Phosphorus transformation in soils following co-application of charcoal and wood ash

ABSTRACT

Phosphorus (P) is a vital soil macronutrient required by plants for optimum growth and development. However, its availability is limited because of fixation. The phosphorus fixation reaction is pH dependent. In acid soils, the predominance of aluminium (Al) and iron (Fe) oxides in both crystalline and amorphous forms reduces the solubility of soil inorganic P through fixation on positively charged surfaces and formation of insoluble Al and Fe precipitates. In alkaline soils, P readily reacts with calcium (Ca) to form sparingly soluble calcium phosphates. As a result, a large proportion of applied P may become chemically bound, whereas only a small fraction of soil P remains in the soil solution and available for plant uptake. To date, there is little information available on the use of charcoal with a highly negative charge and wood ash with high alkalinity to minimise P fixation in acid soils. Thus, this study examined the potential of the combined use of charcoal and wood ash to unlock P fixation in acid soils. Numerous studies have been conducted to identify effective approaches to improve P availability through the use of different types of soil amendments, regardless of whether P is organically or inorganically present. For example, to mitigate P fixation in acid soils, amendments such as compost and zeolite are used to reduce P sorption sites. These amendments have also been used to increase P uptake and crop productivity in P deficient acid soils by reducing soil acidity and the toxicity of Al and Fe. It is believed that long-term application of charcoal and sago bark ash can positively change the physical and chemical properties of soils. These improvements do not only reduce P fixation in acid soils, but they also promote an effective utilisation of nutrients through timely release of nutrients for maximum crop production.