

Genome downsize insight into plant biodiversity conservation: a case study of polyploid *Morus* spp.

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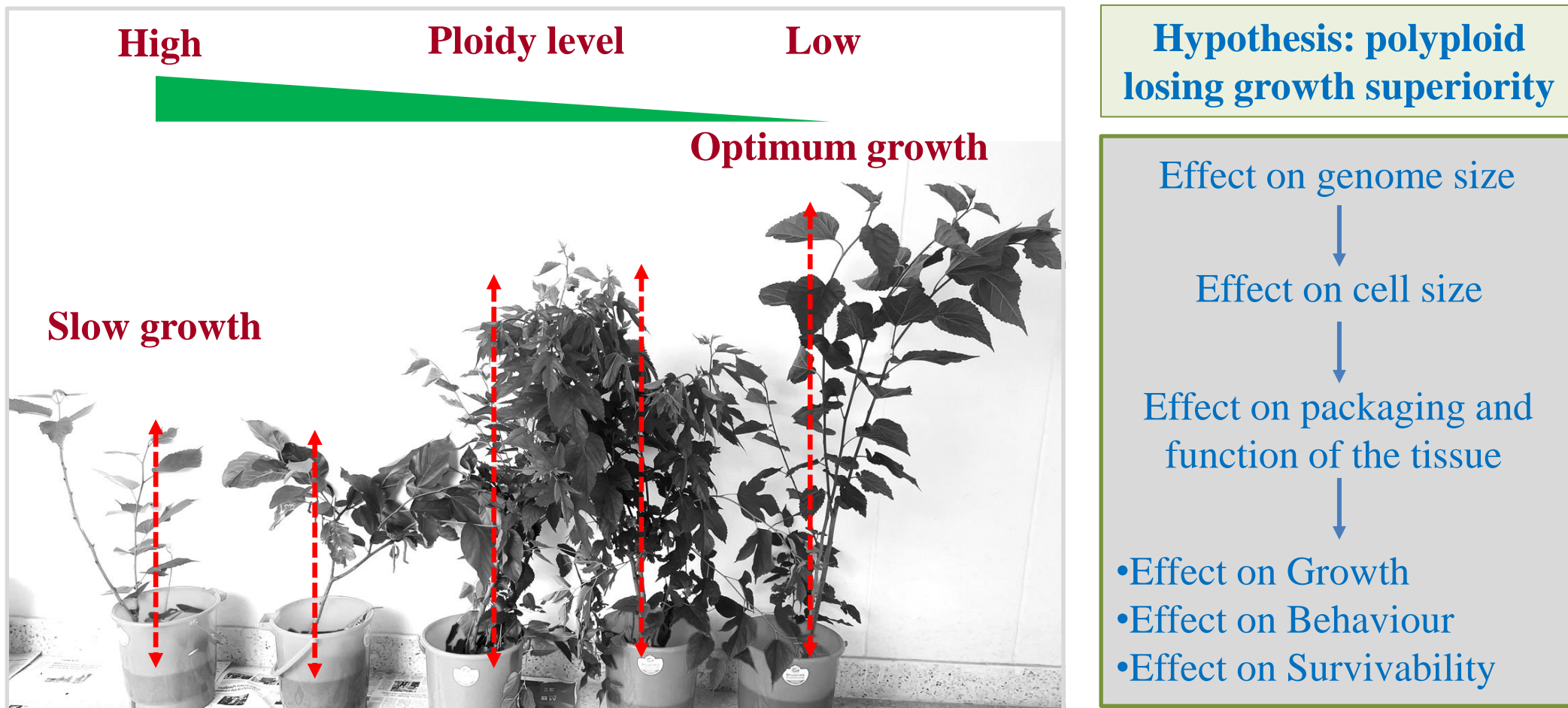
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INTRODUCTION & AIM

- Sericulture is one of the oldest (5000 BC) agro-based industries that start with agriculture, that production of tree mulberries (*Morus* spp.) to feed silkworms (*Bombyx mori*) for production of silk.
- Sericulture is an integrated model of eco-physiology, and evolution system.
- *Morus* spp. complex experienced significant effect of polyploidization, as evidenced by genome size diversity from haploid ($x=14$) to decasaploid ($22x=308$).
- Aim to understand the influenced of increased genome size/ploidy of *Morus* spp. on plant performance.



METHOD

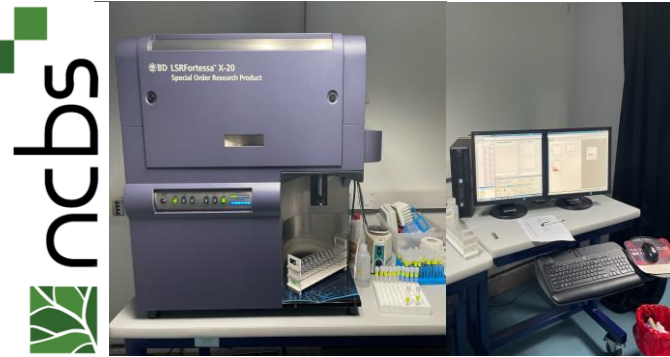
#	Study/Parameters	Method/Instrument	Unit
1	Chromosomes number	Metaphase study	number
2	Ploidy level	Flow cytometry	Pg/MBp
3	Leaf thickness	•Sample staining with iodine and of potassium iodide solution for 1 min. Followed by wash with 70 % ethanol.	μm
4	Guard cell volume		μm^3
5	Chloroplasts per guard cell	•Light Microscope •Image J software	number
6	Stomatal size		μm^2
7	Stomatal open pore size		μm^2
8	Stomatal density		no. mm^{-2}
9	Trichome length		μm
10	Photosynthetic rate (Pn)	LI-6400XT instruments	$\mu\text{mol CO}_2 \text{ m}^{-2} \text{ s}^{-1}$
11	Instantaneous Water Use Efficiency (iWUE)		Pn/E ratio
12	Stomata conductance (gs)		$\text{mol H}_2\text{O m}^{-2} \text{ s}^{-1}$
13	ROS and Starch content	In situ localization; Image J software	Ratio (Intensity)

Metaphase study

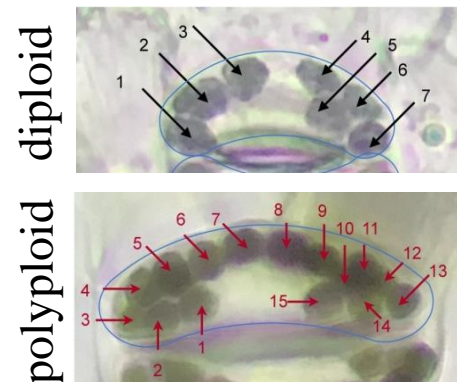
bio-protocol
A Protocol for Mitotic Metaphase Chromosome Count Using Shoot Meristematic Tissues of Mulberry Tree Species

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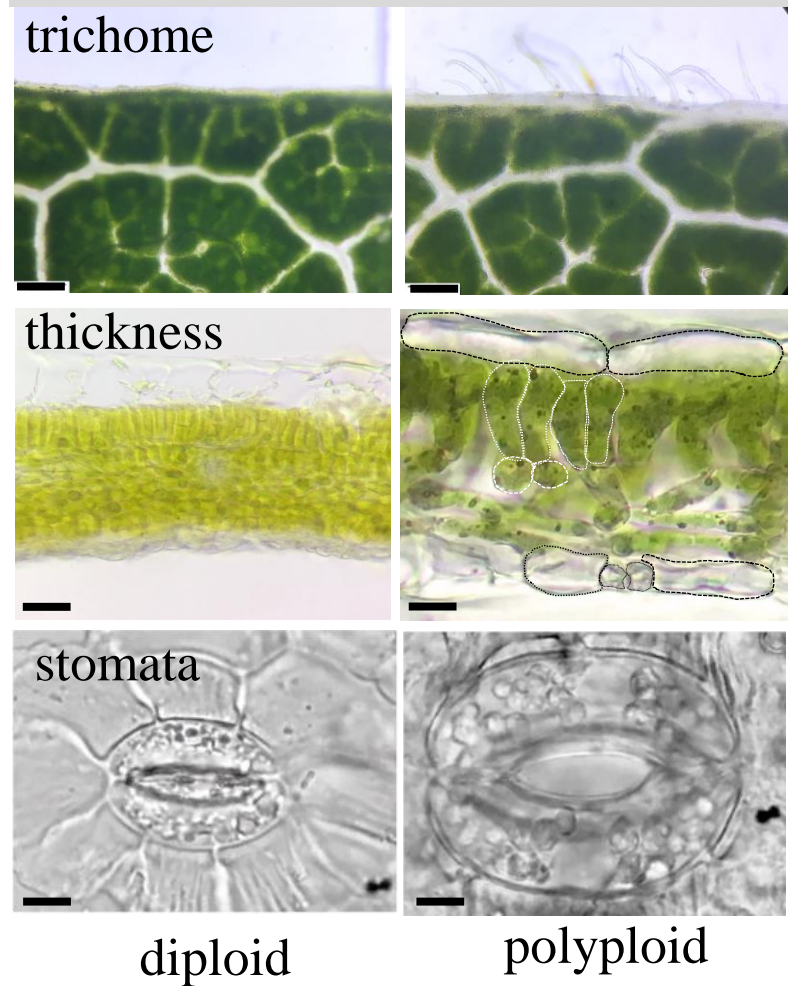
Flow cytometry



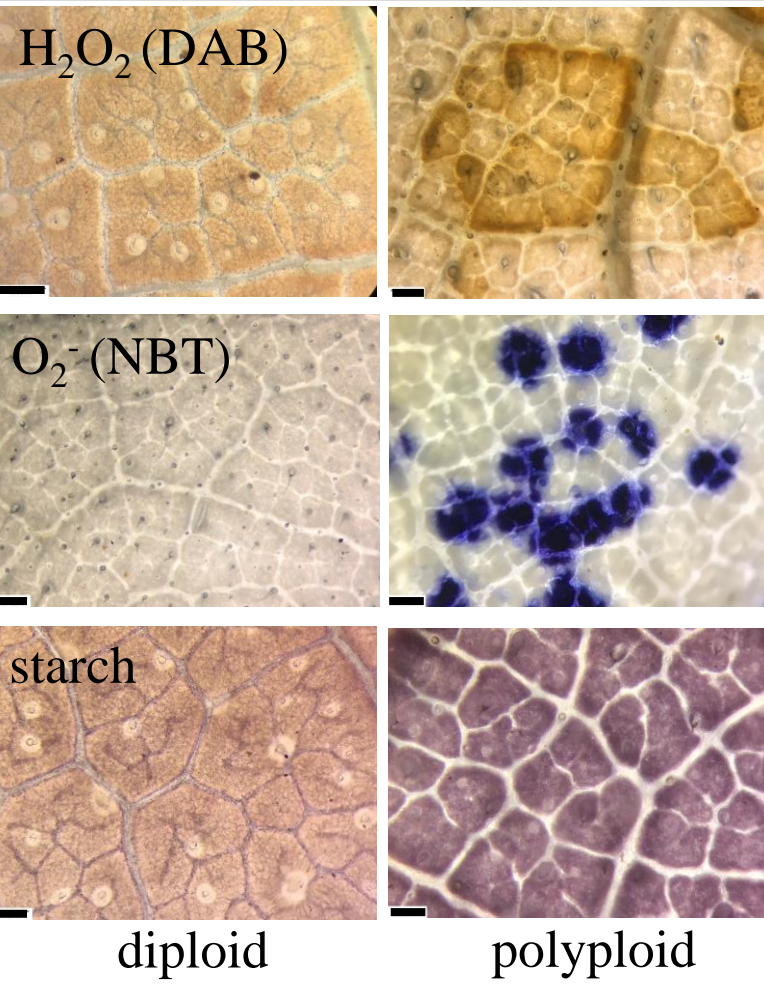
Chloroplasts



Morpho-anatomical traits



Metabolic traits

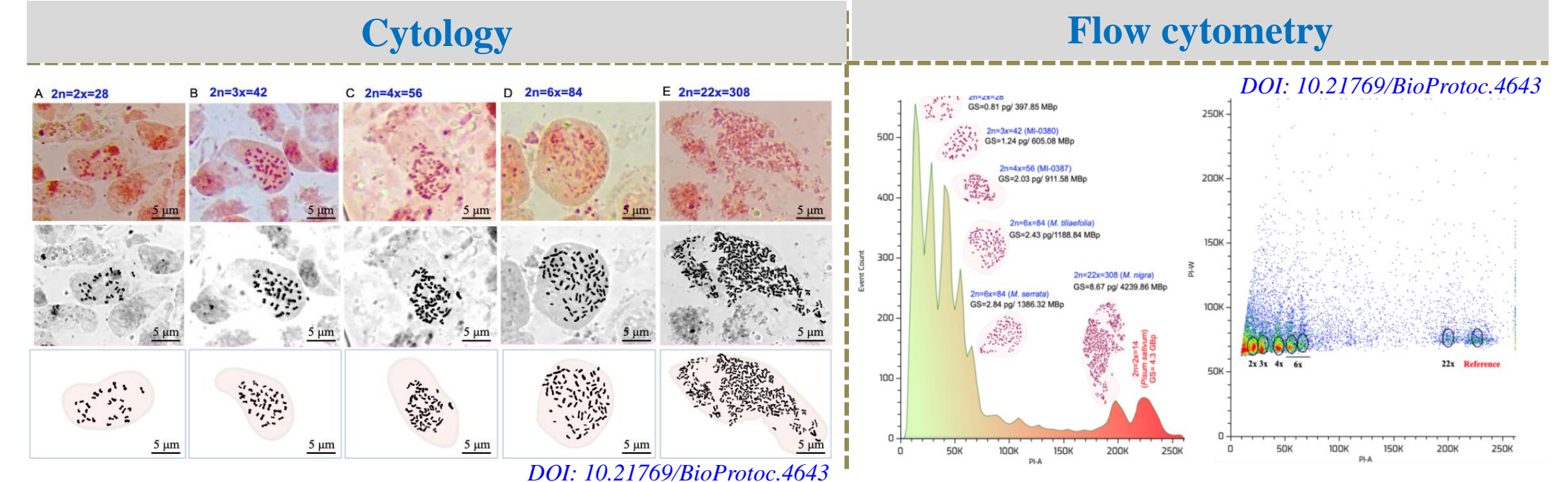


Leaf gas exchanges



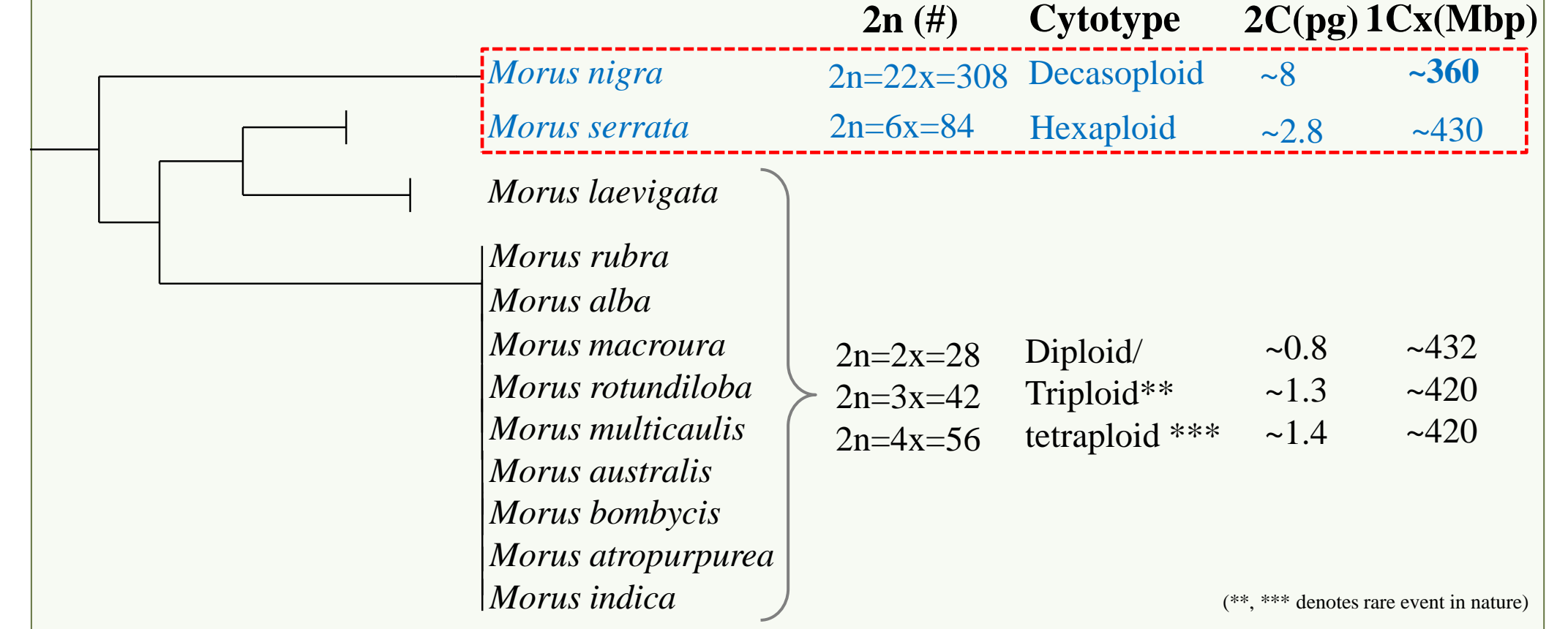
RESULTS & DISCUSSION

- ✓ Identified major cytotypes of *Morus* spp. are diploid ($2n=2x=28$), triploids ($2n=3x=42$), tetraploids ($2n=4x=56$), hexaploid ($2n=6x=84$), and decasaploid ($2n=22x=308$).



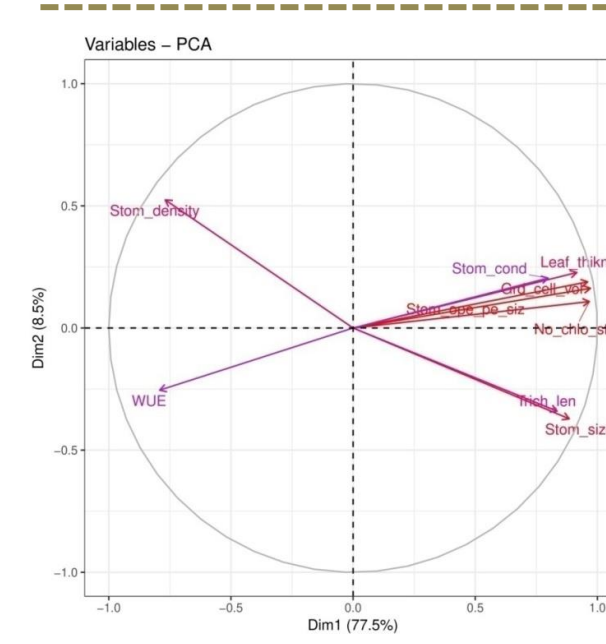
- ✓ Flow cytometry analysis estimated the genome size of highly polyploid species such, and considerable genome downsize observed in decasaploid *M. nigra* L. ($1Cx$, ~ 360.25).

Relationship of *Morus* spp. based on cytotypes

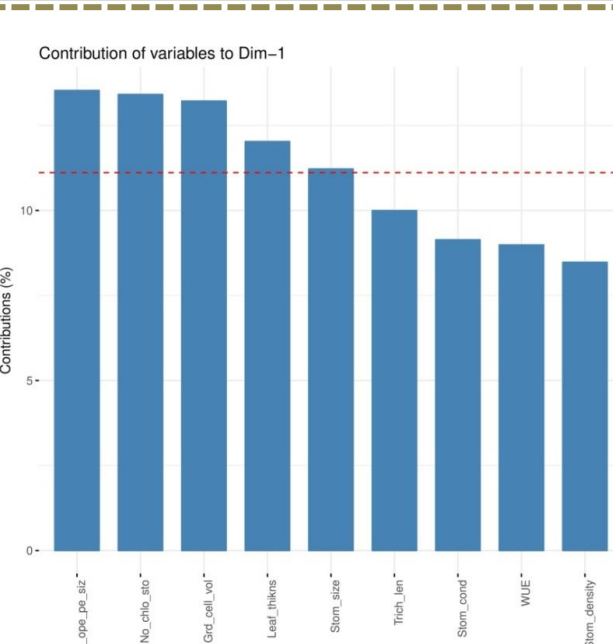


- ✓ Despite of higher number of chloroplasts and volumetric guard cell, mulberry polyploid photosynthetic traits has downsized, which may associated with higher operational stomatal conductivity and lower iWUE.

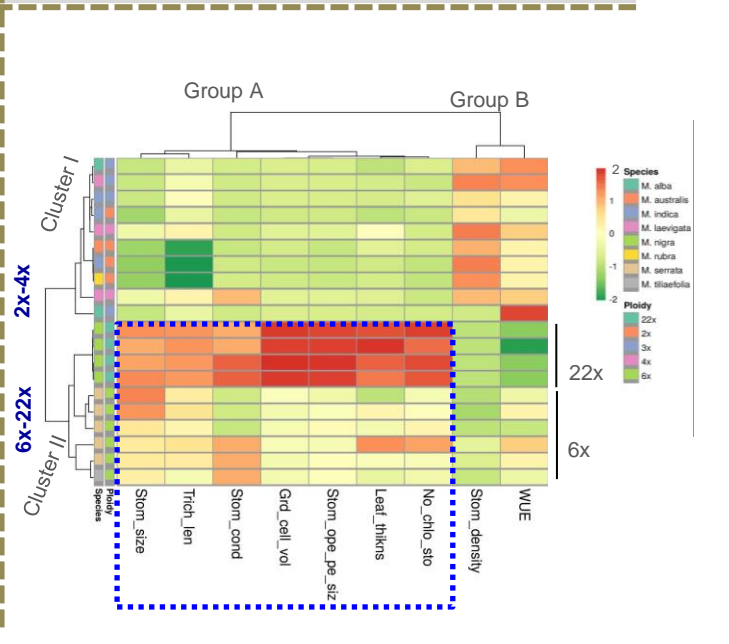
Correlation: GS and traits



Contribution of component

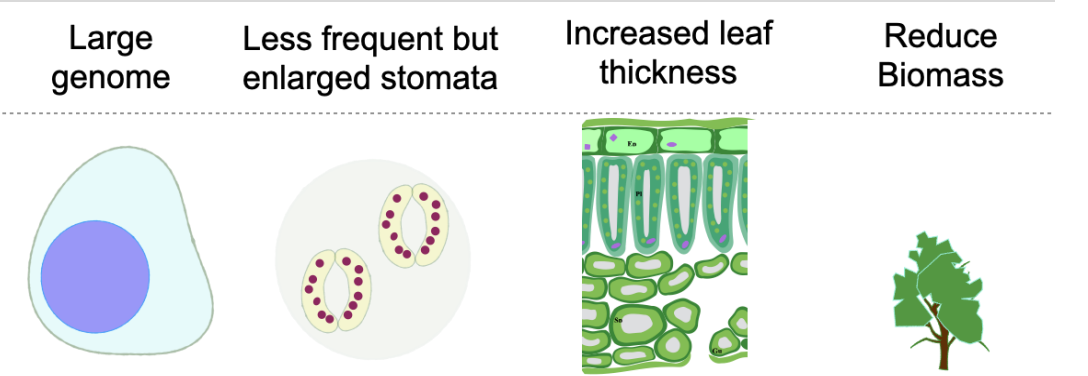


Clustering



- ✓ Increased genome size experienced expensive cellular & tissue function.

Consequence of increased genome size



- ✓ Our results point to a possible decrease in growth superiority of polyploids.

CONCLUSION

Over episodes of polyploidization and selection pressure, factors like the growth rate, genome size, and nutritional constraints enforced not only reduce the genome size but also restrict the growth of polyploid.

FUTURE WORK

- Needs immediate attention to understand the structural and functional aspect of polyploid particularly in tree species of wild origin.
- Conservation efforts need to refocus on managing tree polyploids.

FUNDING

Central Silk Board (CSB), Ministry of Textile, Govt. of India, Bangalore funded projects **PIG06004SI** & **PIG06010SIC**. We thank National Centre for Biological Sciences (NCBS), Bengaluru, India for the flow cytometry facility.

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- 1) Mondal et al., 2023. *Bio-protocol*, 13(17). 1-11.
- 2) Šmarda et al., 2023. *New Phytologist*, 239(1), 399-414.
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