

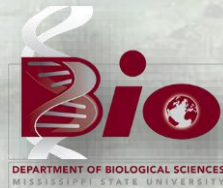
Response of Water Quality Metrics to Foliar Herbicide Applications and Subsequent Plant Breakdown of American Frogsbit

Adrián Lázaro-Lobo, Gray Turnage, Landon Sanders, Ally Ratliff and Gary N. Ervin.

Department of Biological Sciences
Mississippi State University



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Introduction



Objectives

- To evaluate the efficacy of seven herbicides at low and high doses in an effort to control *L. spongia*.
- To assess possible impacts of herbicide-induced plant death on standard aspects of water quality.



Treatments

- Study site: 242 L mesocosms.
- Treatments (3 replicates each):

Treatment	Site of Action	Type	Dose	Quantity
Reference	NA	NA	NA	NA
2,4-D	Auxin, Group 4	Systemic	High	9.35 L/ha
			Low	4.67 L/ha
Florpyrauxifen-benzyl	Auxin, Group 4	Systemic	High	2 PDU
			Low	1 PDU
Flumioxazin	PPO, Group 14	Contact	High	0.88 L/ha
			Low	0.44 L/ha
Glyphosate	EPSP, Group 9	Systemic	High	8.76 L/ha
			Low	4.38 L/ha
Imazamox	ALS, Group 2	Systemic	High	9.35 L/ha
			Low	4.67 L/ha
Imazapyr	ALS, Group 2	Systemic	High	3.51 L/ha
			Low	1.75 L/ha
Triclopyr	Auxin, Group 4	Systemic	High	18.70 L/ha
			Low	9.35 L/ha



WAT (Weeks After Treatment)

MAT (Months After Treatment)

DAF (Days after treatment reached 50% mortality of *L. sponsgia*)

WAF (Weeks after treatment reached 50% mortality of *L. sponsgia*)

Variables measured

Time of measurements

• Plant attributes

- Percent area cover
- Percent mortality
- Inflorescence number
- Emerged and submerged biomass

Weekly 0 – 8 WAT; monthly 4 – 12 MAT

0 WAT, 8 WAT, 12 MAT

• Water quality attributes

- Dissolved oxygen
- Electrical conductivity
- pH
- Ammonium (NH₄⁺)
- Nitrate (NO₃⁻)

Weekly 0 – 12 WAT; monthly 4 – 12 MAT

2 DAF, 2 WAF, 4 WAF, 8 WAF, 6 and 12 MAT

Statistical analyses

- Generalized linear models (GLMs)
 - Data distributions:
 - Beta distribution: Percent area cover and percent mortality
 - Poisson distribution: Inflorescence number
 - Gamma distribution: DO, electrical conductivity, NH_4^+ and NO_3^-
 - Gaussian distribution: pH
 - Repeated-measures: all time periods included as a fixed factor
 - Specific periods of time:
 - 4 WAT, 8 WAT and 12 MAT
 - 8 WAT and 12 MAT (for emerged and submerged biomass)
 - 2 WAF, 8 WAF and 12 MAT (for NH_4^+ and NO_3^-)

Plant attributes

Reduction % Area cover

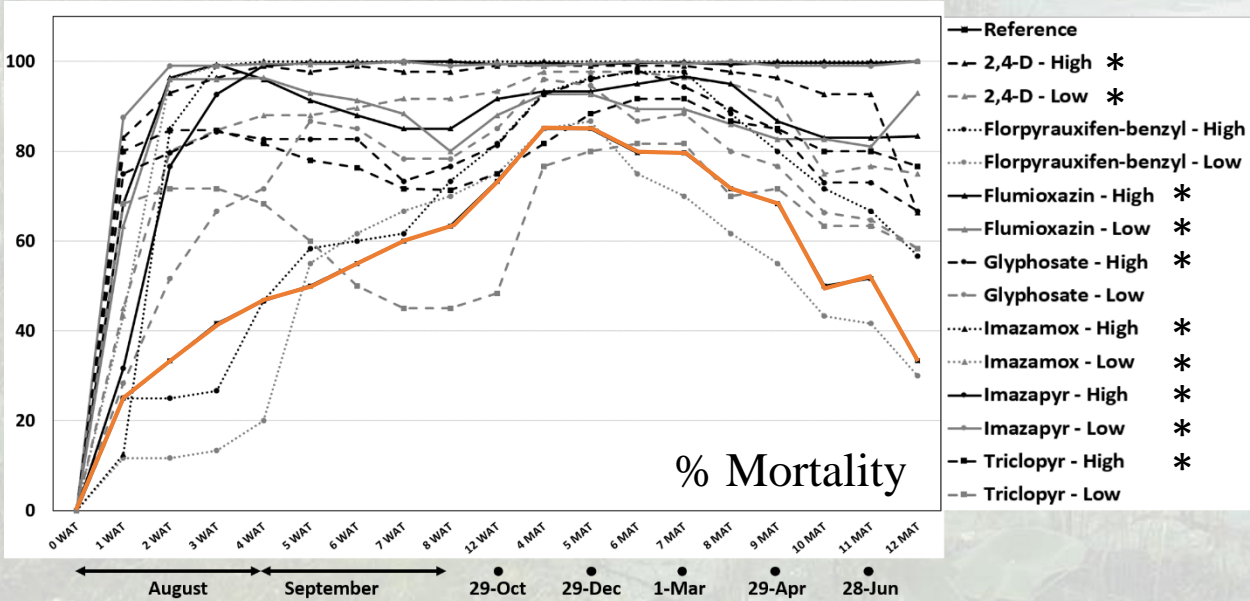
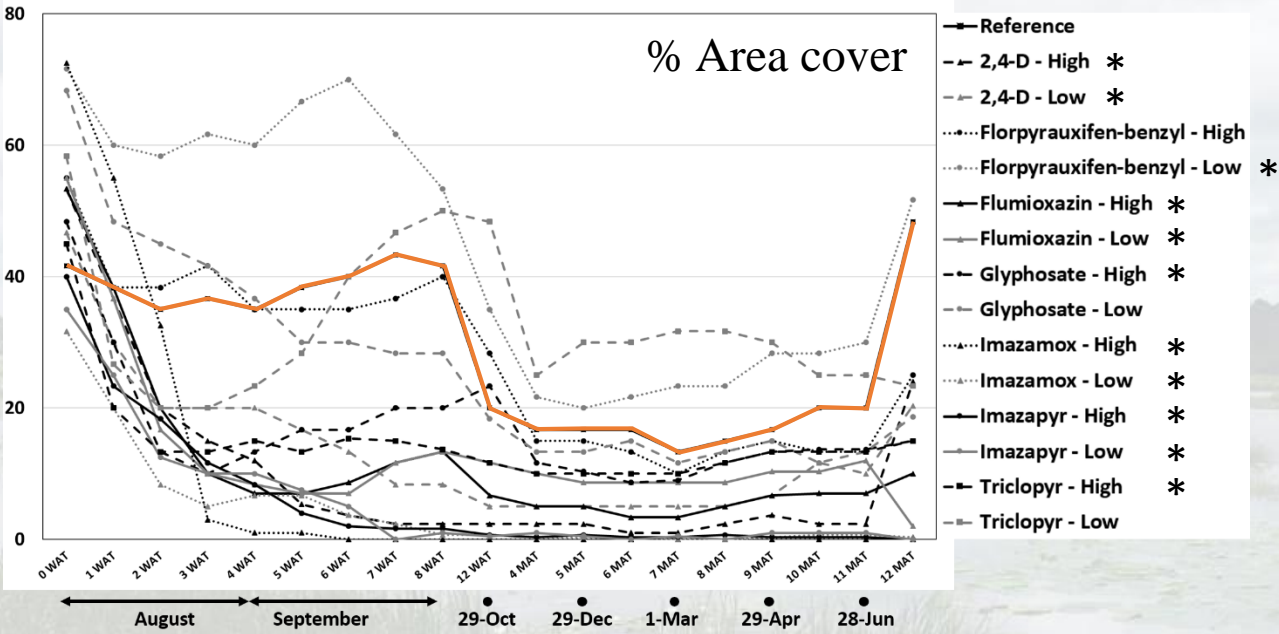
Excellent: 90-100%

Good: 70-90%

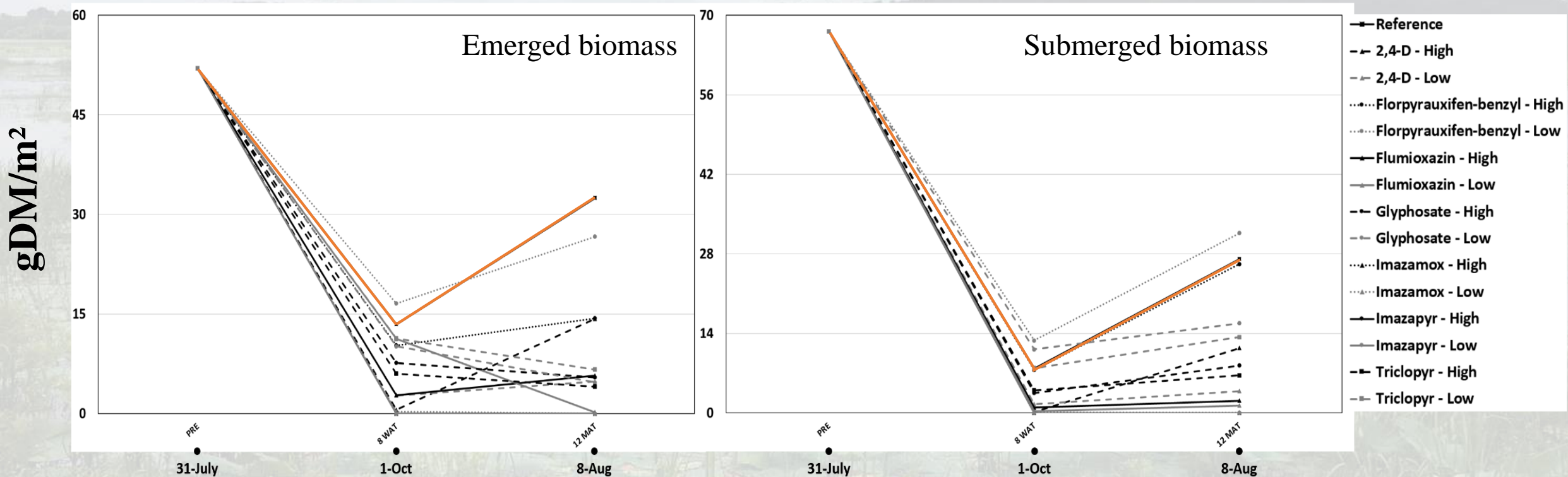
Poor: 50-70%

None: <50%

Treatment	Dose	Initial control	Control in next growing season
Reference	NA	NA	NA
2,4-D	High	Good	Poor
	Low	Good	Poor
Florpyrauxifen-benzyl	High	None	None
	Low	None	None
Flumioxazin	High	Excellent	Good
	Low	Excellent	Good
Glyphosate	High	Good	Poor
	Low	Poor	Poor
Imazamox	High	Excellent	Excellent
	Low	Excellent	Excellent
Imazapyr	High	Excellent	Excellent
	Low	Excellent	Excellent
Triclopyr	High	Good	Poor
	Low	Poor	Poor



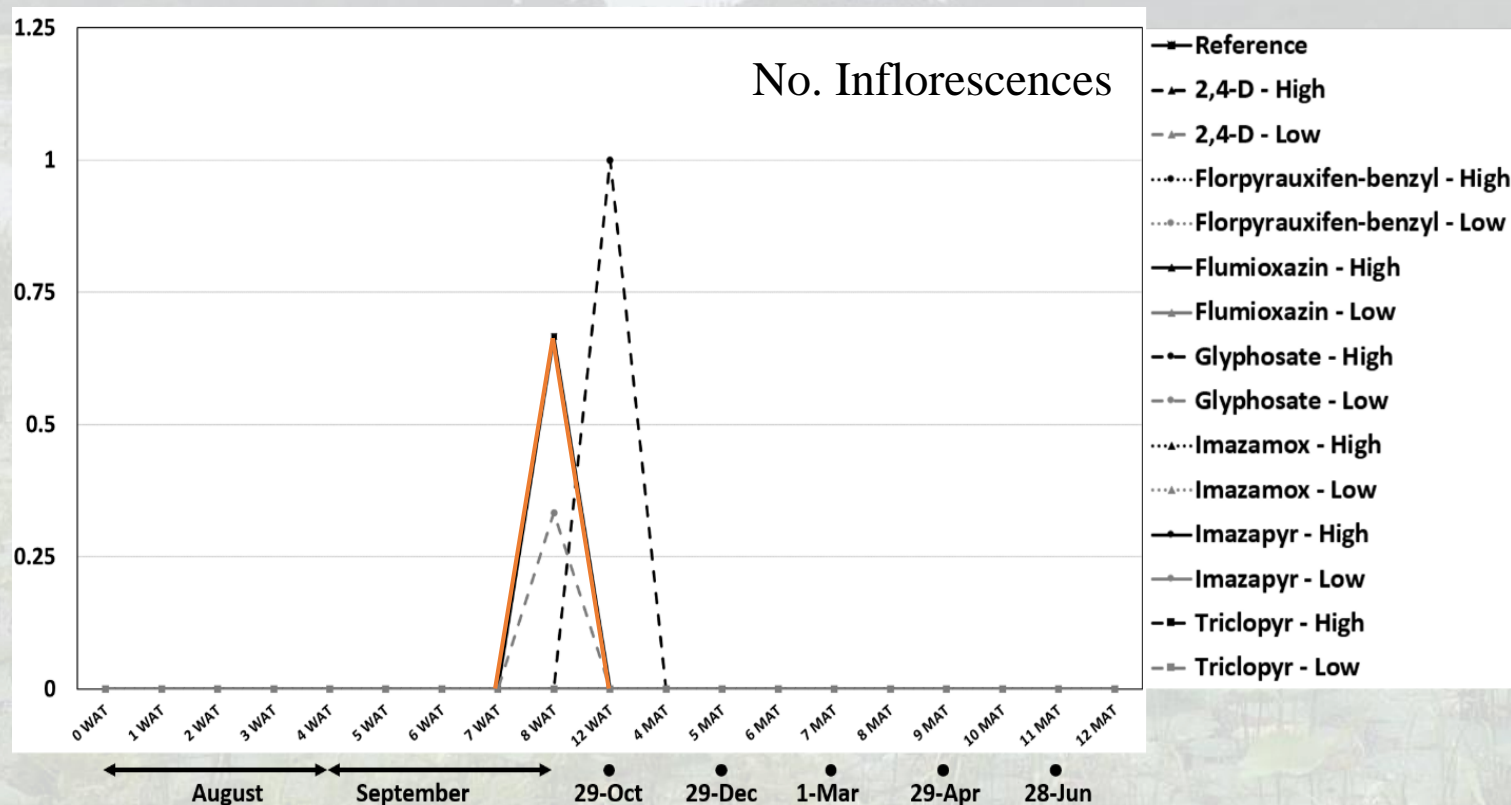
Plant attributes



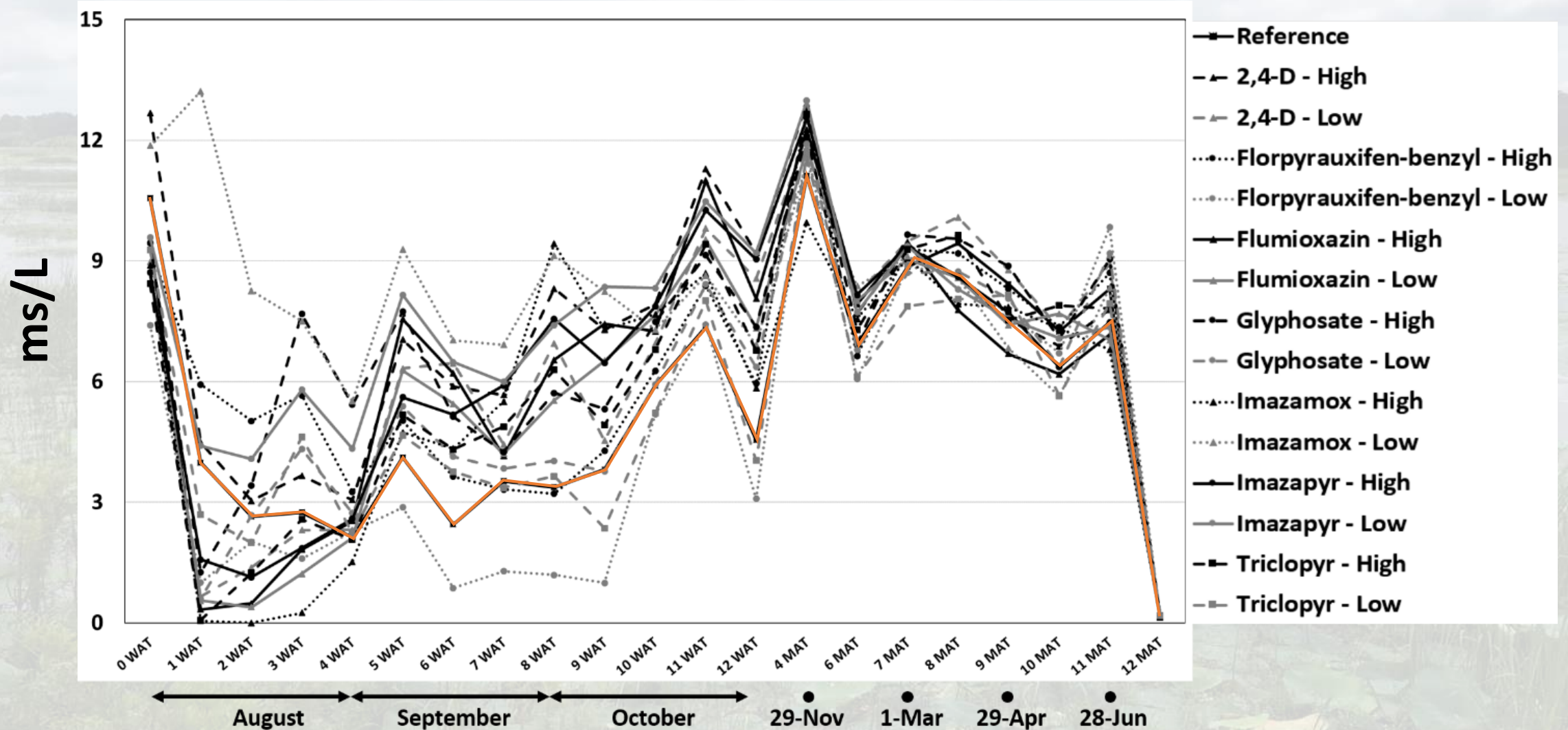
Mean biomass

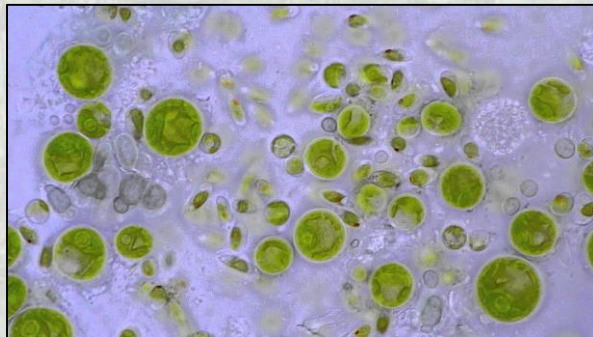
Treatment	Emergent biomass		Submerged biomass	
	8 WAT	12 MAT	8 WAT	12 MAT
Reference	13.5	32.5	7.8	27.1
2,4-D - High	0.6	14.3	0.2	11.4
2,4-D - Low	2.7	4.8	1.6	3.8
Florpyrauxifen-benzyl - High	10.3	14.4	7.6	26.2
Florpyrauxifen-benzyl - Low	16.6	26.6	12.8	31.7
Flumioxazin - High	2.8	5.7	0.9	2.1
Flumioxazin - Low	11.2	0.2	0.3	1.3
Glyphosate - High	7.6	5.4	3.5	8.4
Glyphosate - Low	10.1	4.7	11.2	15.8
Imazamox - High	0.0	0.0	0.0	0.0
Imazamox - Low	0.3	0.0	0.1	0.1
Imazapyr - High	0.0	0.0	0.0	0.0
Imazapyr - Low	0.0	0.0	0.0	0.0
Triclopyr - High	6.0	4.1	4.0	6.6
Triclopyr - Low	11.3	6.6	7.9	13.4

Plant attributes

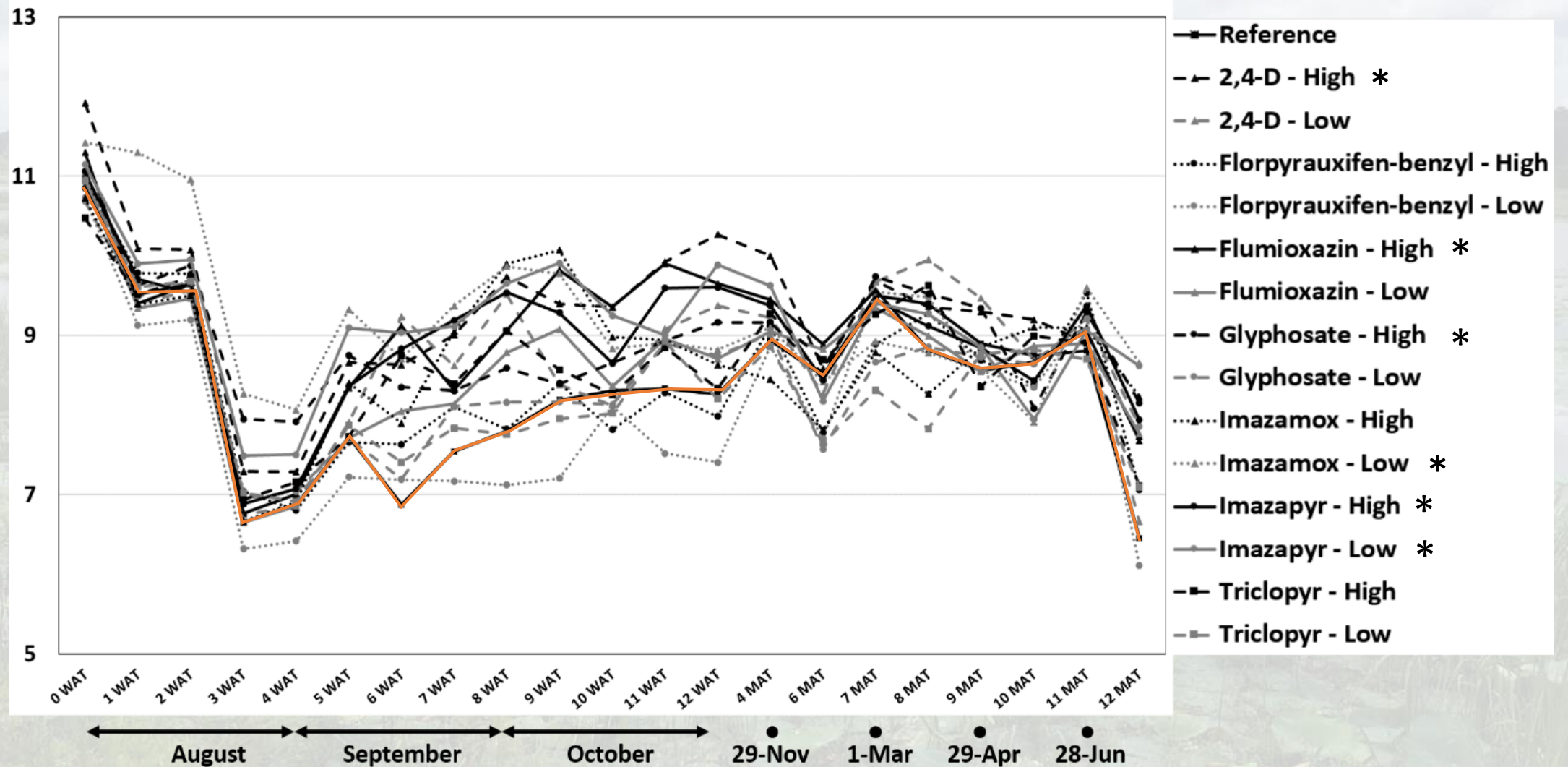


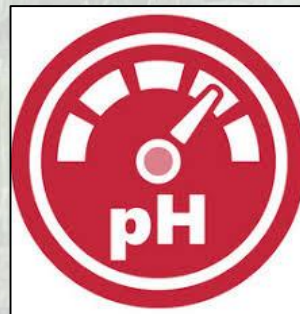
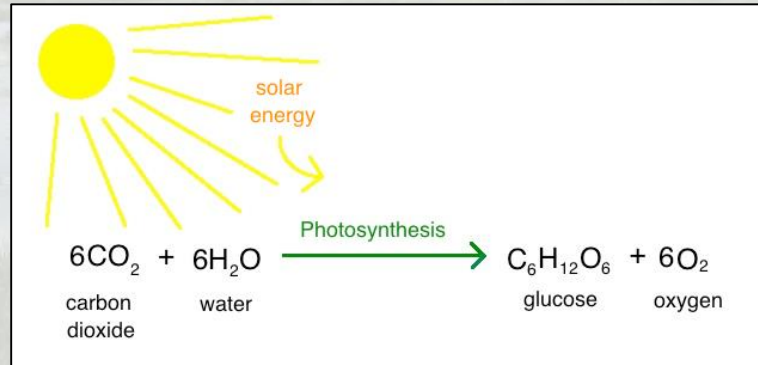
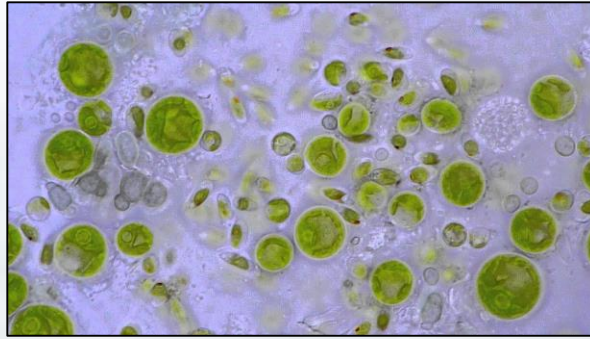
Water quality attributes - DO



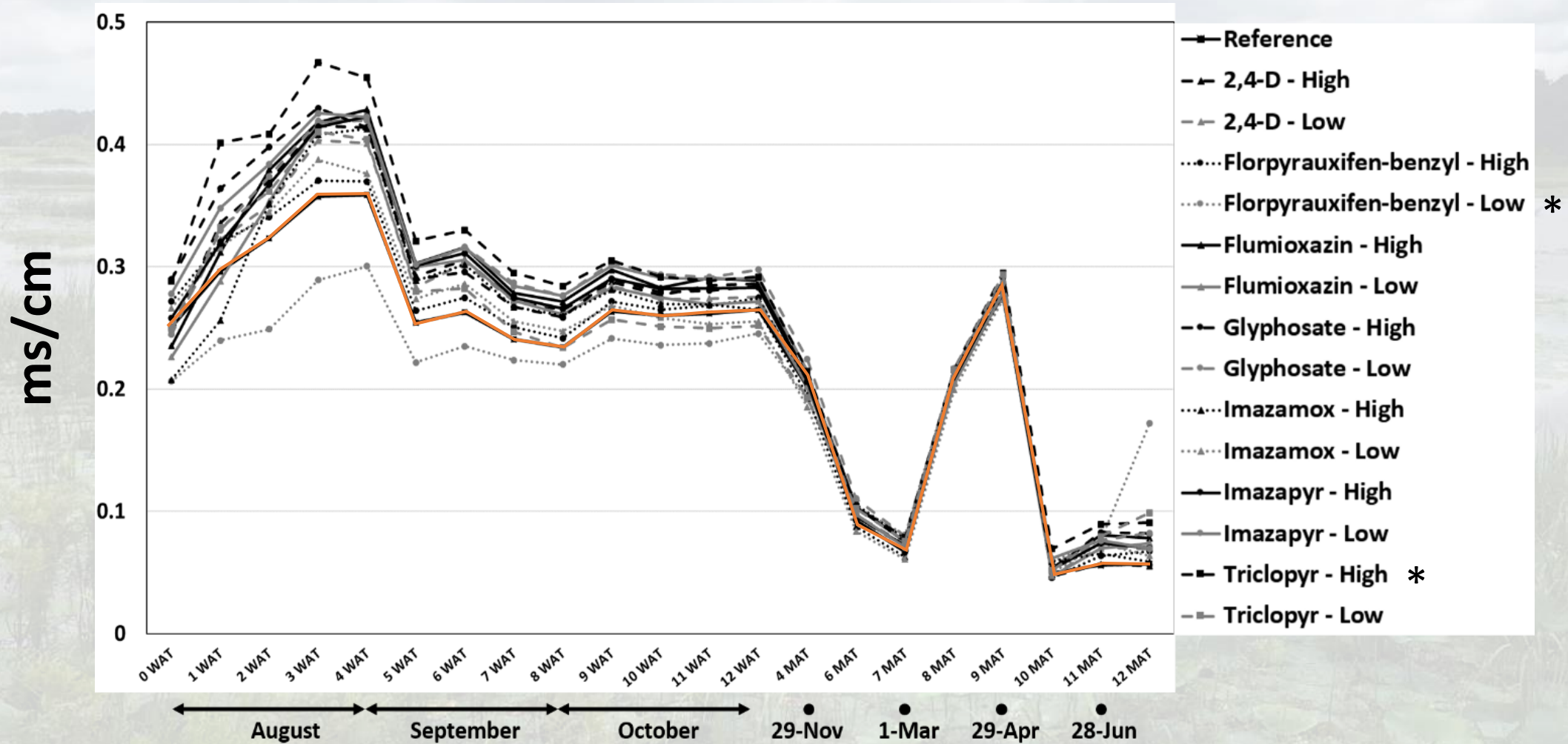


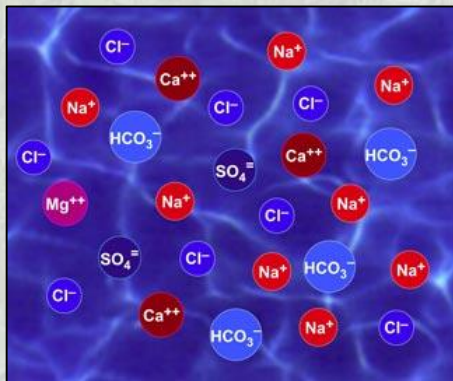
Water quality attributes - pH



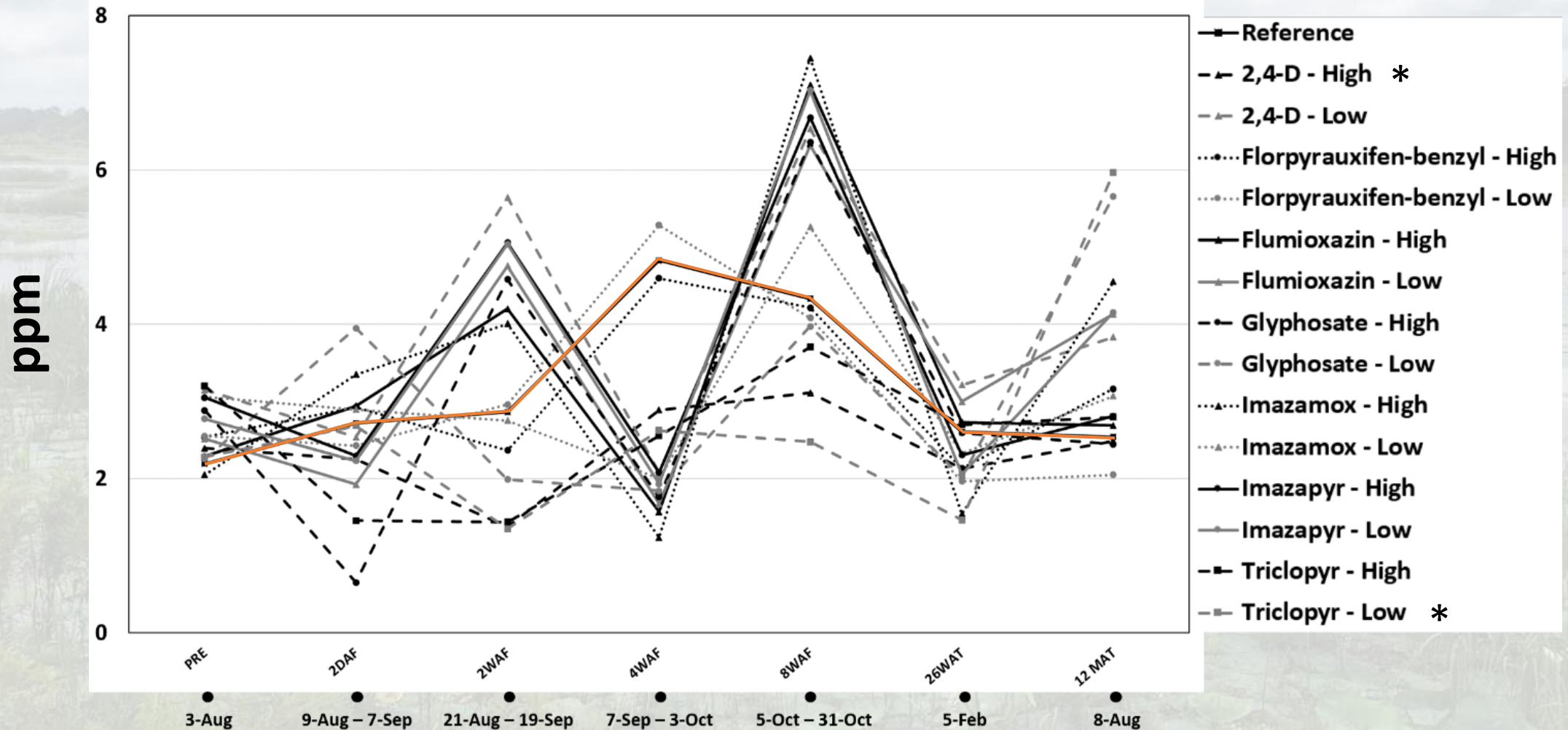


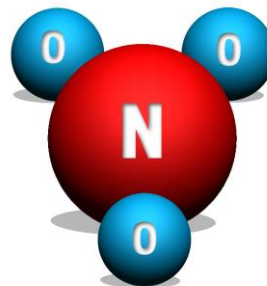
Water quality attributes - Conductivity



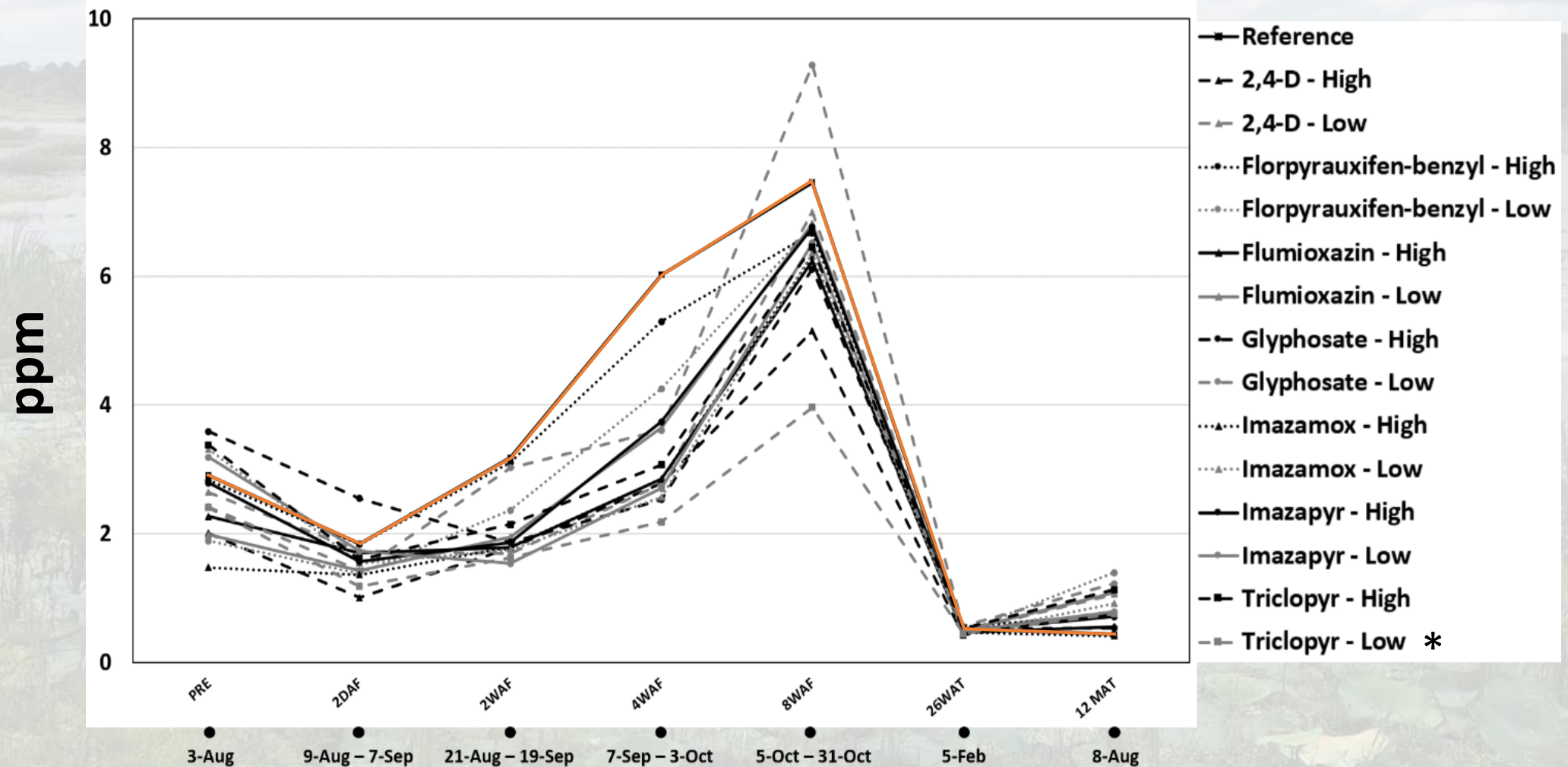


Water quality attributes - NO3-





Water quality attributes – NH₄⁺



Conclusions

- Mass mortality of aquatic plants in control efforts cause impacts in water quality.
- Effect of treatments on *L. sponsgia*:

Treatment	Dose	Initial control	Control in next growing season
Reference	NA	NA	NA
2,4-D	High	Good	Poor
	Low	Good	Poor
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	Low	None	None
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Imazamox	High	Excellent	Excellent
	Low	Excellent	Excellent
Imazapyr	High	Excellent	Excellent
	Low	Excellent	Excellent
Triclopyr	High	Good	Poor
	Low	Poor	Poor



Acknowledgements

- Aquatic Plant Research Facility at Mississippi State University's R.R. Foil Plant Research Center.
- Grants from the Mississippi Water Resources Research Institute.

