

Fertilizers and Their Negative Effects on Amphibians

By: Parker Hurst

What is Fertilizer?

- Fertilizer is a material designed for use or claimed to have value in promoting plant growth or increasing plant-available nutrients in soil.



Source: Savoy

Primary Fertilizer Ingredients

- Nitrogen, Phosphorus, and Potassium are the three main nutrients in fertilizers because they are often the limiting factors of plant growth.
- Nitrogen-N
 - Promotes rapid growth, chlorophyll formation and protein synthesis
- Phosphorus-P
 - Stimulates early root growth. Speeds maturity. Stimulates blooming and aids seed formation.
- Potassium-K
 - Increases resistance to drought and disease. Increases stalk and straw strength. Increases quality of grain and seed.

Source: Savoy

Why are Fertilizers Detrimental to Amphibians

- Fertilizer runoff from misuse or over application can make its way into nearby watersheds and lead to:
 - Reduced survivorship (Hamer et al.)
 - Altered feeding activity (Hamer et al.)
 - Altered mobility (Hamer et al.)
 - Decreased growth and development of amphibian larvae(Hamer et al.)
 - Developmental abnormalities(Baker et al.)
 - Increased susceptibility to disease (Baker et al.)

Study 1: Juvenile amphibians do not avoid potentially lethal levels of urea on soil substrate

- Purpose
 - Examine avoidance behavior, survival, and feeding behavior of select amphibians exposed to urea.
- What is Urea?
 - 46-0-0
 - A compound found in urine that contains mostly Nitrogen. Ideal for use as a forest fertilizer.
 - In this study urea concentrations were equivalent to 50 or 100 kg N/Ha which is significantly lower than some fertilizer levels that reach up to 460 kg N/Ha.

Source: Hatch et al.

Study 1: Results

- Juvenile Western Toads and Cascades Frogs showed no preference in choosing to spend time on the control side vs. the treatment side.
 - Indicates that these two species do not purposefully avoid urea treated soil.
- Western Toad Mortality
 - No death in control treatment
 - 5 of 30 urea exposed toads died
- Cascades Frog Mortality
 - In control treatment 1 frog died and 1 escaped
 - 12 of 20 urea exposed frogs died

Source: Hatch et al.

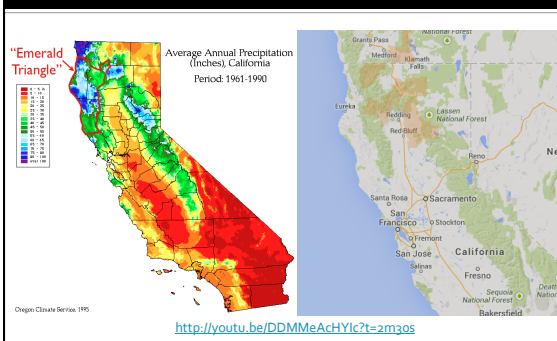
Study 1: Results Continued

- Feeding behavior after being exposed to Urea
 - Western Toads and Cascades Frogs both showed decreased consumption after being exposed to urea.



Source: Hatch et al.

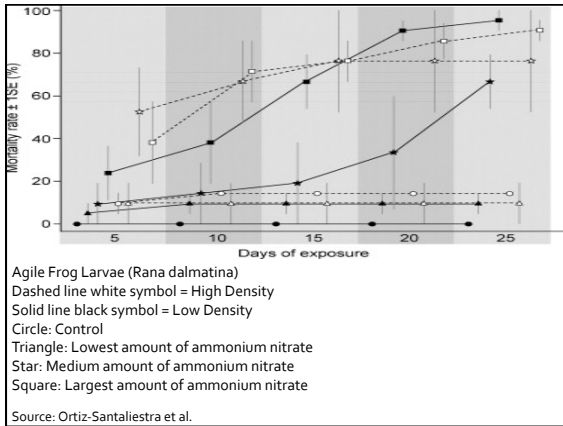
Cascades Frog and "Emerald Triangle" overlap could cause serious fertilizer exposure



Study 2: Density effects on ammonium nitrate toxicity on amphibians. Survival, growth, and cannibalism.

- Purpose
 - Investigate effects of ammonium nitrate (34-0-0) on larval amphibians at different densities.

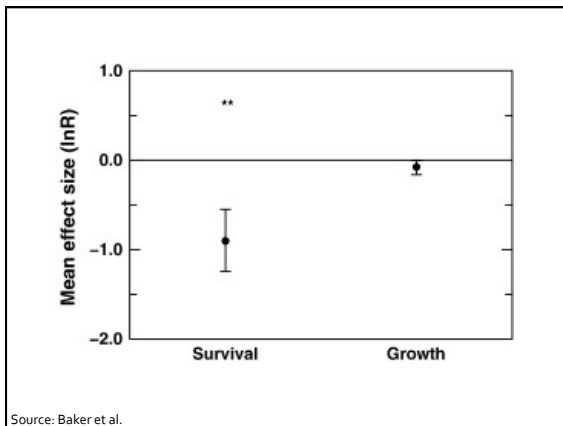
Source: Ortiz-Santaliestra et al.



Study 3: A meta-analysis of the effects of pesticides and fertilizers on survival and growth of amphibians

- Purpose
 - To produce generalized conclusions on the effects of fertilizers and pesticides on amphibians based on 66 survival studies and 45 growth studies.
- Results
 - Using globally important pesticides and fertilizers found significant effects on both survival and growth of amphibians

Source: Baker et al.



Further information on nitrogen and phosphorus in pond management

- According to Wells, fertilizer runoff can create severely eutrophic ponds.
 - Highly eutrophic ponds are also usually the goal in pond management because it creates more phytoplankton for fish to eat.
- This is bad because eutrophic ponds can increase snail populations and likely result in higher parasitic infections in amphibians.

Source: Wells

References

- Baker, N.J., B.A. Bancroft, T.S. Garcia. 2013. A meta-analysis of the effects of pesticides and fertilizers on survival and growth of amphibians. *Science of The Total Environment*. 449:150-156.
- Hamer, A.J., J.A. Makings, S.J. Lane, M.J. Mahony. 2004. Amphibian decline and fertilizers used on agricultural land in south-eastern Australia, Agriculture. *Ecosystems & Environment*. 102:299-305.
- Hatch, A.C., L. K. Belden, E. Scheessele, A. R. Blaustein. 2009. Juvenile amphibians do not avoid potentially lethal levels of urea on soil substrate. *Environmental Toxicology*. 20:2328-2335.

References Continued

- Ortiz-Santaliestra, M.E., M.J. Fernández-Benítez, A. Marco. 2012. Density effects on ammonium nitrate toxicity on amphibians. Survival, growth and cannibalism. *Aquatic Toxicology*. 110-111:170-176
- Savoy, H. 1999. Fertilizers and Their Use. University of Tennessee Graphic Arts, Knoxville.
- Wells, K.D. 2010. The Ecology and Behavior of Amphibians. University of Chicago Press, Chicago.

Questions?