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Systematic review of methodologies for analysing plant-available silica content in fertilisers

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ABSTRACT

The recognition of silica as a soil nutrient has grown significantly in the past 20 years, driven by an improved understanding of soil silica depletion caused by intensive agriculture and silica's role in improving plant resilience. Although silica is common in soil, typically in the form of quartz, it cannot be utilised by plants except through geological weathering. Consequently, silica-amending fertilisers have become increasingly common in agriculture. Silicic acid is the primary soluble form of silica, referred to as plant-available silica (PAS). To provide accurate product information and application rate recommendations, accurate PAS quantification techniques are required.

A wide range of methodologies are used for analysing soluble silica content in areas such as soil science, geothermal engineering, and aquatic science. These techniques are often tailored to their field but may prove useful in other fields including fertiliser production. This review will aim to collate the approaches applied in multiple disciplines for determining PAS content in solids and solutions. Existing methodologies will be compared in terms of their accuracy, processing time, and applicability for analysing silica-amending fertilisers.

A systematic review of existing extraction methods and analytical techniques applied to PAS detection and measurement across multiple disciplines will be performed. Literature relevant to silicic acid extraction and characterisation techniques will be reviewed to provide an up-to-date understanding of the field and industry standard techniques within it. The work is significant as existing silica extraction and characterization techniques vary significantly in testing time and cost. Industry standard processes for fertiliser analysis are slow, with Australian companies having to send their samples to be analysed internationally. Outcomes from this review aim to support the development of more efficient and accessible methodologies for quantifying PAS content in versatile samples.

KEY WORDS

soluble silica, plant-available silica, silica fertilizer, silicic acid characterisation

BIOGRAPHY

Flynn Bohonis is a first-year PhD student at Adelaide University. He holds B.Eng (Hons) in Chemical Engineering from the University of Adelaide. His research interests include mineral processing and sustainable process development.

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