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Soil Arsenic Pollution: A Threat to Crops

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Arsenic (As) is a naturally occurring toxic metalloid and it is widely occurring at a mean content of 5 mg kg^{-1} in the earth's crust [1]. It occurs mainly in its inorganic forms (arsenate AsV and arsenite AsIII) which are more toxic than its organic forms. The reductive dissolution of soil mineral hydroxides by microbes and organic matter is regarded as the main mechanism releasing arsenic into the aquifer [2]. The use of arsenic contaminated groundwater for irrigation of agricultural fields facilitates the entry of arsenic in the food chain through consumption of contaminated food products affecting a large number of people mainly in the South Asia and other parts of the world [3]. The long term use of arsenic contaminated groundwater for irrigation of agricultural soils may lead to excessive accumulation of arsenic in the soil which, in turn, may exert land degradation in terms of loss of yield i.e. decline in crop production and disease like 'straighthead disease' with empty panicle in rice [4]. It is highly warranted to initiate monitoring and assessment programmes for arsenic contamination into irrigation groundwater sources, agricultural fields being irrigated using those sources and the crops grown in those fields. These programmes will explore the threat of arsenic contamination in the newer areas still unexplored for the purpose. Because, data of spiked soil and hydroponics experiments cannot be extrapolated as truly representative of the field condition of arsenic contamination of soil and crops [5]. An understanding of soil arsenic content and other soil properties (physico-chemical and biochemical) in relation to its uptake and toxicity to crops is therefore urgently needed under field conditions. A good correlation between arsenic uptake in plants/crops and total arsenic content in soils is not always found. It is revealed that soil total arsenic content is not likely a good predictor of arsenic uptake and toxicity under different soil types and micro-climatic conditions. It is the bioavailable fraction of total arsenic in specific soil condition, which is potentially causing a threat to the crops/plants. The arsenic-induced phytotoxicity is likely to be observed at 20 mg As kg^{-1} soil [6]. In case of paddy crop cultivation with reference to soil arsenic pollution, representative data of arsenic toxicity are required under non-flooded and flooded soil conditions to ascertain role of arsenic in limiting paddy growth and yield under field conditions. It is necessary to sufficiently understand and quantify the factors determining soil arsenic accumulation, its bioavailability and toxicity to crops in the fields. Identification of geographic areas either presently contaminated with arsenic or susceptible to its contamination, is an important step for risk assessment and developing remediation strategies. The mapping of arsenic content which is being transported from soil or irrigation water to edible plant parts, is important for protecting against human arsenic exposure through arsenic contamination of the food chain. Assessment of soil arsenic bioavailability may greatly support the scope of remediation required at contaminated sites. It is concluded that future R&D is to be focused on speciation, transformation and bioavailability of arsenic in soil and associated soil properties to reveal tangible latent hazards of soil arsenic contamination to agriculture and related food chain links.

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