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Fertilizers and soil conditioners — Determination of monosilicic acid concentrations in nonliquid fertilizer materials

Détermination des concentrations en silicium soluble dans les matières fertilisantes non liquides

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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Introduction

Although silicon is ubiquitous in nature, making up a quarter of the earth's crust[3], not all forms of silicon found in soils or fertilizer products are soluble and plant-available[4],[5]. The form of silicon in soils that is soluble and available for plant uptake is monosilicic acid. Worldwide, it has been estimated that annual removal of silicon from soils during crop production can amount to 239-255 mega tons annually, based on FAO 1998 global crop production estimates, and a conservative annual increase of 1 % through 2012. Although the first US patent on a solid Si fertilizer was issued in 1881[6], fertilizer manufacturers, governmental regulators and consumers had no means of evaluating nonliquid silicon fertilizer materials for their monosilicic acid supplying capacity to meet and replace plant uptake needs.

The first research into the use of silicon fertilizers was reported in 1840[7]. Additionally, increased plant silicon concentrations were first associated with reductions in rice (*Oryza sativa* L.) blast disease (*Magnaporthe grisea* M.E. Barr) over a century ago in Japan[8]. Since then, research has extended to other grasses and grains (e.g. barley (*Hordeum vulgare L.*)[9], corn (*Zea mays* L.)[10], oats (*Avena sativa* L.)[11], wheat (*Triticum aestivum* L.)[12], sugar cane (*Saccharum officinarum* L.)[13], pasture[14], turf grasses[15], and to dicotyledonous crops (e.g. cucumber (*Cucumis sativus* L.)[16], grapes (*Vitis vinifera* L.)[17], pepper (*Capsicum* L.)[18], pumpkin (*Curcubita pepo* L.)[19], soybean (*Glycine max* (L.) Merr.)[20], tomato (*Solanum lycopersicum* L.)[21]. Beneficial effects from silicon fertility have included increased stress tolerance (disease, insect, drought, salt, nutrient imbalance, UV-rays, low and high temperature) and yield increases with or without stress[4]. Other benefits from silicon supplements to soils have included CO_2 sequestration[22], reductions in metals toxicity[23], and reduced phosphorus run-off while increasing phosphorus use efficiency[24].

Considering the extensive research, a growing market, and the potential benefits from silicon fertility to global agriculture; it is important that a standard method exists to enable regulation of nonliquid silicon fertilizer materials based on their monosilicic acid supplying capacity. This is the first method developed which correlates well with plant silicon uptake while using commonly available laboratory equipment at a reasonable cost for the analysis. Reference the peer reviewed published version, single lab validated AOAC method[25].