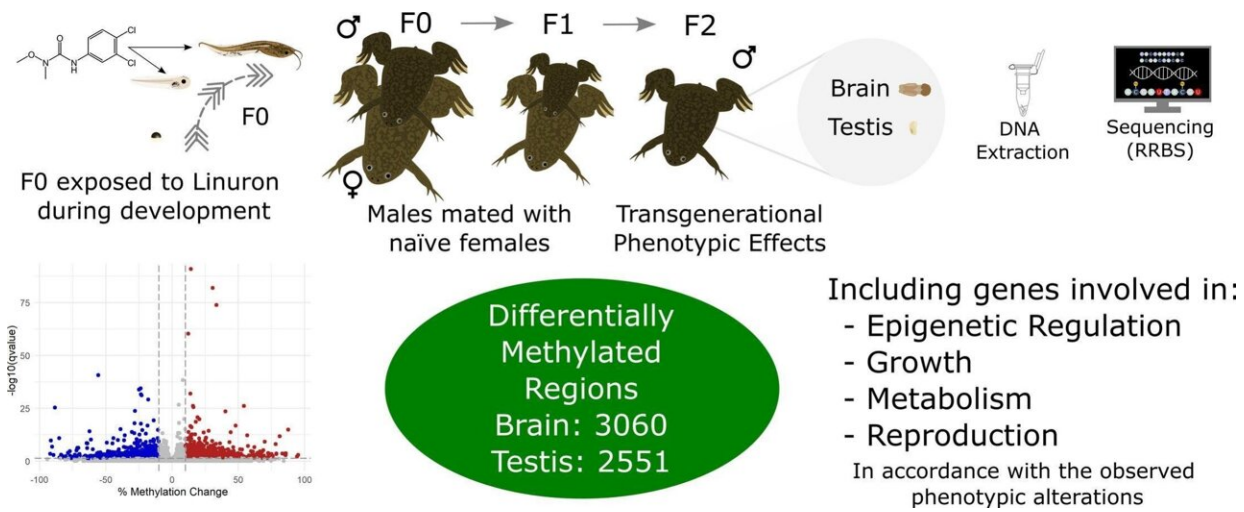
New study reveals transgenerational effects of pesticide linuron on frogs

March 11 2024



Graphical abstract. Credit: *Science of The Total Environment* (2024). DOI: 10.1016/j.scitotenv.2024.170949

Grand-offspring of male frogs exposed to the pesticide linuron exhibited changes in their DNA that were linked to significant physiological impacts, a study from Stockholm University reveals. The research highlights the profound transgenerational consequences of environmental pollution on amphibian populations, which are already

under threat of extinction. The study is published in the journal *Science of the Total Environment*.

Amphibians, particularly frogs, play a crucial role in our ecosystem. However, nearly half of all amphibian species are facing the risk of extinction, with synthetic chemicals in the environment being a significant contributing factor. Among these chemicals, endocrine-disrupting pesticides like linuron pose serious threats to amphibian growth, metabolism, and reproductive systems.

This study sheds light on the extensive and heritable changes induced by such pesticides, revealing that the effects of linuron exposure can span generations, through epigenetic inheritance.

Associate Professor Oskar Karlsson from the Department of Environmental Science at Stockholm University, who is also a researcher at the Science for Life Laboratory, stated, "This is the first study to demonstrate that pesticides can cause transgenerational epigenetic effects in frogs. Our findings underline the complex interactions between environmental chemicals and species extinction, particularly frogs."

Linuron exposure triggers DNA changes across generations

The study's results are alarming, with the linuron-exposed frogs' male offspring exhibiting altered spermatogenesis, increased body weight, and modifications in fat and carbohydrate metabolism. By employing advanced sequencing techniques, the researchers identified significant differences in DNA methylation across thousands of regions in both the

brain and testis of the affected frogs.

These epigenetic changes impact crucial genes involved in hormone signaling and germ cell development, as well as regulation of the epigenetic landscape, suggesting that environmental exposure can have lasting and hereditary effects on gene regulation.

Associate Professor Cecilia Berg, an ecotoxicologist involved in the study, and at the time of the study working at the Department of Organismal Biology, Uppsala University, added, "The findings confirm our hypothesis that linuron exposure can lead to transgenerational changes in the epigenome, particularly affecting genes related to hormonal systems and germ cell development."

How linuron's effects move from parents to offspring

The transgenerational effects of pesticides like linuron are likely transmitted during fertilization via sperm, carrying not only genetic material but also epigenetic information reflecting the environmental exposures of previous generations.

"A likely explanation is that the pesticide disrupts testosterone and thyroid hormone functions in the body, and that these effects are passed on to subsequent generations through sperm and epigenetic processes. This results in hereditary changes in the offspring's gene regulation," Karlsson explained.

According to Karlsson, the research not only provides new insights into the mechanisms of pesticide toxicity but also emphasizes the urgent need for incorporating transgenerational studies into chemical risk assessments to better protect future biodiversity.

More information: Mauricio Roza et al, Male-transmitted transgenerational effects of the herbicide linuron on DNA methylation profiles in Xenopus tropicalis brain and testis, *Science of The Total Environment* (2024). DOI: 10.1016/j.scitotenv.2024.170949

Provided by Stockholm University