

Evidence for negative effects of glyphosate on life history traits of *Ceriodaphnia reticulata* (Crustacea, Cladocera)



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INTRODUCTION

❖ The use of herbicides, especially glyphosate (N-(phosphonomethyl) glycine), grew up in Argentina, being widely used in soybean transgenic varieties. Freshwater environments usually receive it, with possible negative consequences to the aquatic biota.

❖ Under laboratory conditions has a half-life for degradation, ranging from a few days to approximately 20 days (WHO 1994). It has been found to dissipate from the sediment of a farm pond with a half-life of 120 days, and still be present in pond sediment at a concentration of 0.1 ppm one year later (EPA, 1993).

❖ The presence of glyphosate in surface water is most likely to occur as a result of heavy rainfall after recent application on neighboring land, with subsequent rapid displacement into stream sediment.

❖ The objective of this work was to evaluate possible negative effects of the commercial formulation of glyphosate (GLY) on life history traits of *Ceriodaphnia reticulata* (Crustacea, Cladocera) (Fig.1), a frequent zooplanktonic species of the Parana River system.

❖ The traits under consideration were survival, fecundity and net reproduction rate (Ro).

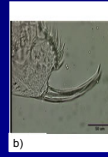


Fig.1: a) *Ceriodaphnia reticulata*
b) detail of the postabdomen.

METHODOLOGY

▪ The specimens were collected in freshwater ponds in the University Ecological Reserve (Santa Fe City). Cladocerans were separated and identified under a binocular microscope.

▪ One neonate (<24 h) was separated to initiate a clonal culture and acclimated to laboratory conditions (22±1°C, 16:8 L-D), 2300 lux. The stock culture was reared in synthetic medium, following *Ceriodaphnia dubia* tests (EPA, 1995).

▪ 10 neonates *C. reticulata* were individually placed in 15 ml of test solution, using 10 replicates per assay. Culture media was renewed three times a week, fed with a *Chlorella* sp. culture (5.105 cel/ml). The essays were made using three concentrations of glyphosate: T1=5.33 mg/l; T2=15.99 mg/l and T3=31.98 mg/l and a control (T0=0 mg/l). Water parameters tested were: pH, conductivity and dissolved oxygen.

▪ Disappearance of glyphosate in test medium without renewal and the possible presence of its principal metabolite (AMPA) was also analyzed. Measurements were performed three times a week by HPLC with post-column derivatation (EPA, 1990, Fabre and Bordey 1992).

Statistical Analysis

- Survival, Fecundity (number of neonates and age of the first reproduction) were analyzed by ANOVA and Tukey post test ($\alpha=0.05$). Net reproductive rate was obtained by $R_o = \sum (l_x \cdot m_x)$ where m_x = fecundity specific of age x and l_x = survival at age x .

RESULTS

Physico-chemical variables didn't vary during the study period (pH = 7.62 ± 0.74; conductivity = 0.49 ± 0.1 μs/cm; dissolved oxygen = 6.63 ± 0.23 mg O₂/l).

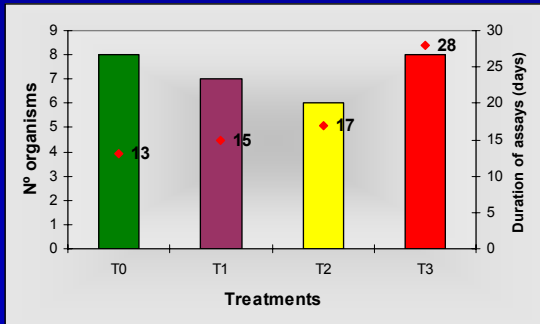


Fig. 3: Survival (N° organisms) in T0 (control) and T1=5.33 mg/l; T2=15.99 mg/l and T3=31.98 mg/l GLY.

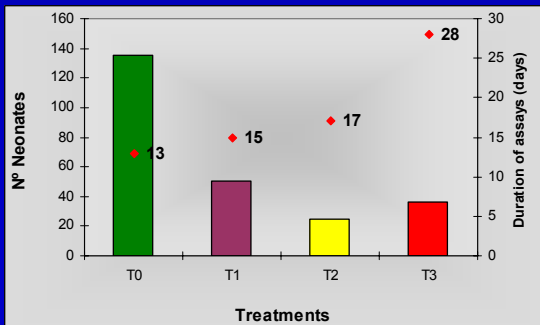


Fig. 4: Fecundity (N° neonates) in T0 (control), T1=5.33 mg/l; T2=15.99 mg/l and T3=31.98 mg/l GLY and duration of each assay.

✓ GLY degradation was recorded only in T2 (74.53%) and T3 (34.8%) (Fig. 5).

✓ The metabolite AMPA was not recorded.

✓ The analysis of variance of the survival was not significant (ANOVA $p=0.690$) (Fig. 3).

✓ The fecundity showed highly significant differences between the control and all the treatments (ANOVA, $p<0.001$) (Fig. 4).

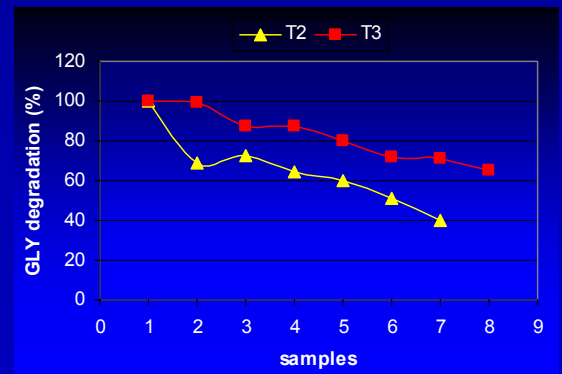


Fig. 5: GLY Degradation in culture medium of T2 and T3 samples. (DL = 0.2 μg/l)

CONCLUSIONS

Glyphosate showed highly negative effects on *C. reticulata* fecundity but not on survival.

▪ GLY delayed the first reproduction time and diminished the number of neonates with the increase in GLY concentration.

▪ The R_o values: 13.5 for T0; 5 for T1; 2.5 for T2 and 3.6 for T3: confirm the glyphosate toxicity to *C. reticulata* with the concentration increase.

▪ The observed effects can have negative consequences at the population and community levels in freshwater environments.

Bibliography

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