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Loss of Chromosome Y in Male Farmers Genotoxic Implications for Cancer

by **Beyond Pesticides**
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(*Beyond Pesticides,* January 3, 2024) A study published in *Environmental Health Perspectives* finds elevated, chronic exposure to glyphosate throughout one's lifetime increases the risk of mosaic loss of chromosome Y (loss of chromosome Y occurs to many men in some cells due to aging [mLOY]) that impacts a noticeable fraction of cells. Although the loss of this sex chromosome does not cause cell death, like the loss of autosomal chromosomes, the risk of mLOY is a biomarker for genotoxicity (the damage of genetic information within a cell causing mutations from chemical exposure, which may lead to cancer) and expansion of cellular response to glyphosate, resulting in the precursor for hematological (blood) cancers. This study is one of the first to identify sex-specific chromosome degradation, with stark evidence demonstrating links to various cancers, including non-Hodgkin lymphoma. The International Agency for Research on Cancer (IARC) has classified the glyphosate as a probable carcinogen or cancer-causing chemical. However, the U.S. Environmental Protection Agency's (EPA) allowance of widespread use of

glyphosate allows for adverse impacts, especially among vulnerable individuals, like pregnant women, infants, children, and the elderly. Glyphosate exposure levels and resulting residues in urine has been documented with recent data showing that four out of five (81.6%) U.S. residents have detectable levels of glyphosate in their bodies. Despite these concerning data, evidence of widespread exposure to a carcinogen has so far failed to influence regulators at EPA, which puts increasing responsibility on local elected officials and consumers, according to advocates, to stop glyphosate use in their community's land management.

The study notes, "Although future studies are needed to confirm the observed associations, our findings for glyphosate add to the limited literature on occupational and environmental exposures as contributors to mLOY, the most common acquired chromosomal alteration in men, and provide novel mechanistic evidence supporting the potential carcinogenicity of this widely used herbicide."

The study analyzes blood-derived DNA from 1,606 farmers to detect mLOY using genotype assessments of the sex chromosomes in the cells. Researchers gathered self-reported pesticide exposure from the farmers and estimated the association between mLOY and glyphosate use, employing a multivariable logistic regression. The results find that mLOY is detectable in 21.4 percent of farmers, with mLOY expanding throughout most cells in 9.8 percent of farmers. Most farmers with mLOY expanding throughout most cells are older in age, with a greater lifetime exposure and intensity of exposure to glyphosate. However, these individuals are non-smokers and non-obese, which are other risk factors for mLOY.

Glyphosate is the most commonly used active ingredient worldwide, appearing in many herbicide formulas, including Bayer's (formerly Monsanto) Roundup®. The use of this chemical has been increasing since the inception of crops genetically modified to tolerate glyphosate over two decades ago.

Glyphosate is often promoted by industry as a "low toxicity" chemical and "safer" than other chemicals, yet it has been shown to have detrimental impacts on humans and the environment. The toxic herbicide readily contaminates the ecosystem, with residues pervasive in food and water commodities. In addition to this study, decades of accumulated scientific literature commonly associates glyphosate with human, biotic, and ecosystem harm. Additionally, glyphosate's ubiquity threatens 93 percent of all U.S. endangered species, resulting in biodiversity loss and ecosystem disruption (e.g., soil erosion, loss of services, and trophic cascades). Moreover, chemical use has been increasing since the inception of crops genetically modified to tolerate glyphosate. Not only do health officials warn that continuous use of glyphosate will perpetuate adverse health and ecological effects, but that use also highlights recent concerns over antibiotic resistance. Thus, glyphosate has been extensively controversial about its safety for humans, nonhuman organisms, and ecosystems. For instance, the presence of glyphosate in human bodies has risen dramatically during the past three decades. Research at the University of California San Diego found that, between two data collection periods (1993–1996 and 2014–2016), the percentage of people testing positive for the presence of glyphosate (or its metabolites) in urine rose by an average of 500 percent, peaking at 1,208 percent.

Although the EPA classifies glyphosate herbicides as "not likely to be carcinogenic to humans, glyphosate exposure has implications for the development of various health anomalies, including the distortion of DNA function, leading to several chronic diseases like cancer, Parkinson's disease, metabolic disorders, gut dysbiosis, nervous system disorders, and neurodevelopment disorders like autism. In recent years, numerous lawsuits have targeted Monsanto (now Bayer), which contains glyphosate, alleging that the herbicide contributes to the plaintiffs' cancers. Beyond Pesticides has

reported on EPA's ongoing failures to protect people and the environment from glyphosate-based herbicide (GBH) compounds. Therefore, advocates say it is crucial to comprehend the full spectrum of glyphosate's effects on human health from its potential carcinogenicity.

This study is one of the first to investigate mLOY as a biomarker for genomic instability (loss of sex chromosome), providing new insight into the biological mechanism involved in carcinogenicity beyond general genotoxicity (i.e., DNA damage) and oxidative stress. However, considering the co-occurring effects of glyphosate exposure, including the chemical's breakdown product AMPA, is essential. Since glyphosate and its formulations have long been associated with oxidative stress and strong evidence of genotoxicity, multiple biological mechanisms can work synergically (together) to increase the risk, time of onset, or disease severity.

It is essential to understand the effects of widely used pesticides and their breakdown products on the health of current and future generations. Beyond Pesticides challenges the EPA registration of chemicals like glyphosate in court due to their impacts on soil, air, water, and health. However, emphasis on converting to regenerative-organic systems and using least-toxic pest control can mitigate harmful exposure concerns. Public policy must advance this shift rather than allow unnecessary reliance on pesticides. Considering glyphosate levels in the human body can decrease by 70% through a one-week switch to an organic diet, purchasing organic food whenever possible—which never allows glyphosate use—can help curb exposure and adverse health effects. Learn more about pesticides' impacts on human health by visiting Beyond Pesticides' Pesticide-Induced Diseases Database. This database supports the clear need for strategic action to shift away from pesticide dependency. Moreover, Beyond Pesticides provides tools, information, and

support to take local action: check out our factsheet on glyphosate/Roundup and our report, Monsanto's Roundup (Glyphosate) Exposed. Contact us for help with local efforts and stay informed of developments through our Daily News Blog and our journal, *Pesticides and You*. Additionally, check out Carey Gillam's talk on Monsanto's corruption on glyphosate/Roundup at Beyond Pesticides' 36th National Pesticide Forum.

All unattributed positions and opinions in this piece are those of Beyond Pesticides.

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