Pesticide Use and Pesticide Residues in Drinking Water, Soil and Cocoa Beans in The Dormaa West District Of Ghana

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ABSTRACT

Pesticide residue levels in drinking water, soils and cocoa beans were assessed in four cocoa growing communities in the Dormaa West District of Ghana to assess the levels of pesticides contamination. In all 127 samples were collected between December 2014 and February 2015 from sixteen (16) selected cocoa farms and six (6) selected control sites. The samples were extracted and analyzed for organochlorine and synthetic pyrethroids, and organophosphate pesticide residues using the Gas chromatography equipped with electron capture detector (ECD) and pulse flame photometric detector (PFPD), respectively. Some water and soil physico-chemical properties were also determined to evaluate the quality of drinking water and soils using standard procedures. Two hundred and forty (240) cocoa farmers were randomly selected and interviewed using a structured questionnaire. Information on the types, sources, methods of pesticides application, operational habits and common health related issues with pesticides usage were sought. The results obtained showed that samples analyzed from the various sites contained measurable levels of the studied pesticides. The organochlorine pesticide residues found in all the samples were aldrin, dieldrin, lindane, p,p -DDT, endosulfan-sulfate, alpha-endosulfan, beta-hexachlorocyclohexane, methoxychlor, and heptachlor, with heptachlor (from non- detectable (ND)-0.04 µg/L), dieldrin (ND-0.02 mg/kg) and lindane (0.03-0.05 mg/kg) occurring most frequently in water, soil and cocoa beans, respectively. The organochlorine residue concentrations ranged from ND-0.05 ug/L, ND-0.05 mg/kg and ND-0.06 mg/kg for water, soil and cocoa beans, respectively. In addition, the organophosphate pesticide residues recorded in the samples analyzed were diazinon, chlorpyrifos, pirimiphos-rnethyl and profenofos, with chlorpyrifos occurring most frequently in water, soil and cocoa beans at respective concentration range of ND- 0.06 µg/L, ND-0.04 mg/kg and ND-0.42 mg/kg. The synthetic pyrethroids pesticide residues recorded were fenvalerate, deltamethrin, cypermethrin, bifenthrin, permethrin, lambda-cyhalothrin, allethrin and cyfluthrin, with allethrin (ND-0.05 µg/L), lambda-

cyhalothrin (ND-0.03 mg/kg) and cypermethrin (0.02-0.05 mg/kg) occurring most frequently in water, soil and cocoa bean samples, respectively. The synthetic pyrethroids residues concentrations ranged from ND-0.07 µg/L, ND-0.06 mg/kg and ND-0.06 mg/kg for water, soil and cocoa beans samples respectively. The occurrence of the pesticides indicates a recent or previous use in the study area. The results of the physico-chemical properties of water sampled were in ranges; temperature (25.9-27.9 ^{0}C), pH (5.18-5.82), EC (98.0-198.0 µS/cm), TDS (46.3-65.5 mg/L), TSS (4.00-70.0 mg/L), Turbidity (2.29-63.6 NTU), NO_3 (2.20-5.90 mg/L), NH3 (0.18-1.25 mg/L), PO_4^{3-}(0.67-0.77 mg/L), Na^+ (11.8-18.6 mg/L) and K^+ (2.29- 4.45 mg/L). The physico-chemical properties of soil were in ranges; pH (7.35-8.49), EC (203-251 µS/cm), % OC (1.38-6.25), % OM (2.38-10.8), % N (1.64-2.13), phosphorous (0.63-2.47 mg/kg), potassium (0.35-0.85 ppm), NH_4^+ (34.8-45.0 mg/L), NO_3 (25.7-40.6 mg/L), % sand (50.8-67.8), % clay (11.7-25.0), and % silt (9.96-24.3). Commonly applied pesticides by cocoa farmers in the study area included; diazinon, chlorprifosethyi,acetamiprid,endosulfan,dichlorodiphenyltrichloroethane (DDT), imidacioprid, fenvalerate, permethrin, aldrin, cupric-hyroxide, cuprous-hydroxide, cuprous-oxide, bifenthrin, promecarb, thiamethoxam, metalaxyl cuprous oxide, chlopyrifos, cypermethrin, lambda-cyhalothrin, deltamethrin and cuprous oxide + metaiaxyl. Sources of pesticides used by farmers were agrochemical retailers, fellow farmers and the government of Ghana cocoa mass spraying agents. Majority of cocoa farmers' sprayed their farms using the blanket spraying method with few using the spot spraying method. Farmers' exhibited habits such as eating, drinking, smoking, chewing, talking, not wearing protective cloths, using their mouth to remove blockages from sprayer nozzles, stirring pesticides with their bare hands, among others, during pesticides spraying. Most of the farmers experienced symptoms such as watery eyes, headaches, dizziness, skin irritation, cough, chest pain, body weakness, itching eyes, among others, during and after spraying. The results showed high risk exposure of cocoa farmers to toxicity and health hazards of pesticides usage. The physico-chemical parameters recorded in the drinking water sources were within the World Health Organization (WHO) permissible limits for potable water except turbidity, nitrate, ammonia and pH at some sampled sites. Comparing the mean values of pesticide residues found in drinking water, soils and cocoa beans analyzed with the maximum residue limit (MRLs) adopted by the WHO, US EPA and EU, respectively, shows that water, soils and cocoa beans samples from some sampled sites were

contaminated and thus could be harmful if the trend is not checked. In view of the damaging effects of pesticide on human health and the environment, regular monitoring and analysis of pesticide residues in the study area is recommended. It is also recommended that farmers should be educated on the appropriate use of pesticides to avoid health hazards.

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