

## **AKUMULASI TIMBAL (Pb) DARI RESIDU PUPUK DAN PESTISIDA ANORGANIK PADA TANAMAN CABAI (*Capsicum frutescens* L.) DI HILIR SUNGAI OPAK, YOGYAKARTA**

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### **INTISARI**

Sungai Opak merupakan sungai yang melintasi Kabupaten Sleman dan Bantul, bermuara di Samudra Hindia dengan topografi dikelilingi oleh persawahan, perkebunan, dan perumahan dengan praktik budidaya anorganik, seperti cabai. Cabai rawit (*C. frutescens*) merupakan komoditas unggulan Indonesia yang umum di negara tropis, namun masih banyak dibudidayakan menggunakan pupuk dan pestisida kimia sehingga praktek budidaya tersebut meninggalkan residu logam berat seperti timbal (Pb). Penelitian ini bertujuan menganalisis respons fisiologis cabai rawit (*C. frutescens*) terhadap residu pupuk dan pestisida anorganik yang mengandung timbal, mengevaluasi akumulasi residu di lahan dan organ tanaman di lima titik sampling DAS hilir Sungai Opak, dan menganalisis respons anatomis organ tanamannya. Sampling dilakukan di lima titik persawahan Desa Madurejo, Prambanan, DIY dengan parameter meliputi kondisi lingkungan, pertumbuhan dan produktivitas tanaman, kadar klorofil dengan metode *Soil Plant Analysis Development*, aktivitas SOD dengan metode spektrofotometri, kandungan Pb dengan metode *Atomic Absorption Spectroscopy*, dan analisis anatomis organ akar, batang, dan daun. Data dianalisis menggunakan *Analysis of Variance* (ANOVA) pada SPSS versi 29 dan diverifikasi serta divisualisasi dengan pemrograman *Python*. Hasil menunjukkan residu penggunaan pupuk dan pestisida anorganik mampu menurunkan tinggi tanaman, jumlah daun, dan berat kering total, serta meningkatkan berat segar total dibandingkan dengan tanaman organik, variasi kadar klorofil daun, dan variasi aktivitas SOD yang selaras dengan kadar timbal pada tanah. Selain itu, akumulasi logam berat Pb di tanah sebesar 4,8–5,9 mg/kg dengan akumulasi di organ tanaman mencapai lebih dari 0,5 mg/kg, sehingga memicu *stress* cekaman logam berat. Tanaman mengalami perubahan struktur anatomi yang mengindikasikan mekanisme adaptasi terhadap paparan logam berat timbal.

Kata kunci: *C. frutescens*, Pestisida, Respons fisiologis, Sungai Opak, Timbal

# **ACCUMULATION OF LEAD (Pb) FROM RESIDUES OF INORGANIC FERTILIZERS AND PESTICIDES ON CHILI PLANTS (*Capsicum frutescens* L.) IN THE DOWNSTREAM OF THE OPAK RIVER, YOGYAKARTA**

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## **ABSTRACT**

The Opak River flows through Sleman and Bantul Regencies, emptying into the Indian Ocean, and is surrounded by rice fields, plantations, and residential areas practicing inorganic farming, including chili cultivation. Chili plant (*C. frutescens*) are a key agricultural commodity in Indonesia and other tropical countries. However, their cultivation largely relies on chemical fertilizers and pesticides, leaving heavy metal residues such as lead (Pb). This study aims to analyze the physiological responses of chili plant (*C. frutescens*) to inorganic fertilizer and pesticide residues containing Pb, evaluate residue accumulation in soil and plant organs at five sampling points along the downstream watershed of the Opak River, and analyze the anatomical response of its plant organs. Sampling was conducted at five chili plant farms in Madurejo, Prambanan, DIY with parameters including environmental conditions, plant growth and productivity, chlorophyll content (Soil Plant Analysis Development method), SOD activity (spectrophotometry), Pb content (Atomic Absorption Spectroscopy), and anatomical analysis of roots, stems, and leaves. The data were subjected to rigorous analysis via Analysis of Variance (ANOVA) utilizing SPSS version 29, with subsequent verification and visualization conducted through Python programming. The findings indicate that the application of inorganic fertilizers and pesticides adversely affects plant height, number of leaves, and total dry biomass, while simultaneously augmenting total fresh biomass in comparison to plants cultivated organically. Additionally, variations in leaf chlorophyll content and SOD activity align with lead levels in the soil. The accumulation of Pb in the soil ranges from 4.8 to 5.9 mg/kg, with plant organ accumulation exceeding 0.5 mg/kg, triggering heavy metal stress. Anatomical structural changes in the plants indicate adaptive mechanisms in response to lead exposure.

Keywords: *C. frutescens*, Lead, Opak River, Pesticides, Physiological response