The Effects of Iron on Polyploids of *Spirodela polyrhiza*

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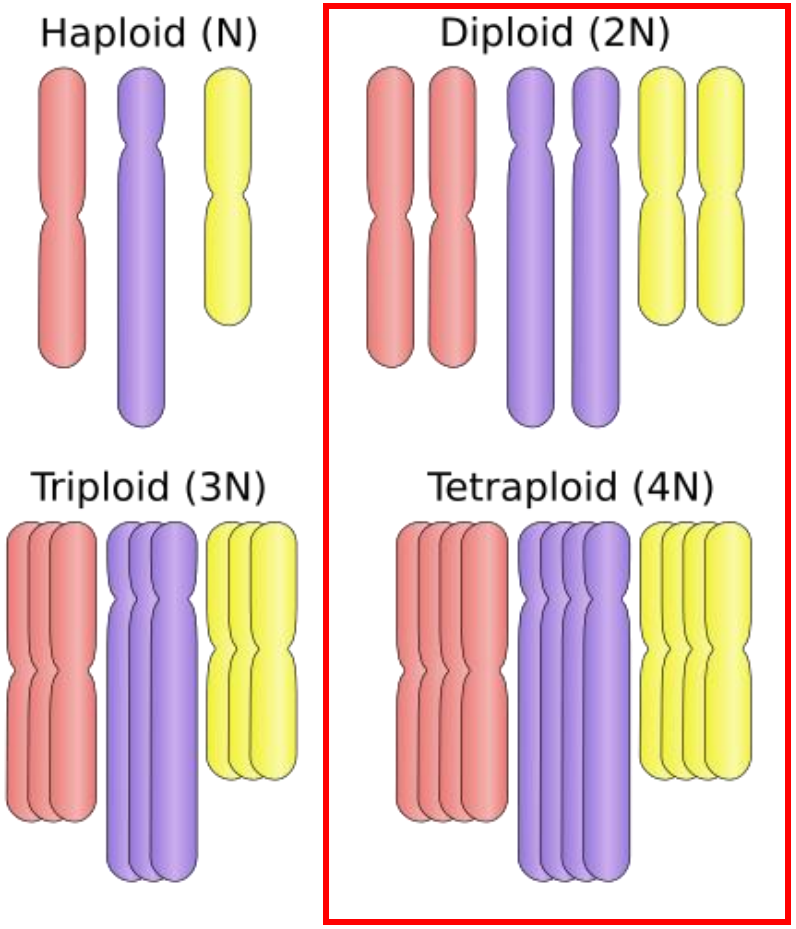
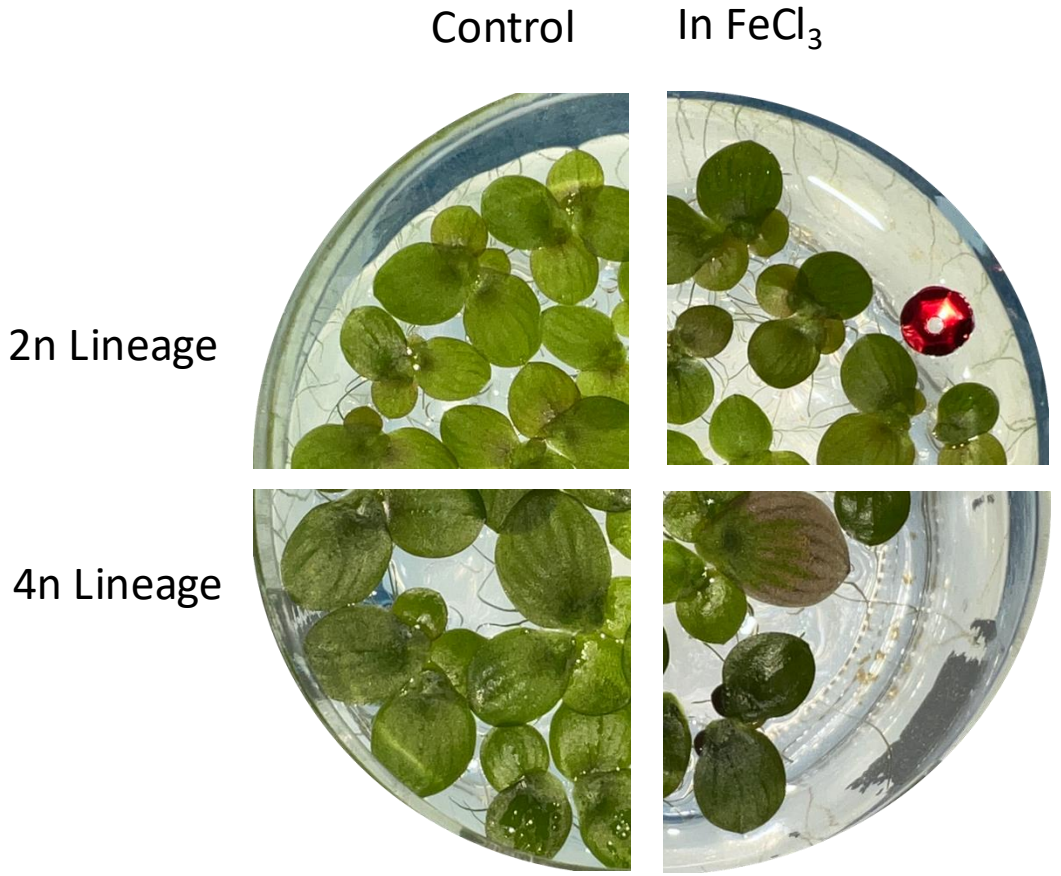
Polyploidy, having 3+ homologous sets of chromosomes, alters plant form and function in response to $FeCl_3$.



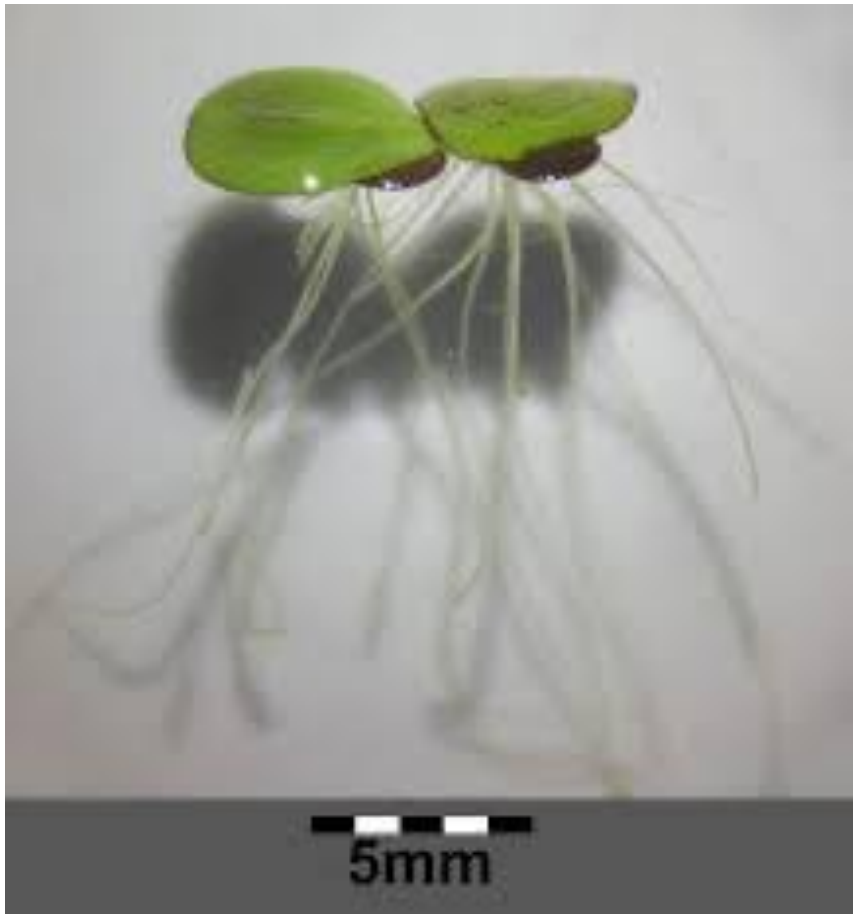
Different Polyploids

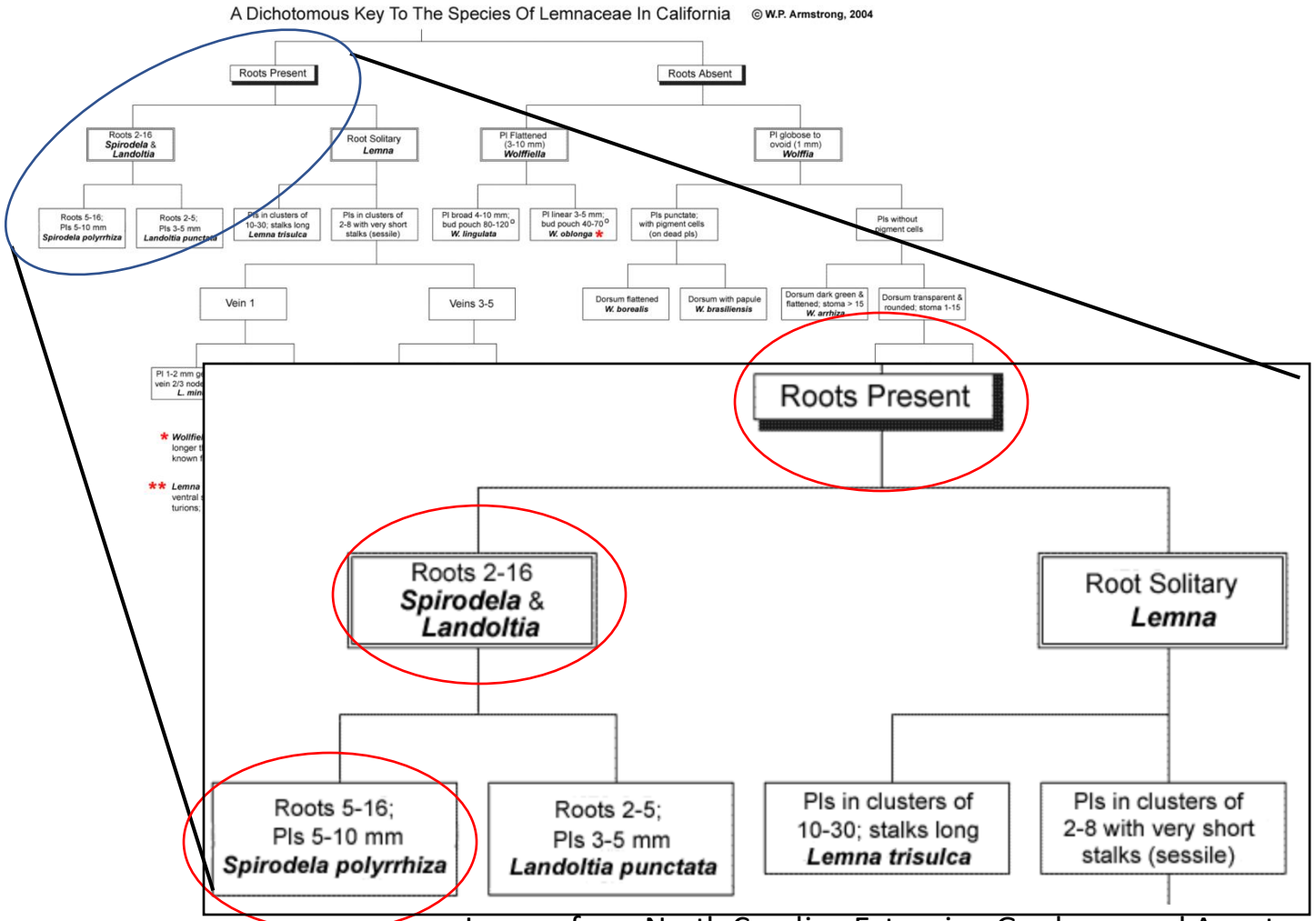


Polyploidy affects how certain plants adapt to changing environments, like forming turions for regeneration.

Donald T. Fox, Sept. 2021

Spirodela polyrhiza is a simple, green, oval shaped aquatic plant that is fast-growing with multiple roots.





Images from North Carolina Extension Gardener and Armstrong

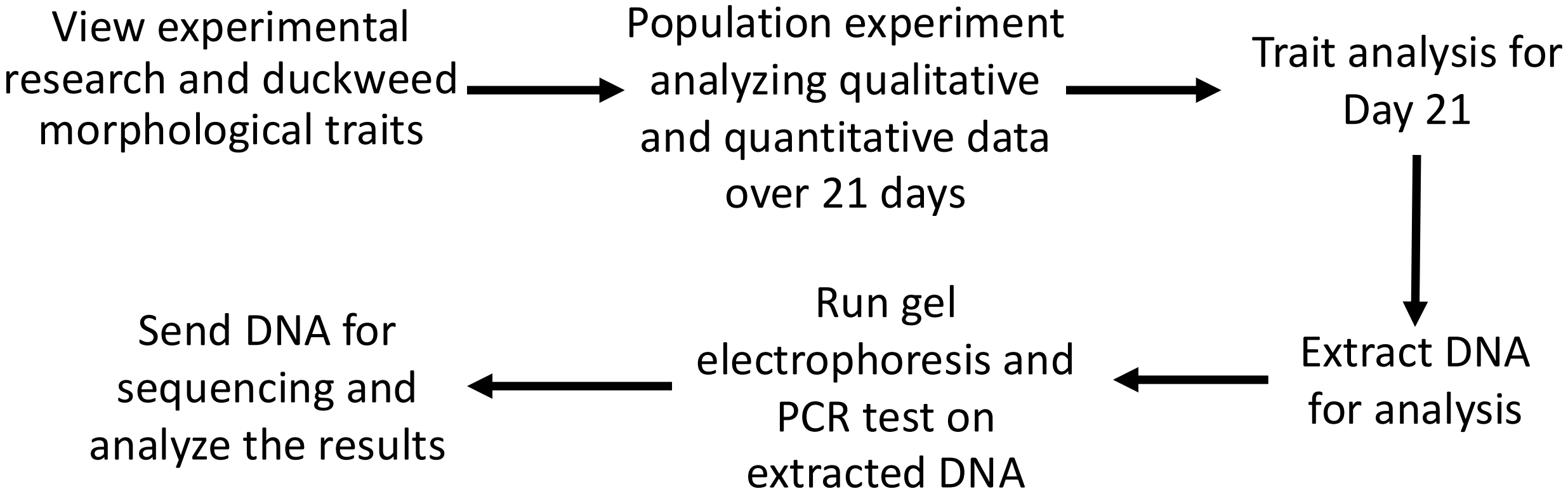
$FeCl_3$ causes stunted growth and bronzing/degrading of leaves.

Physiological Impact

Ecology Impact

Erin L Connolev, 2002

Experimental Methods



The 4n duckweed is known for having larger fronds than the 2n.

Day 0

Day 7

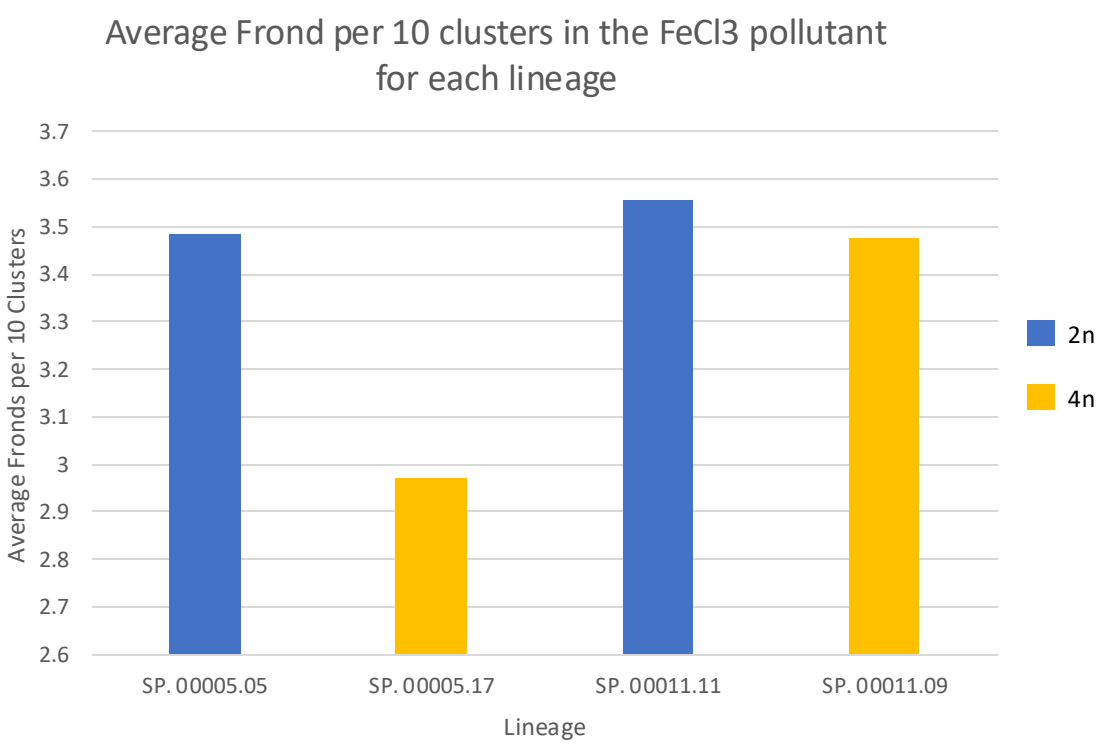
Day 14

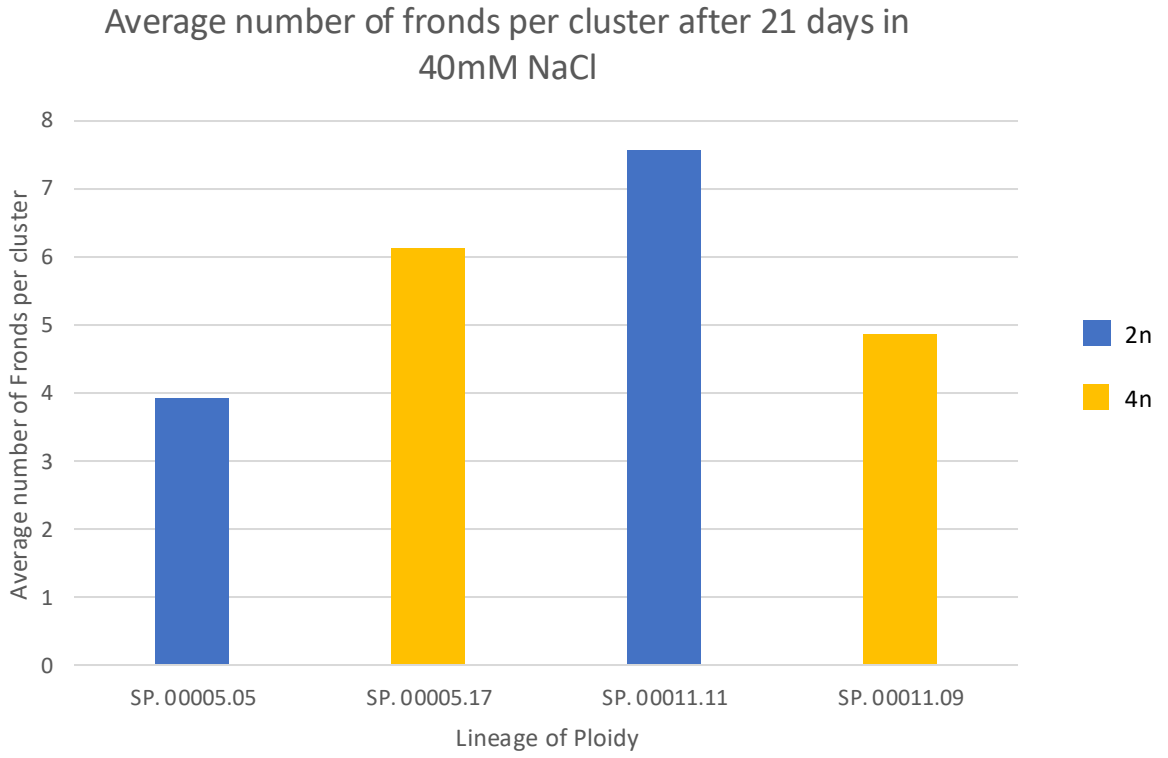
Spirodela polyrhiza
SP00011.11 2n

Spirodela polyrhiza
SP00011.09 4n

Control grown in glass jar with 90mL of 0.25M Appenroth. Both 2n and 4n started with 4 fronds. Pictures captured with phone camera

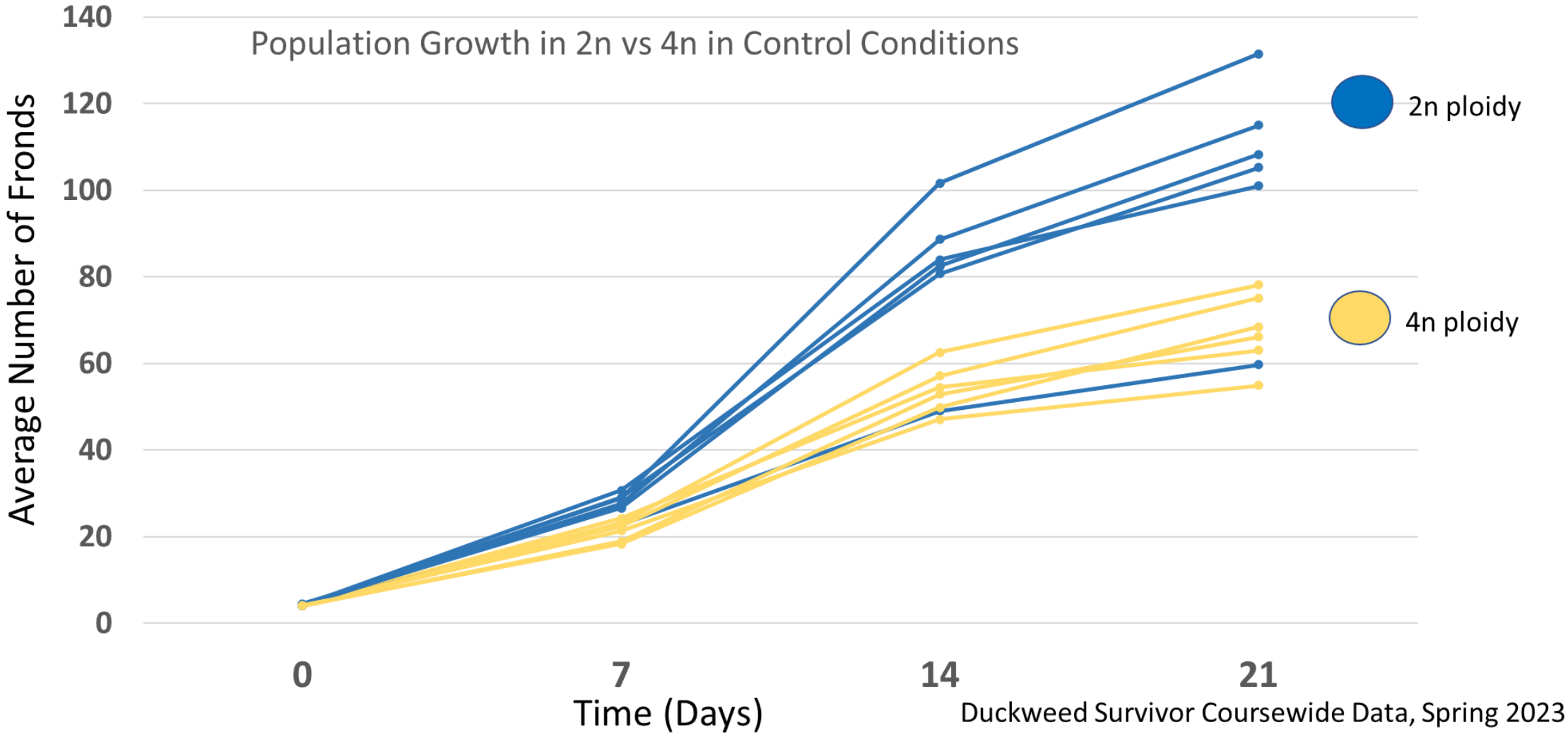
The average number of fronds per cluster is higher in the 2n ploidy for both types of pollutants.



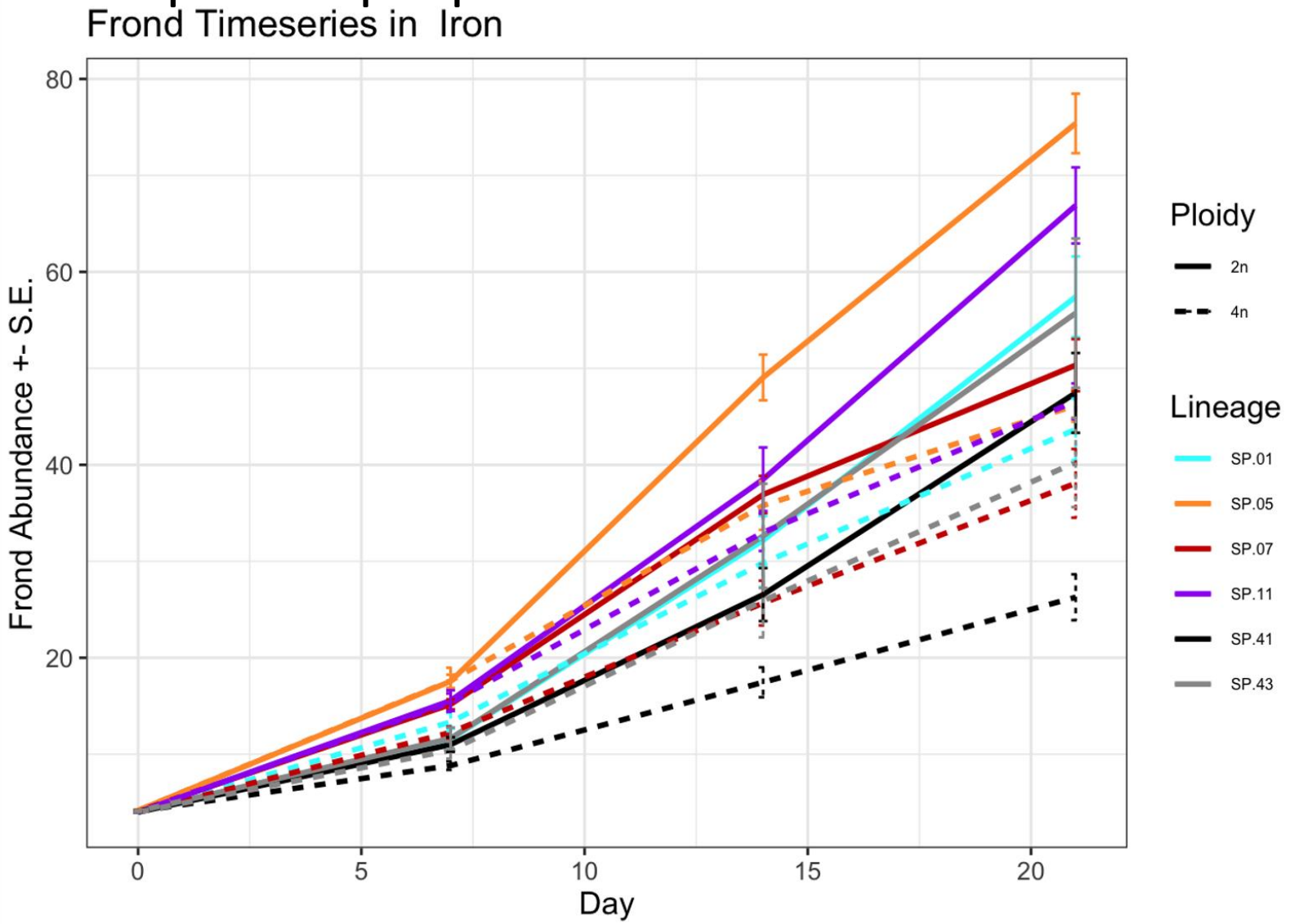


By using the Fiji program, we were able to count the amount of fronds significantly by zooming in and making sure we know we counted that frond already.

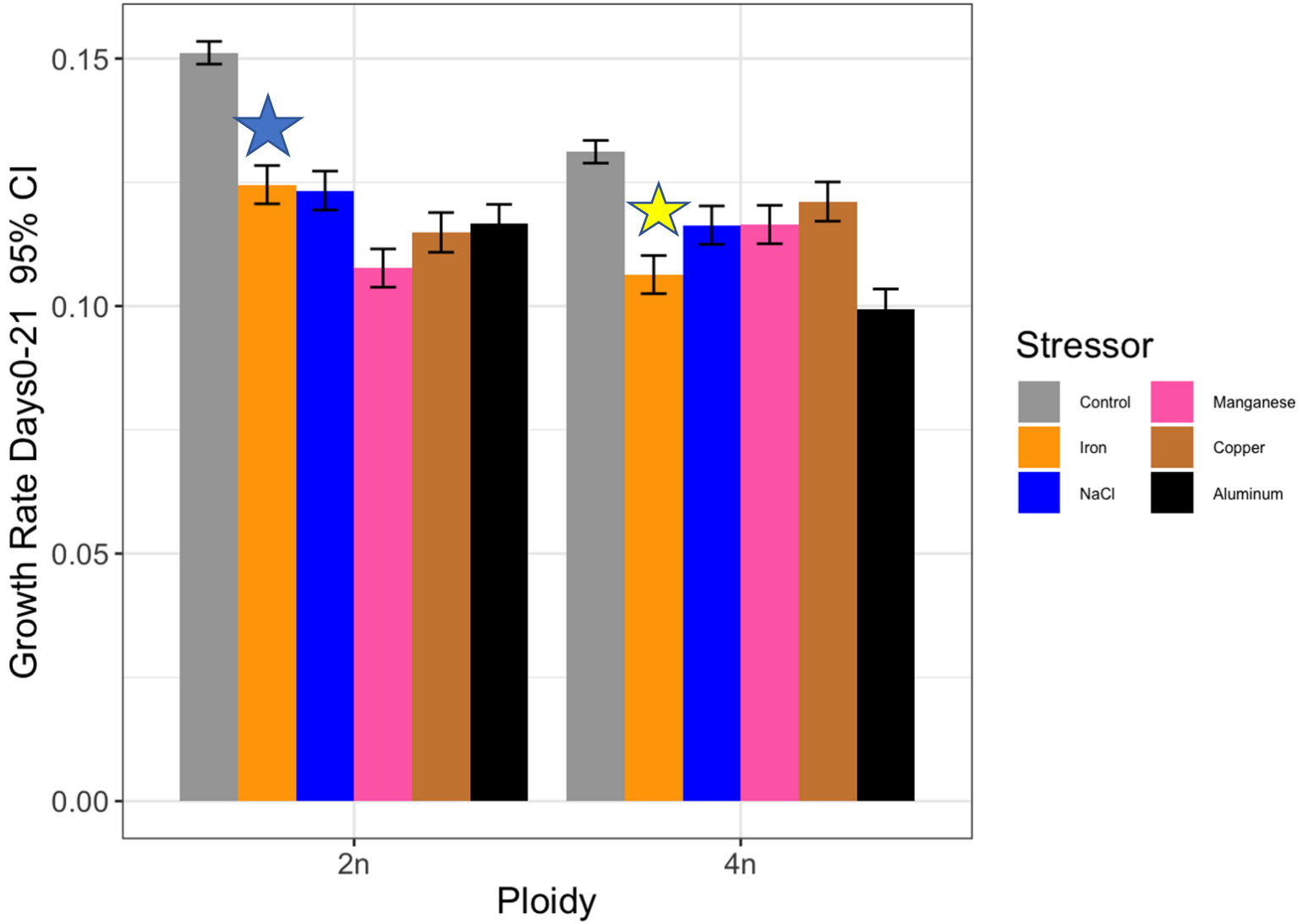
The diploid lineages of duckweed had a higher average frond count throughout the 21 days.



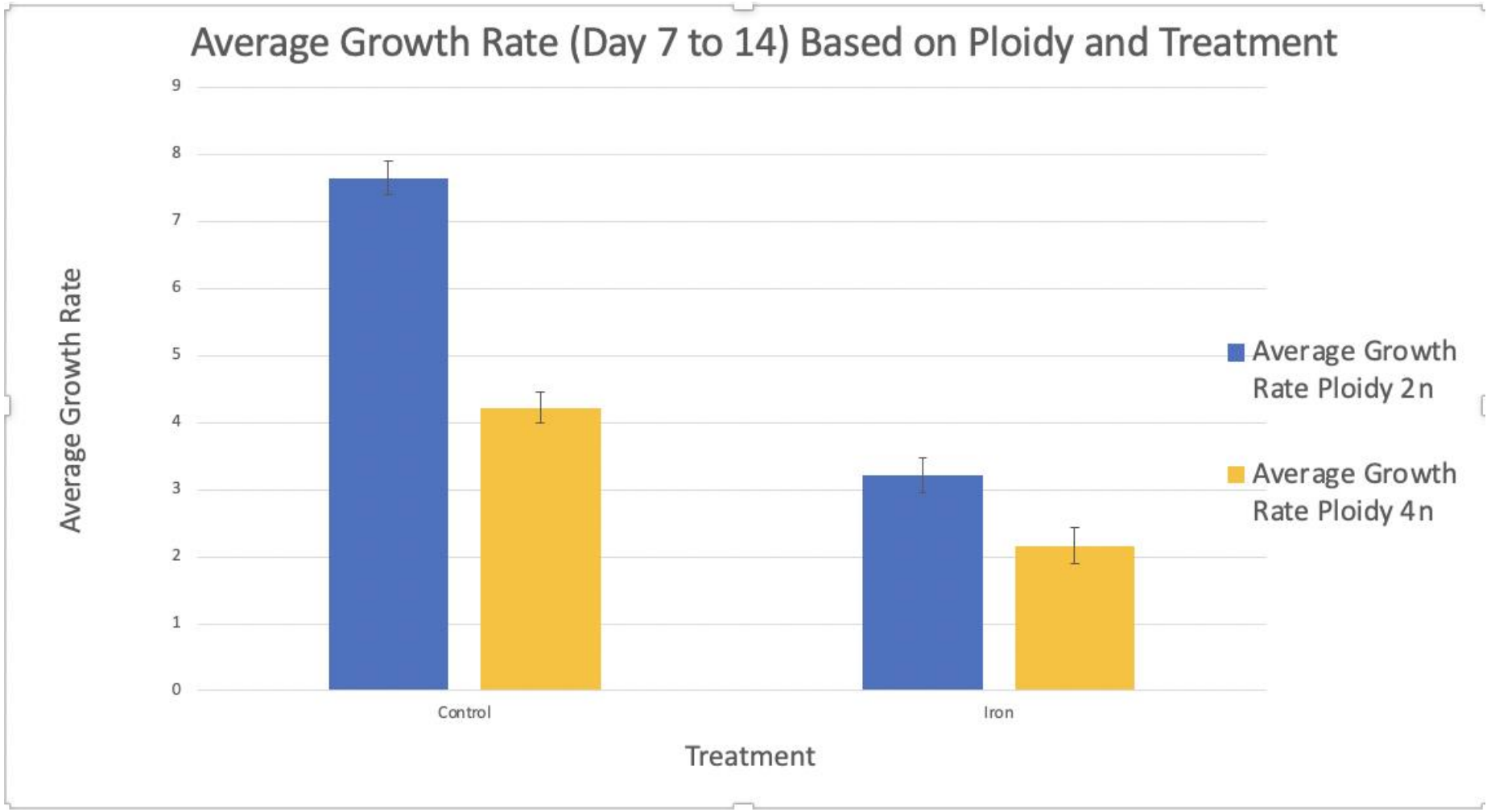
On average, diploid populations produced more fronds than the tetraploid populations in a solution of iron.



The diploid had a higher relative growth rate in both the control and Iron.

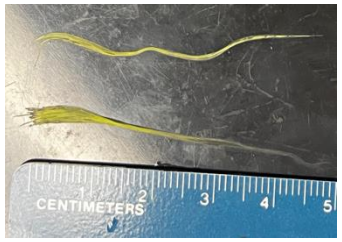
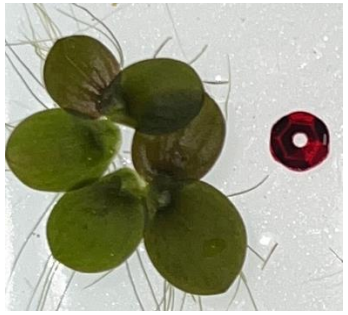
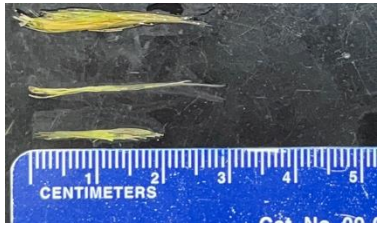


Average Growth Rate was greater in the diploid for both control and Iron.



In this graph, growth rate is shown by the following formula, (# of fronds on day 14 - # of fronds on day 7)/7 days.

The 2n grew better in the $FeCl_3$ pollutant than 4n.

	# of Fronds	Frond Area	Root Length	Turion Production
2n:	Both 2n lineages had more fronds than the 4n	 SP.00011.11 2n had smaller area	 SP.00011.11 2n had longer thinner roots	No 2n lineage had turions
4n:	Both 4n lineages had less fronds than the 2n	 SP.00011.09 4n had larger area	 SP.0005.17 4n had shorter thicker roots	 SP.0005.17 Only one 4n lineage had turions

Extra Info: Fronds from all clusters were counted in FIJI. These numbers were used to randomly pick 10 fronds from each jar to make up the sample size, then, also in FIJI area was found using the sequin for reference. The roots from 10 clusters were measured and all turions were counted by hand.

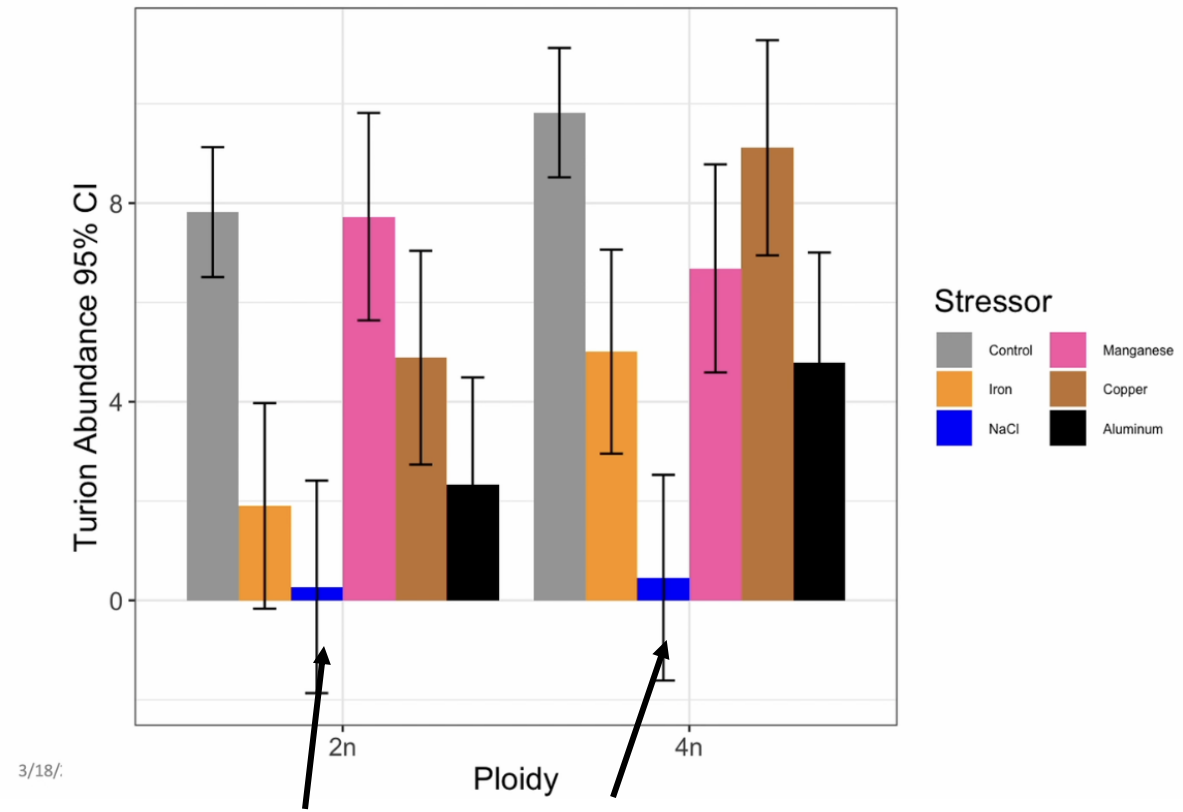
Blast results confirm that our duckweed is in fact *Spirodela polyrhiza*.

Description	Scientific Name	Max Score	Total Score	Query Cover	E value	Per. Ident	Acc. Len	Accession
Spirodela polyrhiza strain 7498 chloroplast, complete genome	Spirodela polyrhiza	675	675	100%	0.0	99.73%	168956	MN419335.1
Spirodela polyrhiza chloroplast, complete genome	Spirodela polyrhiza	675	675	100%	0.0	99.73%	168788	NC_015891.1
Spirodela polyrhiza strain LC07 RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela polyrhiza	675	675	100%	0.0	99.73%	415	KP017721.1
Spirodela polyrhiza strain LC03 RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela polyrhiza	675	675	100%	0.0	99.73%	415	KP017717.1
Spirodela polyrhiza isolate MA_SP_M2_SA RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela polyrhiza	675	675	100%	0.0	99.73%	410	OK493452.1
Spirodela polyrhiza strain 7498 chloroplast, complete genome	Spirodela polyrhiza	675	675	100%	0.0	99.73%	168788	JN160603.2
Spirodela polyrhiza strain 1a RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela polyrhiza	675	675	100%	0.0	99.73%	417	KF726301.1
Spirodela polyrhiza strain 7205 RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela polyrhiza	673	673	99%	0.0	99.73%	389	GU454037.1
Spirodela intermedia strain 7450 RNA polymerase beta subunit (rpoB) gene, partial cds; chloroplast	Spirodela interm…	656	656	99%	0.0	98.91%	389	GU454034.1
Spirodela intermedia genome assembly, organelle: plastid:chloroplast	Spirodela interm…	652	652	100%	0.0	98.64%	169024	LR761918.2

Lineage	rboL	rpoC	rpoB	atpF_atph	pbck_pbcI
SP00011	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*
SP00005	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*	*S. polyrhiza*

By sending our duckweed DNA to Genewiz, we were able to use that sequence to identify and confirm if it was in fact *Spirodela polyrhiza*.

Future experiments for further research



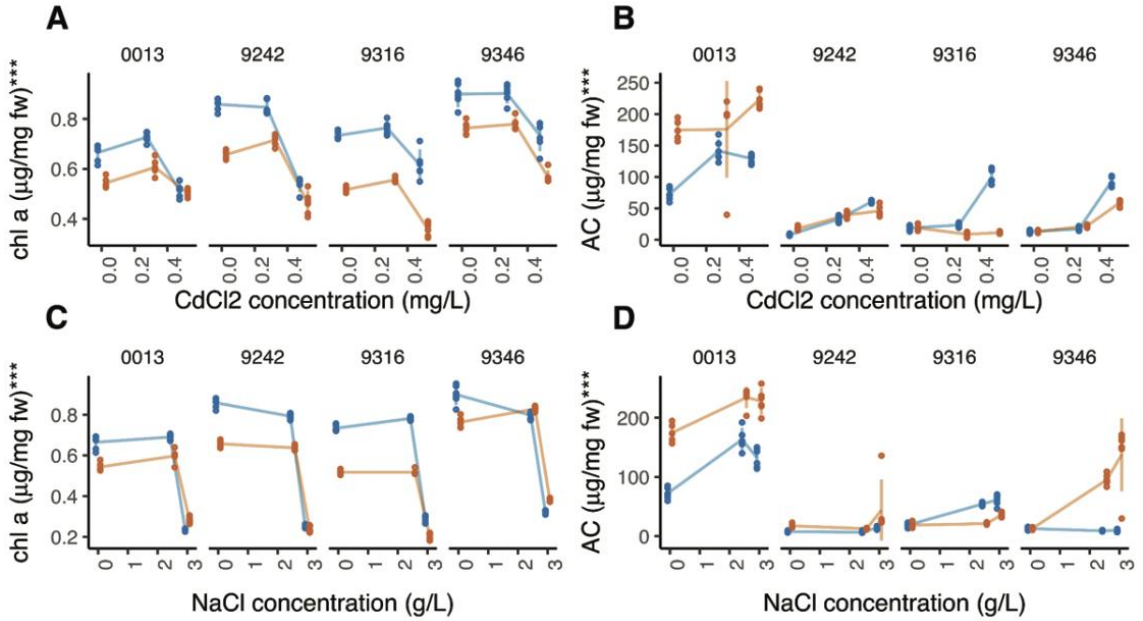
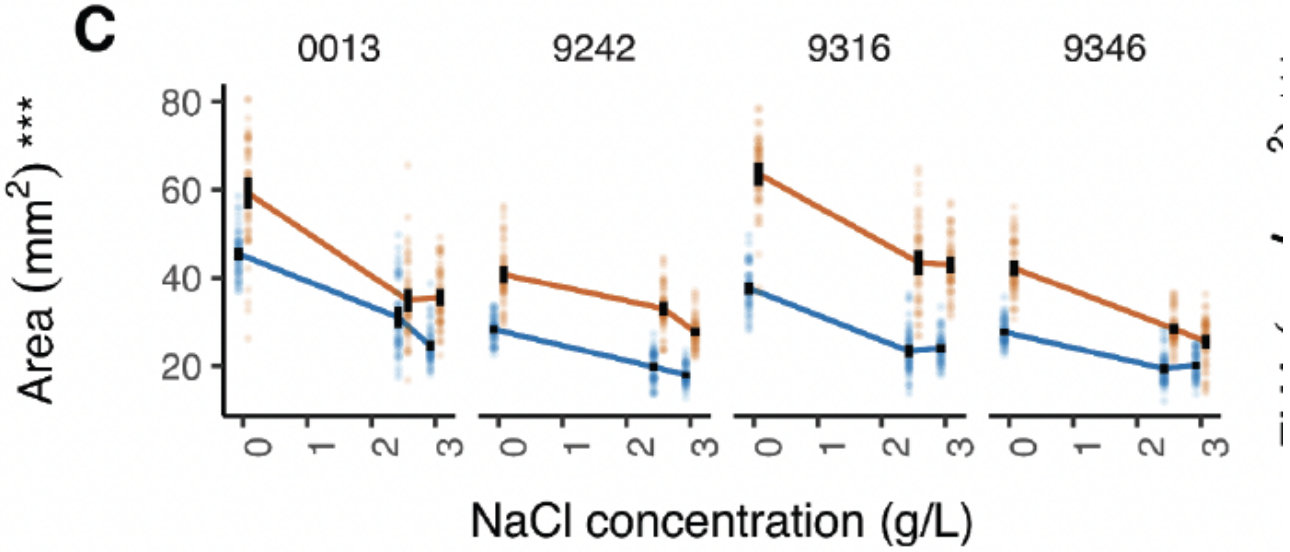


Figure 2. Bafort et al., 2023

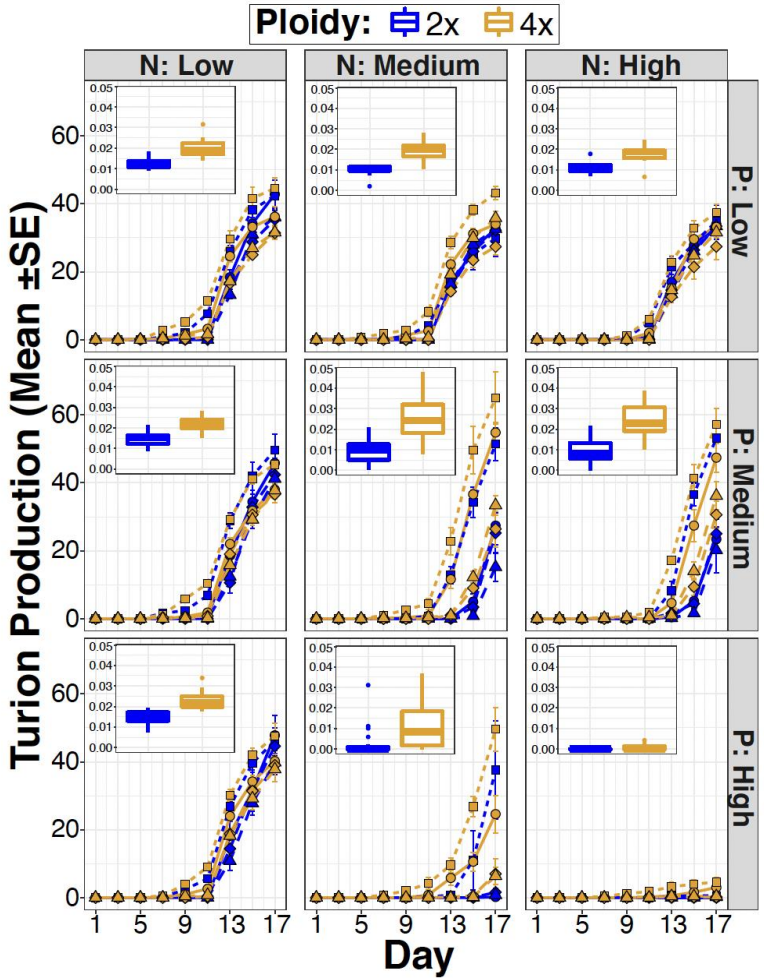
The NaCl stressor did not produce any turions for any lineage, further research done on more lineages can prove if there could be any turion growth

Further testing of chlorophyll a and anthocyanin levels in our lineages can be researched to see if there is a relationship to frond discoloration

References



"The immediate effects of polyploidization of *Spirodela polyrhiza* change in a strain-specific way along environmental gradients."; Bafort, Wu, Natran, Clerck, Van de Peer; 2023



"Polyploidy impacts population growth and competition with dipole: multigenerational experiments reveal key life history tradeoff"; Anneberg, O'Neil, Ashman, Turcotte; Nov. 1 2022

Acknowledgements

Thank you to...
Instructor: Clancy Wiesner
Prep Leaders: Swagatika Battacharya, Kitt Kroeger, Dawn Bisi, Jessica Robertson.
Undergraduate workers: Jayda Sandridge, Julia Witrado, Jae Kim, Lauren Ignatz, Emily Gagliardi, Fabian Matos