

Glyphosate Efficacy in the Control of Woody Invasive Shrubs

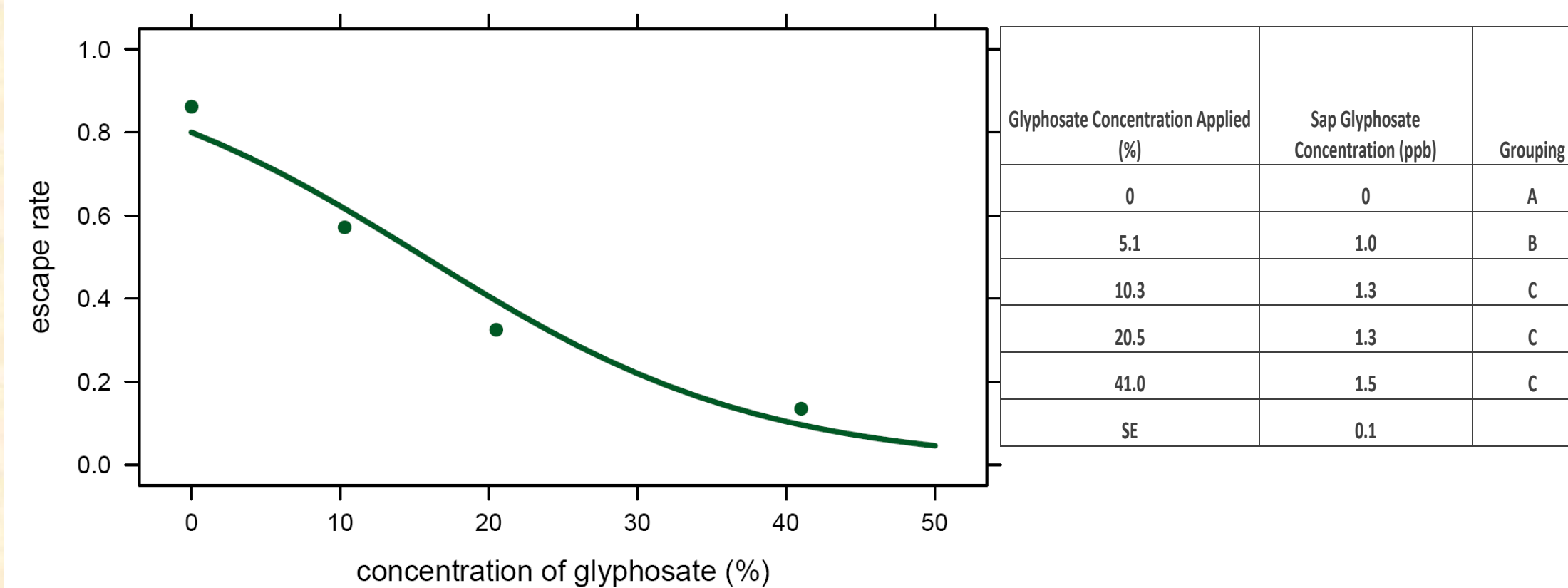
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Synopsis

Stump treatment of mature buckthorn (*Rhamnus cathartica*, *R. frangula*) and autumn olive (*Eleagnus umbellata*) with glyphosate herbicide has successfully controlled these invasive shrubs on some occasions and not others. From 2005-2007, Biology 243 students cut ~300-400 shrubs each October in the Calvin College preserve adjacent to a vernal pond to evaluate the efficacy of glyphosate as a function of concentration, timing delay between cutting and treatment, and soil moisture level. All three factors exhibited significant effects on glyphosate efficacy. While 41% glyphosate produced a >98% kill rate in dry soils with treatment delays less than 20 minutes, concentration was an insignificant factor in wet soils. Glyphosate was undetectable in plant sap expressed with a pressure bomb from root stocks of stumps treated with lower glyphosate concentration or after a delay longer than 30 minutes using an ELISA test. Expressed stump exudates may interfere with the glyphosate absorption, particularly in moist soils.

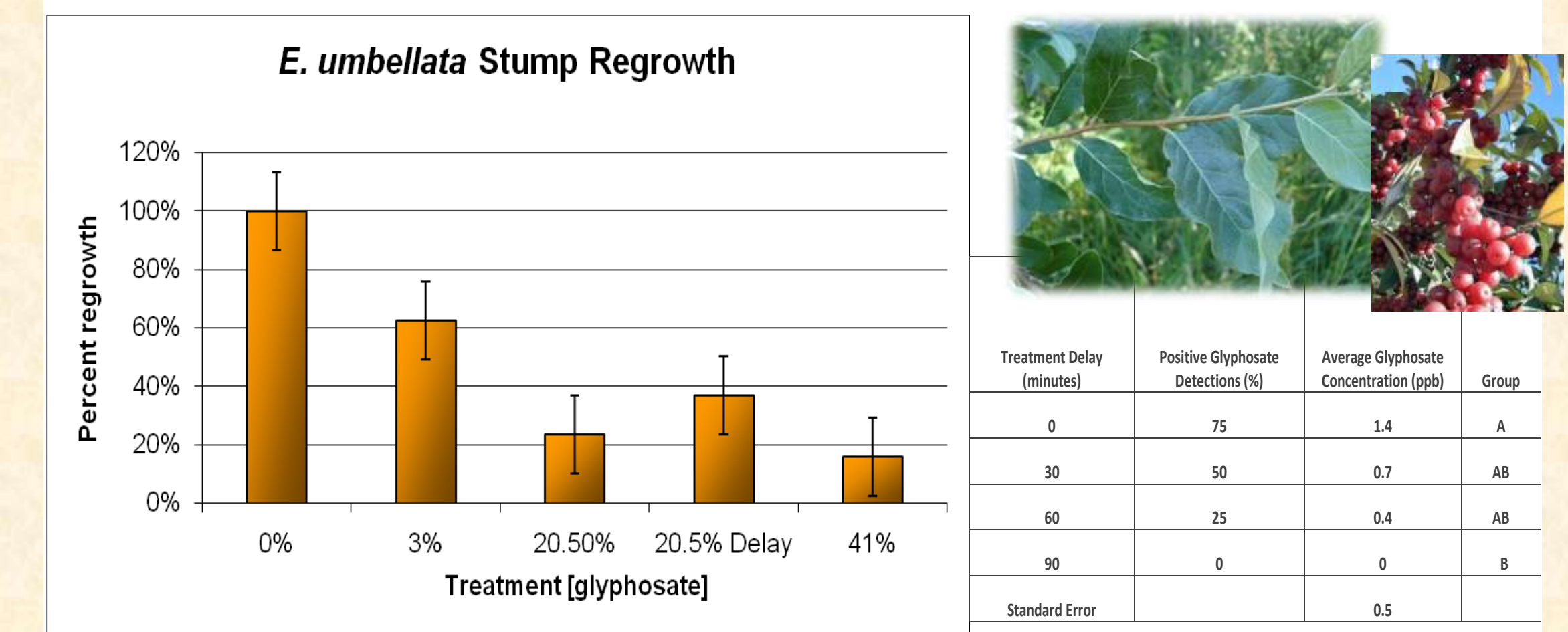
Glyphosate Concentration

- If no glyphosate is applied, >80% of cut stumps produce new growth within one year.
- Higher concentrations of glyphosate reduce re-growth, from 60% at 10% glyphosate to ~20% at 41% glyphosate.
- More glyphosate was detected in the exudate of plants treated with higher concentrations of glyphosate.



Treatment Delay Effect

- With buckthorn and autumn olive, herbicide efficacy was reduced as greater periods of time elapsed between cutting and stump treatment.
- In limited testing, glyphosate was detected more frequently and at higher concentration in the exudate of plants exposed to a shorter delay between cutting and treating.



Problem

Buckthorn and autumn olive are aggressive, non-native invasive shrubs that need to be removed in restoration practice. One way of controlling mature plants 5-30 feet tall is to cut them down and treat the cut stumps with glyphosate, an inexpensive systemic herbicide with low mammalian toxicity and environmental persistence. While providing excellent control in some cases, unacceptably high rates of re-growth have been encountered in others.

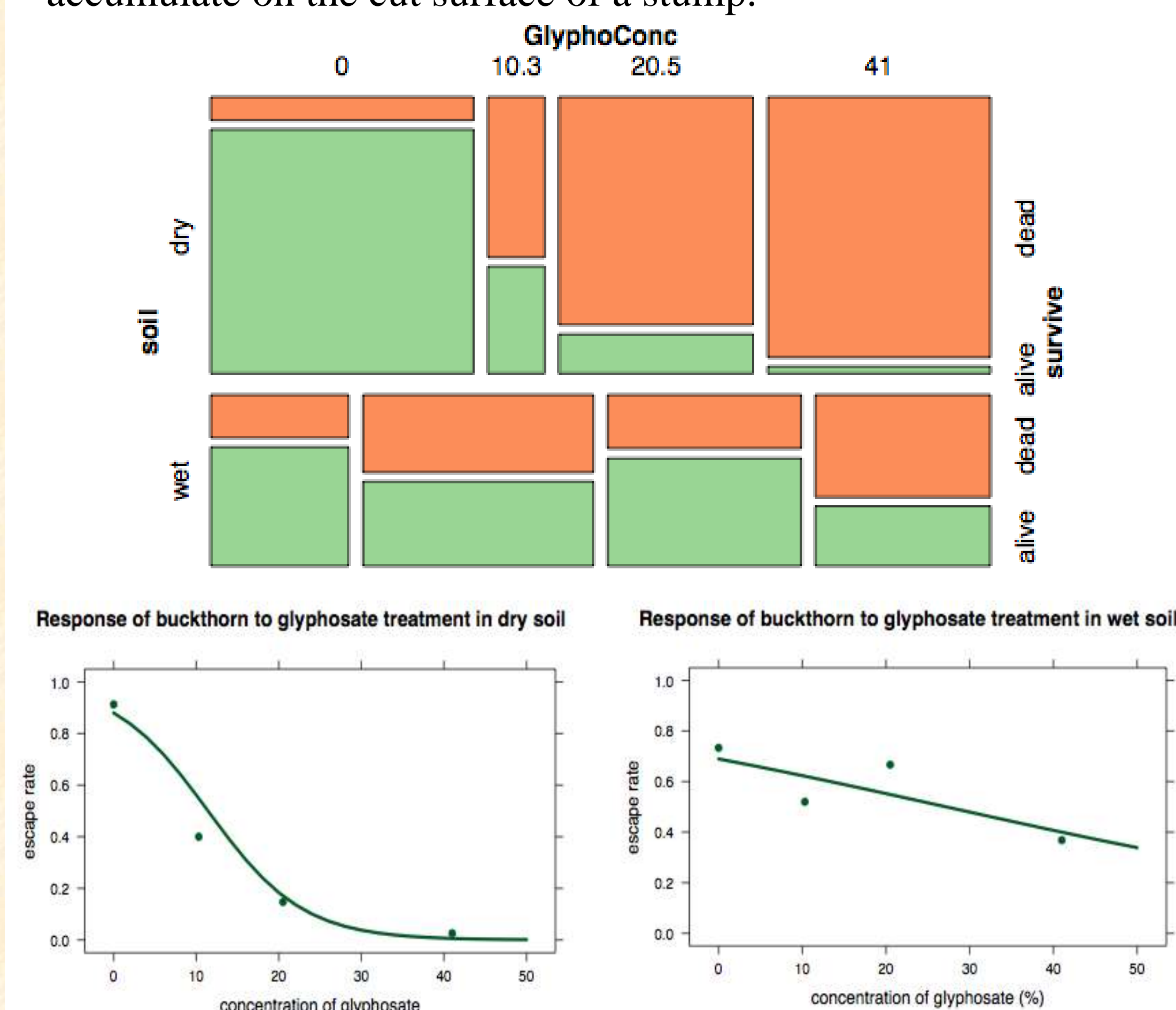
Common Buckthorn Forest Edge

Cut Buckthorn Stumps with:



Soil Moisture & Glyphosate Efficacy

- Glyphosate efficacy was significantly improved in dry soils with variable water content <30% at all concentrations.
- In wet soils, particularly along the margins of wetlands, no significant relationship exists between glyphosate concentration and efficacy.
- After cutting, we observed that root pressure causes a sap to accumulate on the cut surface of a stump.



Conclusions

- An increasingly large proportion of buckthorn and autumn olive plants escape glyphosate treatment:
 - When concentration is reduced below 41%
 - When treatment delay of cut stumps exceeded 20-30 minutes
 - When treatment occurred in wet soils (VWC > 30%)
- ELISA testing with buckthorn seedlings confirmed that glyphosate was detected in lower frequencies and at lower concentration in root exudates following stump treatment with lower glyphosate concentrations or after a delay following cutting.
- The root sap produced on a cut stump surface may interfere with the absorption of glyphosate, a water soluble herbicide that must be absorbed by the stumps vascular tissues to be effective as a systemic herbicide.
- Re-growth frequencies in the field were similar to those of positive detections in plant sap by ELISA testing. Re-growth that did occur was often abnormal, suggesting that a treated stump may have absorbed sub-lethal glyphosate doses.

Acknowledgements

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