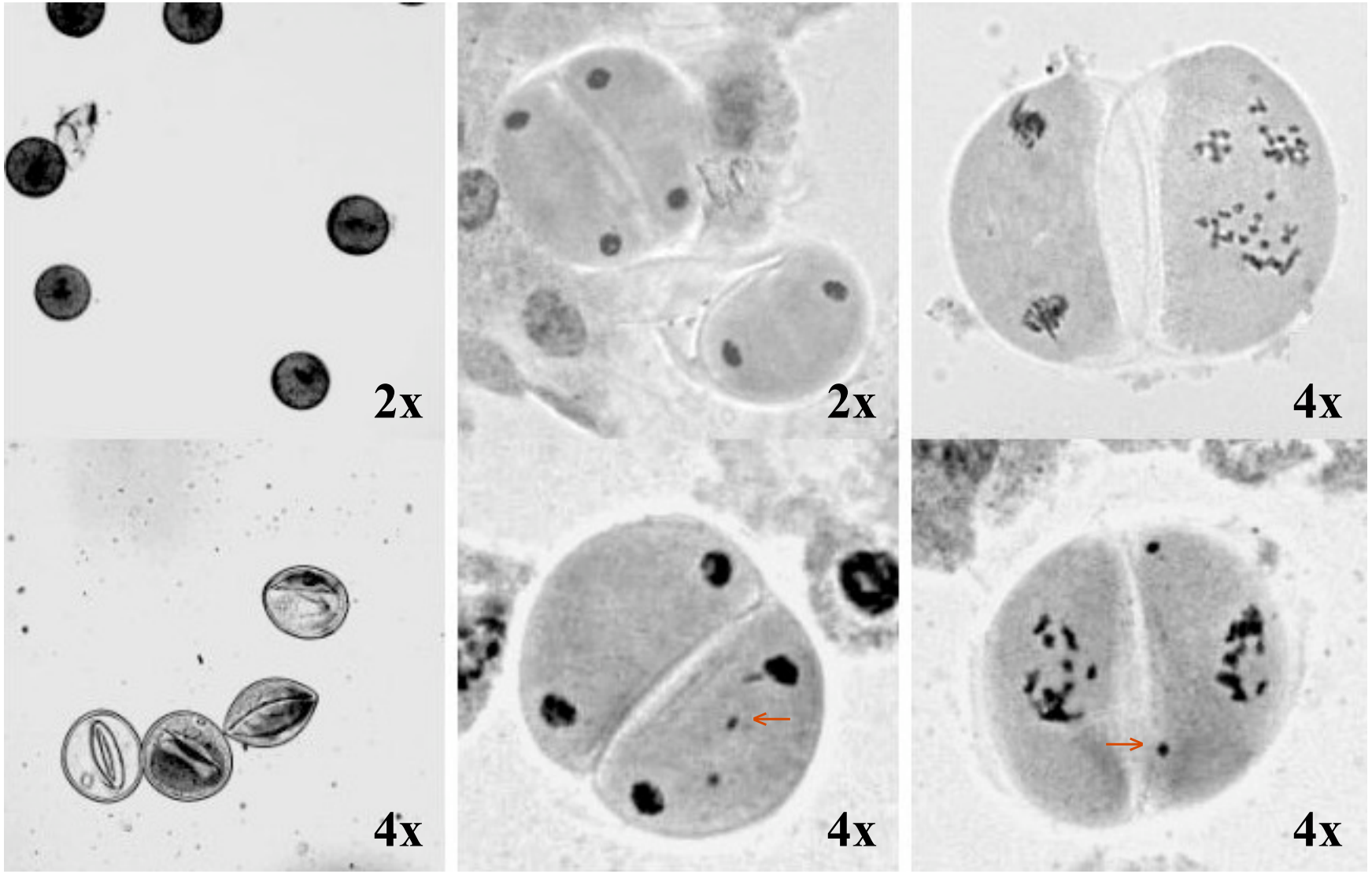

Diploid (2X)
Seeds of Vetiver
Tetraploid (4X)

Relative pollen fertility in 2x vs. 4x

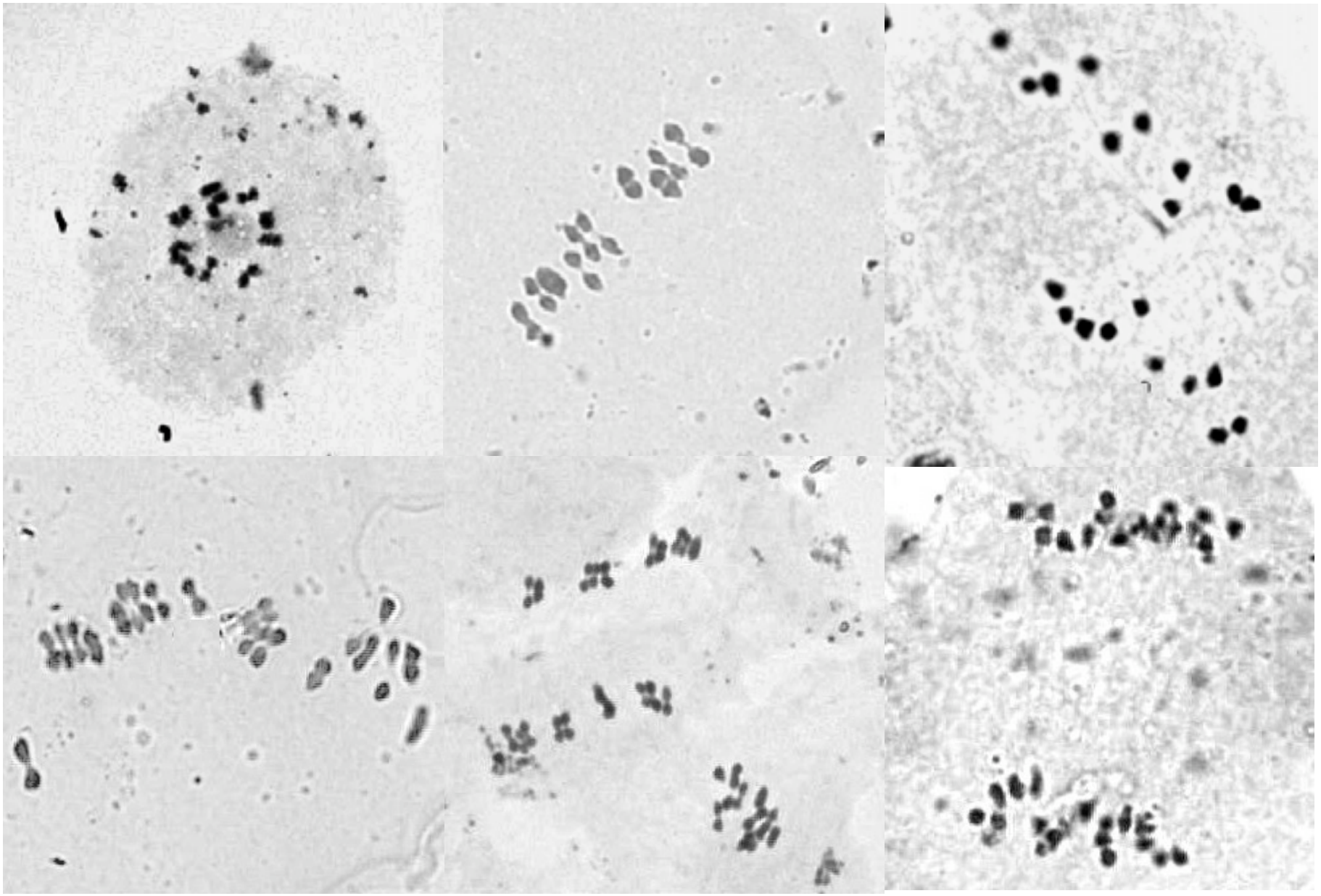


In tetraploid pollen grains are highly deformed and sterile

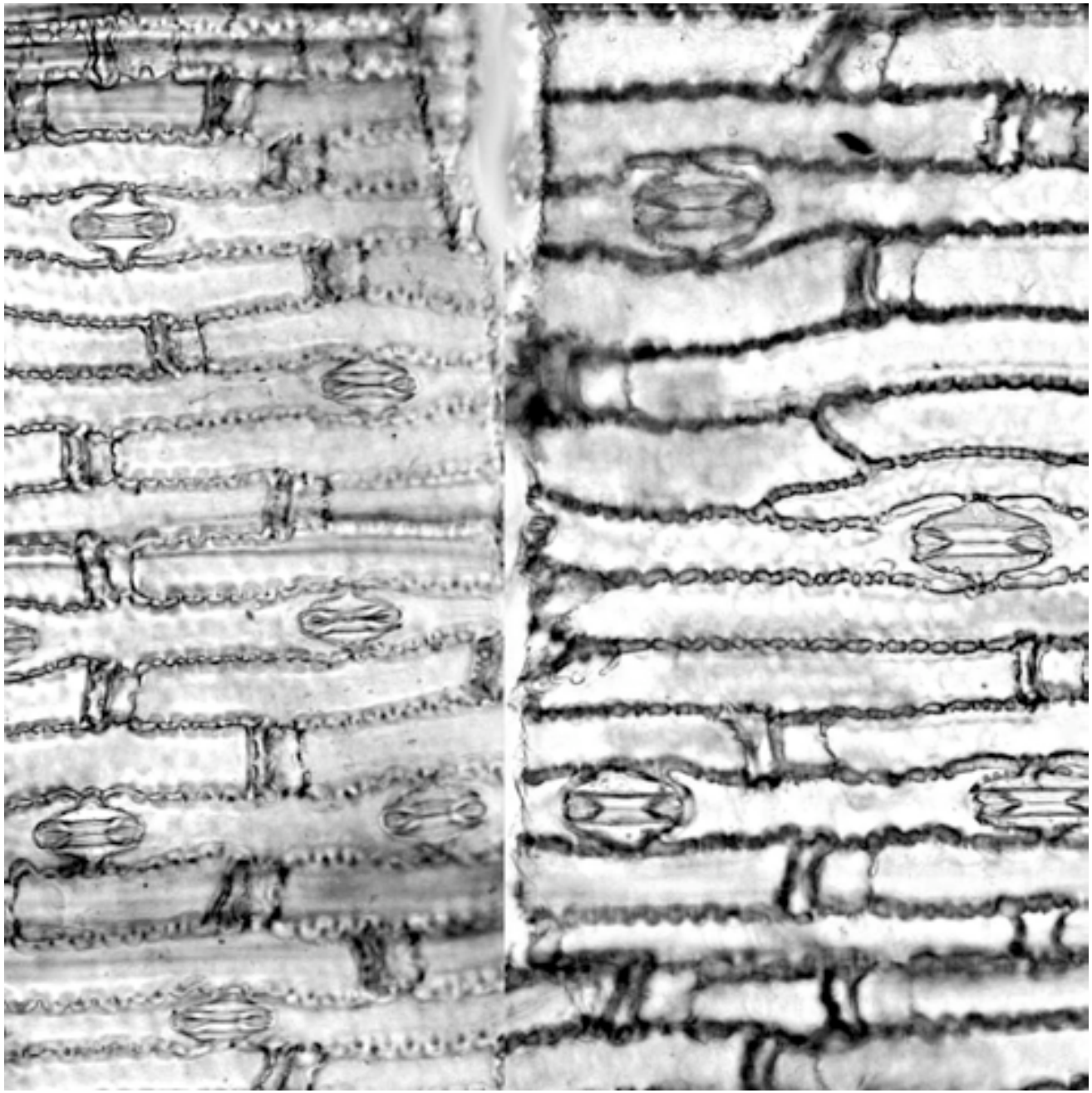
Diad and pollen grain formation in diploid (2x) and tetraploid (4x)



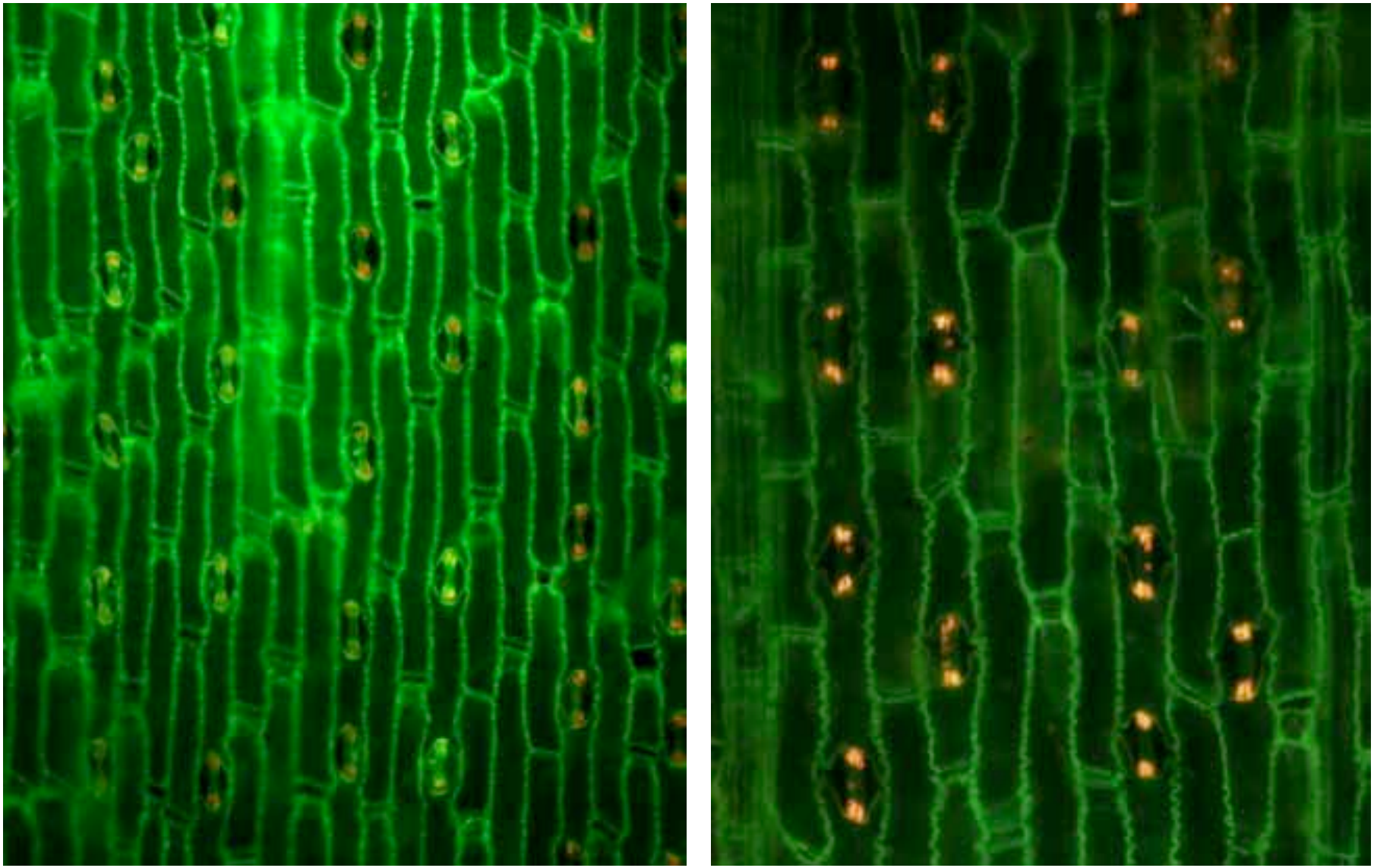
Male meiosis in diploid (upper row) and tetraploid (lower row)

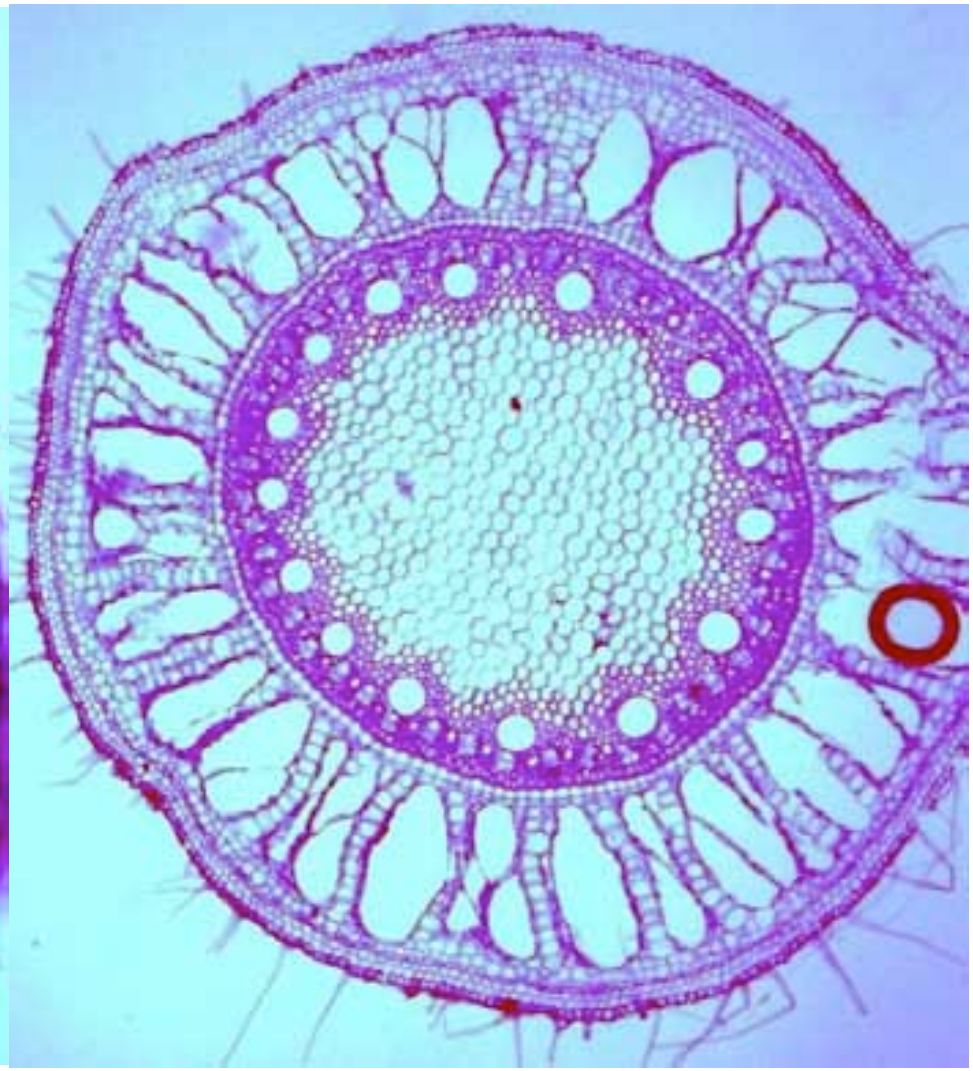


Relative comparison of stomata in 2x (left) vs. 4x (right)

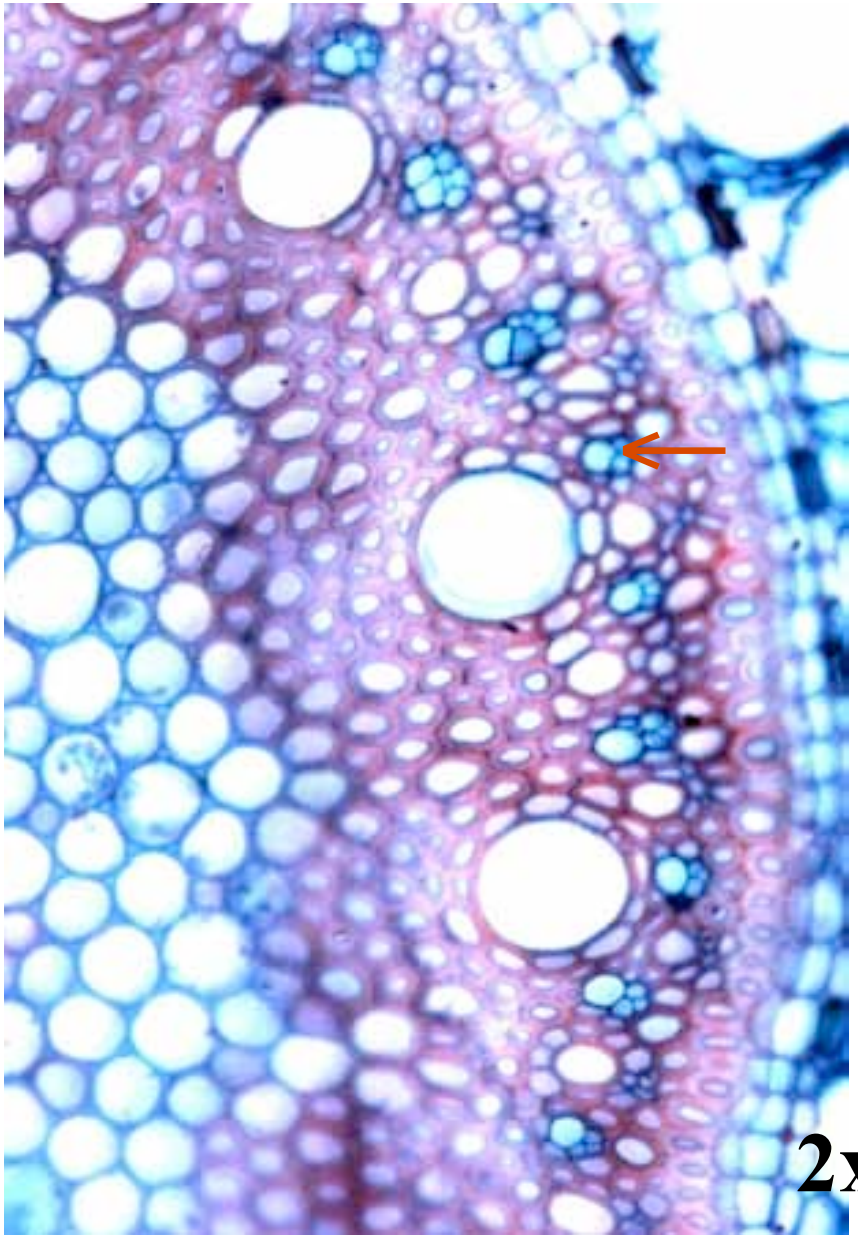


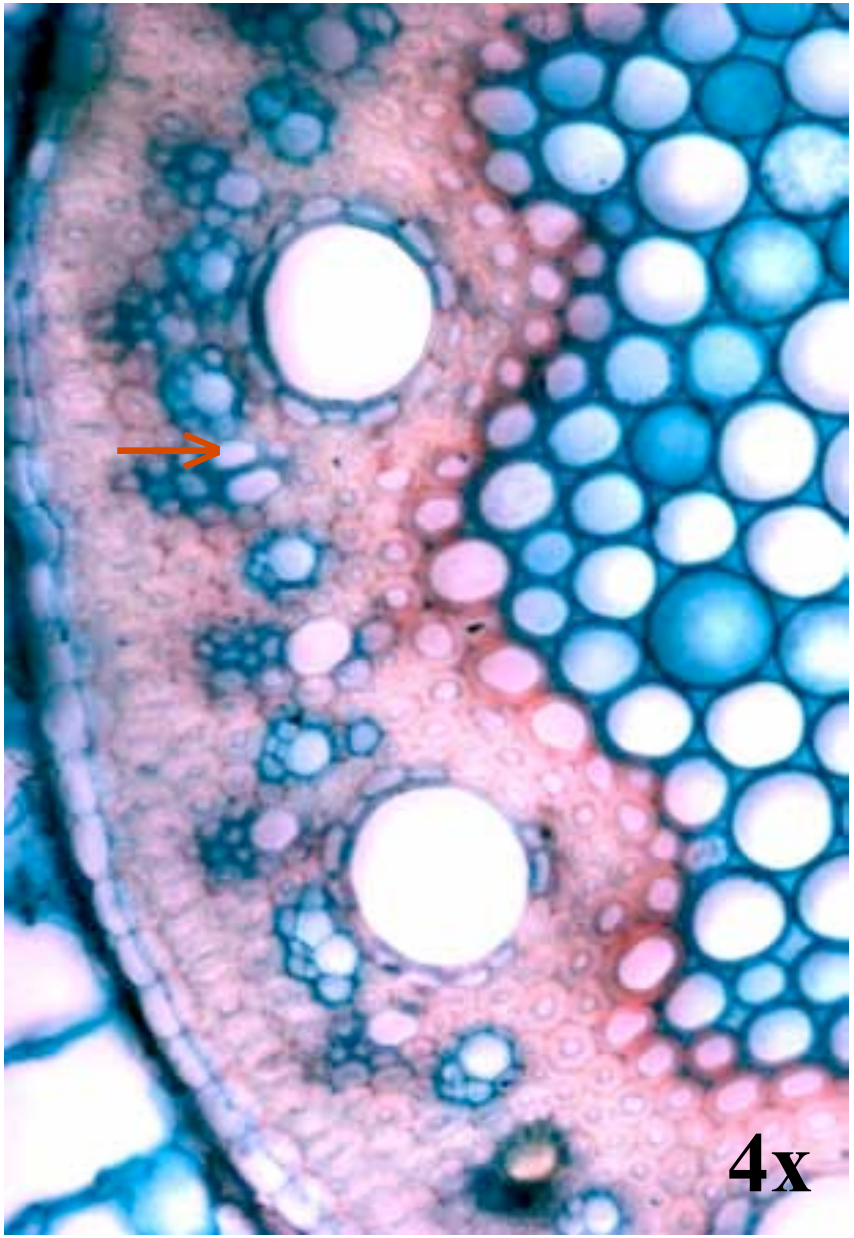
Leaf chloroplasts in 2x (left) vs 4x (right)



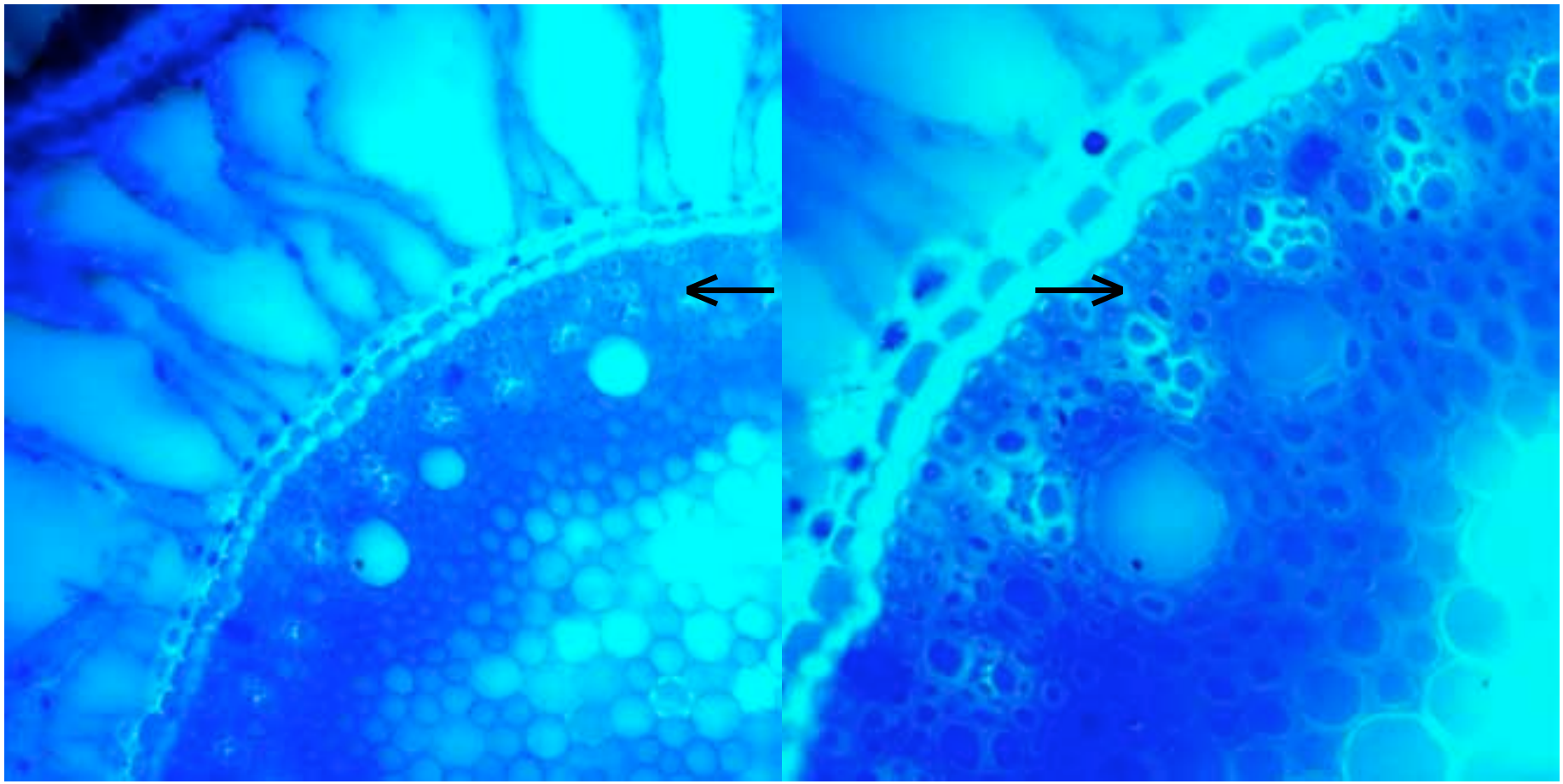


Root anatomy depicting oil secretary region in the diploid vs. autotetraploid

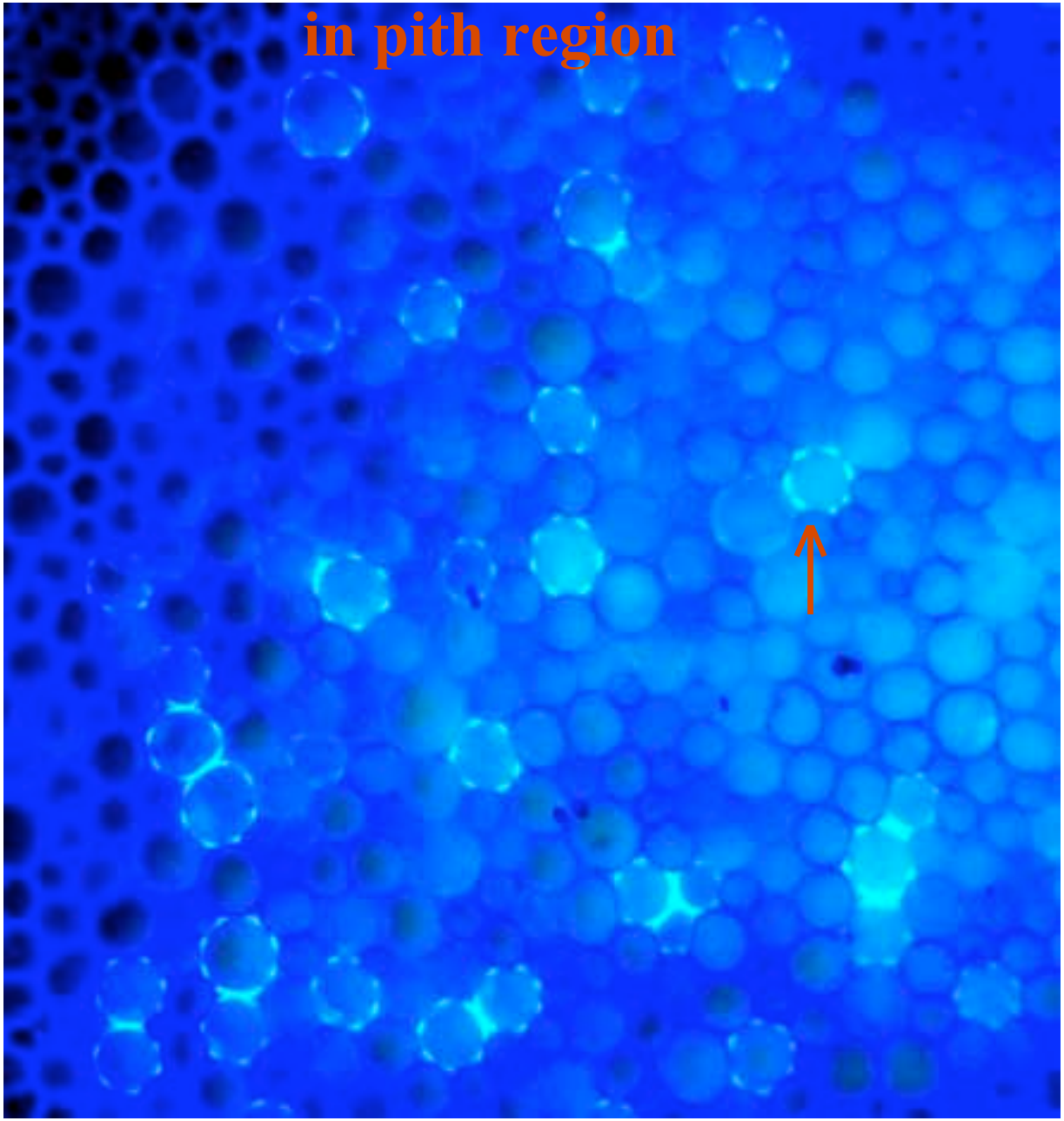


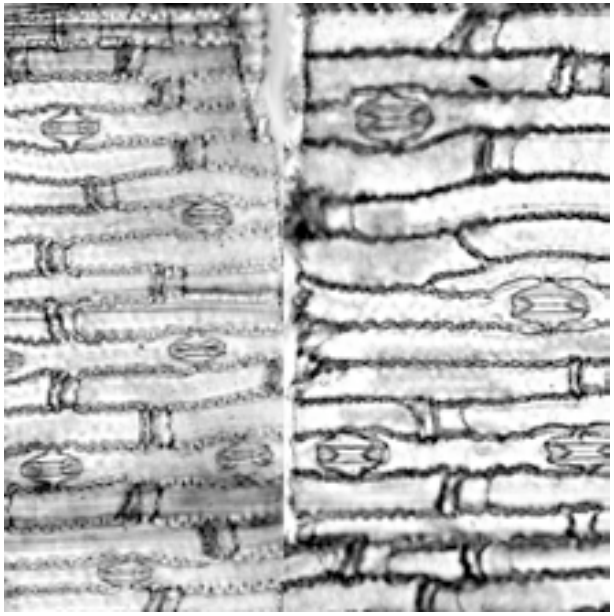
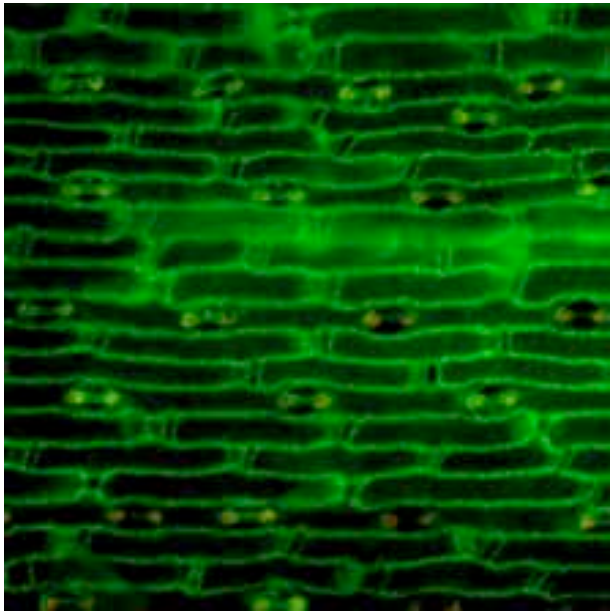
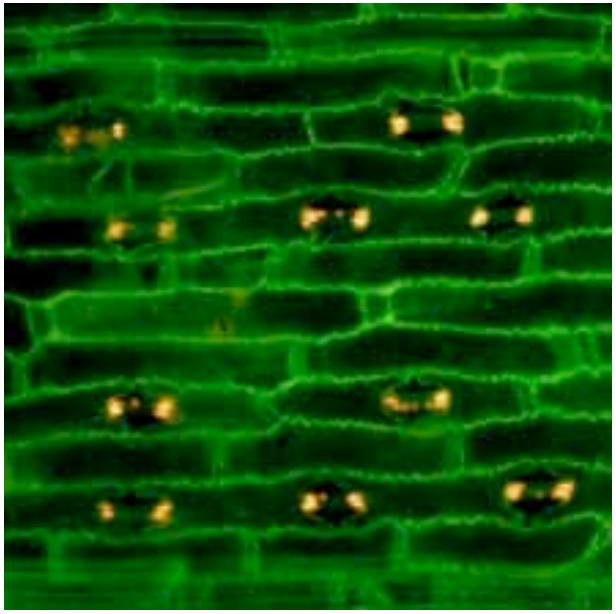
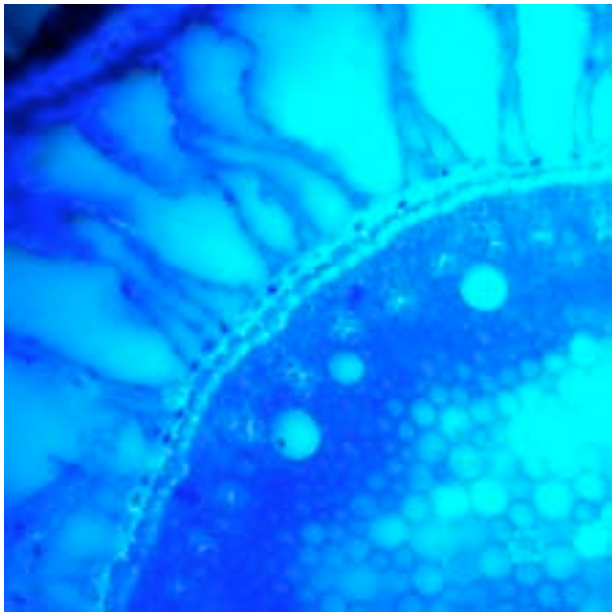
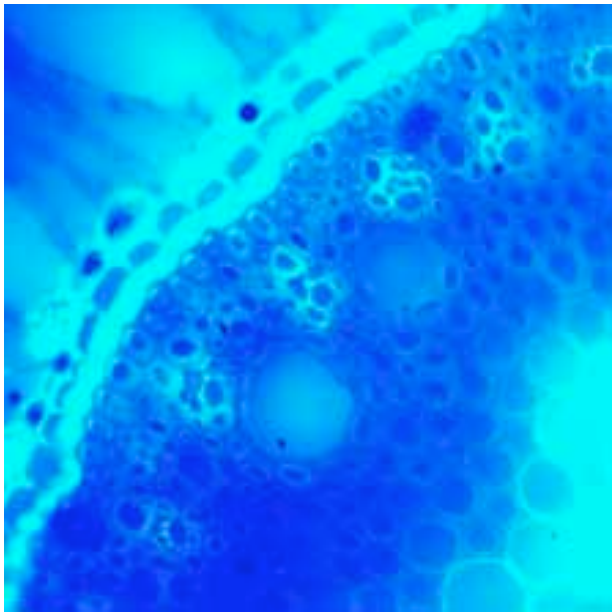
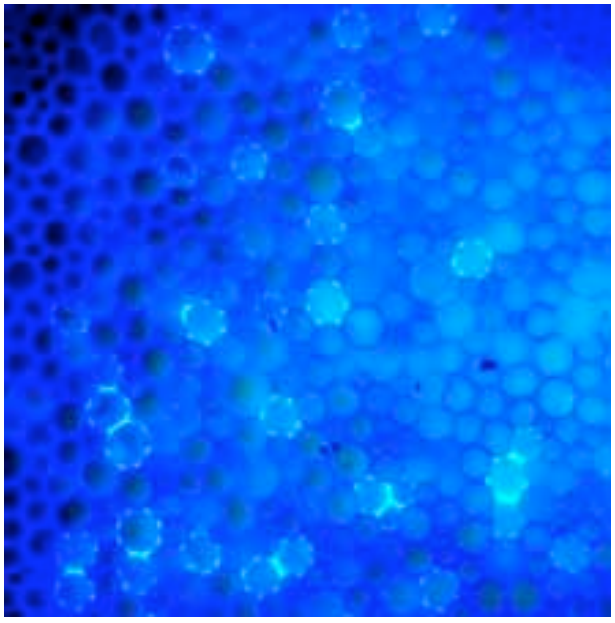


Fluorescent localization of oil secretary cells in bast region



Fluorescent localization of oil secretary cells in pith region



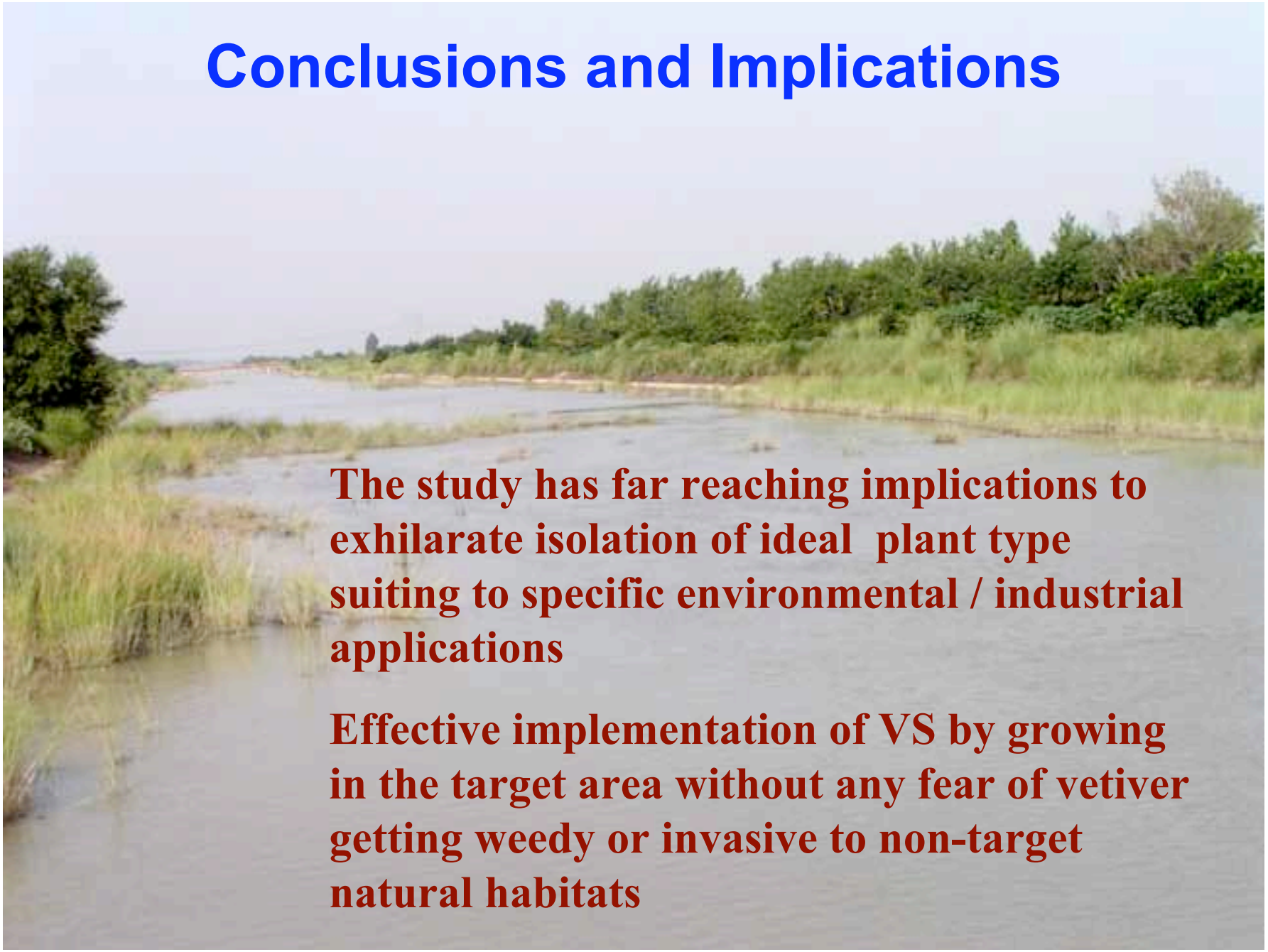
Cell size associated changes in the diploid vs. tetraploid in vetiver with respect to bio-efficiency

Genomic status	Average root diameter (mm)	Average stellar diameter (mm)	Leaf epidermal features			Essential oil secretary cell physiography			% increase in secretary cell area in 4x
			No. of stomata / cm^2	Average size of single guard cell $(\mu m)^2$	% area covered under stomatal guard cells	No. of oil storage sites (phloem region) / root	Average cell size of oil storage group of phloem cells $(\mu m)^2$	% area under cover of essential oil storage cells*	
Diploid	1.6	1.05	14784	532	15.72	100	462	2.3	
Tetraploid	1.8	1.15	7524	1107	16.66	93	713	2.6	14.31

Chlorophyll concentration in diploid vs. tetraploid in vetiver with respect to photosynthetic efficiency

Genomic status	Total Chlorophyll content (mg/g fresh weight)	Chlorophyll a	Chlorophyll b	Ratio of Chlorophyll a / b	% increase on chlorophyll concentration
Diploid	1.0661	0.7648	0.3013	2.54	
Tetraploid	1.3079	0.9287	0.3792	2.44	22.68

Conclusions and Implications



The study has far reaching implications to exhilarate isolation of ideal plant type suiting to specific environmental / industrial applications

Effective implementation of VS by growing in the target area without any fear of vetiver getting weedy or invasive to non-target natural habitats