Agricultural Waste-Derived Biochar and Natural Nano Clay based Phosphorus Fertilizer for Slow-Release Applications

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Research Problem

Phosphorous (P) is an essential macronutrient for crop growth, supplied in the form of **fertilisers**. However, due to ill-managed farming practices and other factors including the chemical fixation of P within the soil, its **reach** is **restricted** to the **top-soil**. The deeper parts of the **soil** become **deficient** in **P,** which is a major cause of **stratification**. **Fig. 1** illustrates the P dynamics in soil **(P cycle)**.

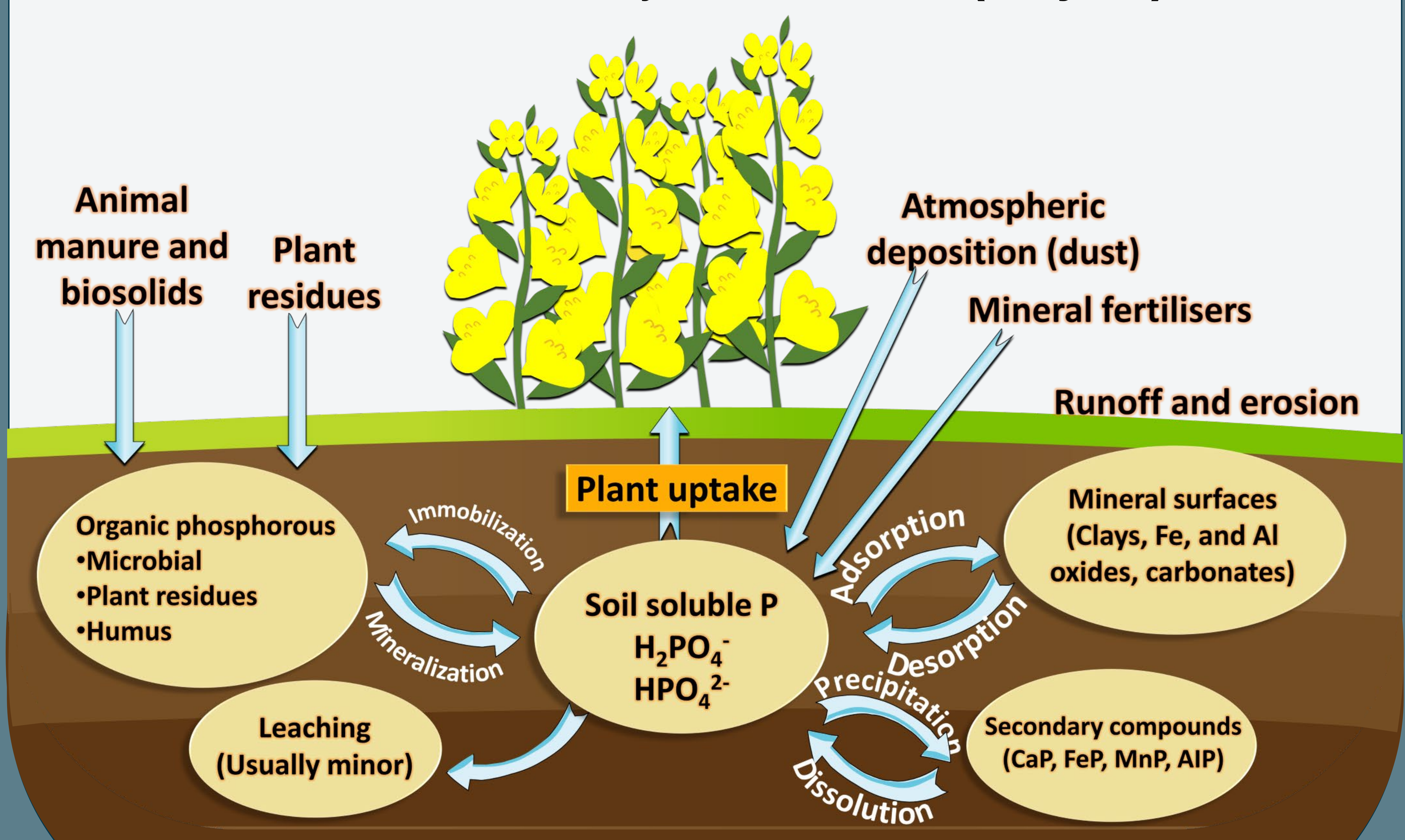

Fig. 1 Phosphorous cycle

Research Approach

- The **research** aims to develop **novel** slow-release **P fertiliser** with a long-term focus on improving soil stratification.
- **Agricultural waste** left over from **Canola** oil extraction is a good preposition to produce **low-cost biochar**, a material like charcoal with surface functional groups. In conjunction with the natural **clay attapulgite**, novel nanocomposites can be designed for optimal loading of P into the structure.
- This research will involve significant **collaborative** work, utilizing advanced nanomaterial technologies for the nanocomposite's synthesis, in-depth characterisation and soil application evaluation by working with local farming communities.
- The overall **goal** is to **benefit Australian farming** and address P **stratification** issues in **soils.**

Preliminary Research Results

- **Biochar (BC)** was produced using an **agricultural crop (Canola) waste** through **controlled** slow **pyrolysis** process at a temperature of **400** °C **(Fig. 2)**.
- Subsequently, the produced BC was **combined** with **attapulgite (ATP)** clay and **P** source (**KH_2PO_4)** in varying ratios and **pyrolysed** at 500 °C **(Fig. 2)**.

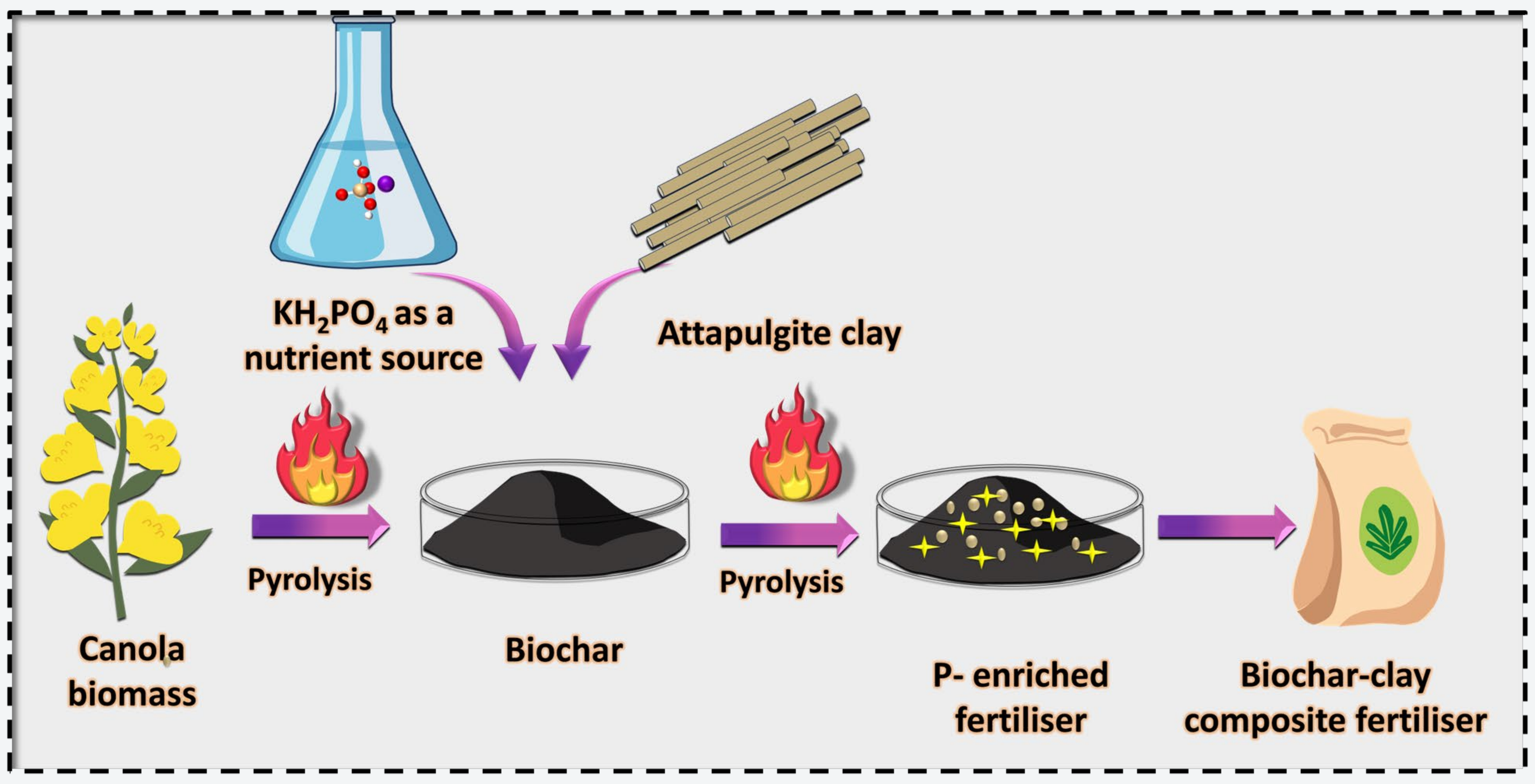

Fig. 2 Design and development of P based slow-release fertilizer

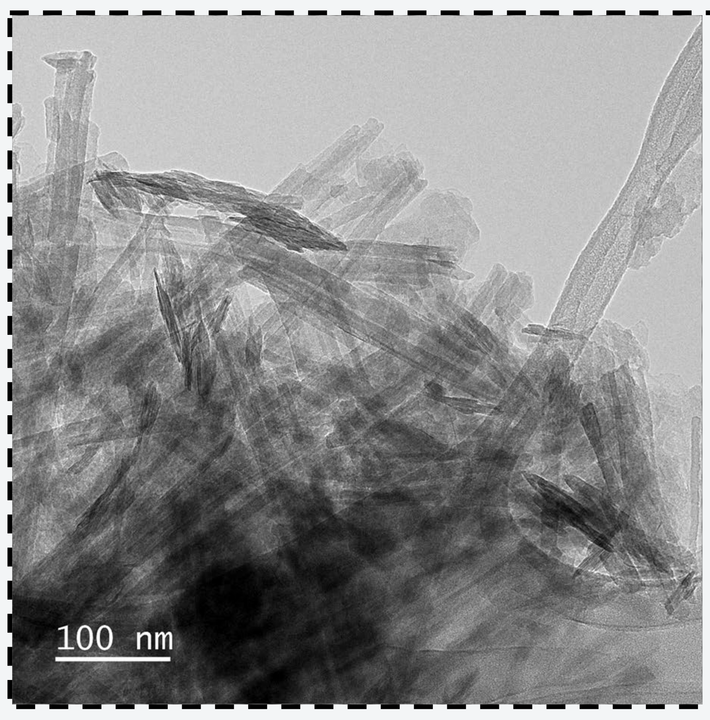

Fig. 3 TEM of BC-ATP-500-P2

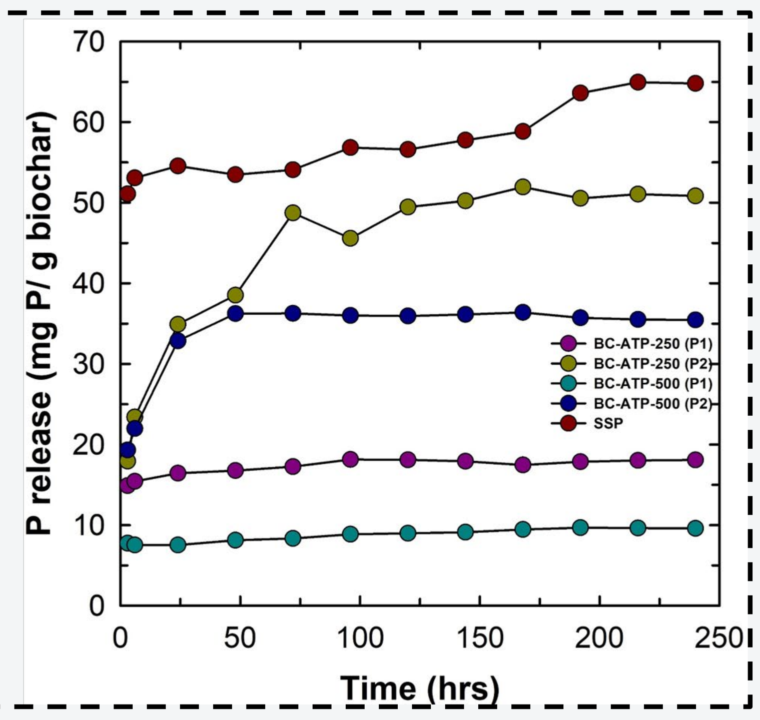

Fig. 4 P release of all materials

- The BC, ATP, composite BC-ATP and further composites with KH_2PO_4 were **characterised** using **transmission electron microscopy (Fig. 3).**
- **Slow-release** behavior of materials was compared to the commercially available fertiliser **single super phosphate (SSP)** and **BC-ATP-500 (P1 & P2)** showed more slow release of P **(Fig. 4).**

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