

# Enhancing fertility in acid Luvisol & sunflower (*Helianthus annuus* L.) yield with fly bioash application

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## Abstract:

Fly bioash is a solid, complex by-product from biomass-fuelled plant facilities with specific physico-chemical and mineralogical properties. As it is very alkaline (pH>12) and contains a high concentration of nutrients, fly bioash emerges as a promising transformative solution for revitalizing acid nutrient-deficient agricultural soils ultimately increasing crop production yields. This study investigated the impact of fly bioash application at increasing rates (0-17.2 t/ha) on chemical pedovariables and sunflower (*Helianthus annuus* L.) yield, during one vegetation season in an acidic Luvisol (pH=4.3) under open-field conditions (Ivan Dvor, Slavonia, Croatia). The results demonstrate a significant positive increase in soil pH (up to 7.6) and macronutrients (P up to 1.6-fold, K up to 4.8-fold, Ca up to 4.2-fold) with fly bioash addition. Moreover, fly bioash substantially enhanced sunflower grain yield (by 60%) and vegetative growth parameters, including root biomass (by 89%) and shoot biomass (by 142%), compared to unamended control soil. These findings underscore the potential of fly bioash to ameliorate soil acidity, replenish phytonutrients, and boost both crop grain yield and vegetative growth parameters. For sustainable fly bioash application, extensive long-term field experiments are crucial, evaluating additional soil variables, including physical properties and microbiome, to comprehensively address potential negative environmental impacts and ensure responsible agricultural practices.

**Keywords:** fly bioash, acid luvisol, sunflower, crop yield, nutrients, field experiment