Preface

The global agriculture sector is confronting with challenges for the sustainability of agricultural production and of the environment to accommodate population growth and living standard increase in the world. Intensive high-yielding agriculture is typically dependent on the addition of fertilizers (synthetic chemicals, animal manure, etc.). However, non-point nutrient losses from agricultural fields due to fertilization could adversely impact the environment. Increased knowledge on plant nutrient chemistry is required for improving utilization efficiency and minimizing losses from both inorganic and organic nutrient sources. For this purpose, we invited a pool of peers consisting of both insightful senior researchers and innovative junior investigators to contribute chapters that highlight recent research activities in applied nutrient chemistry geared toward sustainable agriculture and environment. This book also outlooks emerging researchable issues on alternative utilization and environmental monitoring of manure and other agricultural byproducts that may stimulate new research ideas and direction in the relevant fields.

Chapter topics of interest in this book include, but are not limited, to speciation, quantification, and interactions of various plant nutrients and relevant contributories in manure, soil, and plants. Chapter 1 overviews animal manure and waste production, the benefits of using them as nutrient sources, potential impacts of manure on environmental quality and management strategies in the US as it produces over a billion Mg of animal manure annually. The worldwide heavy use of veterinary pharmaceuticals in confined animal-feeding operations has resulted in annual discharge of 3,000–27,000 Mg of drug chemicals via livestock manure into the environment. Chapter 2 summarizes veterinary pharmaceutical uses in confined animal feeding operations, reports on presence and detection of residual veterinary medicines in manures, and reviews the environmental behaviors of pharmaceutical residues in agricultural soils. As diverse environmental problems (e.g. pathogens, greenhouse and odorous gas emissions, and phosphorus runoff) arose from animal wastes, slow pyrolysis may offer an avenue for mitigating some of these problems and reducing the waste volume prior to land application. Chapter 3 is a critical review exploring the changes in chemical speciation of nutrient elements within manure as a result of pyrolysis and other thermal conversion technologies, and

recommendations are given on the critical areas where further investigation is needed on the relevant issues.

The next four chapters are with soil nitrogen and enzyme activities impacted by animal manure application. Chapter 4 provides up-to-date information on soil amino compound and carbohydrate research, and a case study of soil amino compound and carbohydrate levels impacted by organic amendments based on greenhouse manure experiment with ryegrasses. To increase the understanding of manure management in cropping systems for maximizing nitrogen use efficiency, Chap. 5 discusses the factors that can affect nitrogen mineralization and demonstrates the impact of temperature, moisture, soil wetting and drying cycles, and field spatial variability on manure nitrogen availability. Chapter 6 provides a review of the response of enzyme activities to manure applications and potential implications on soil biogeochemical cycling in agroecosystems, and also offers some perspective areas where more research may be needed and some avenues for future research. Followed Chap. 7 presents information on the most commonly studied soil phosphatases, acid and alkaline phosphomonoesterase and phosphodiesterase, and how manure application influences their activities and phosphorus cycling with a case study showing that soil application of dairy manure increases acid phosphatase activity.

Chapters 8, 9, 10, 11, 12, and 13 are dedicated to the phosphorus issue. Chapter 8 synthesizes and analyzes the basic knowledge and latest research on variety and solubility of phosphorus forms in animal manure and their effects on soil test phosphorus. Chapter 9 focuses on the major organic phosphorus form – phytate. It reviews the current knowledge of the abundance, cycling and bioavailability of phytate in soils and manure, and suggests areas where knowledge is limited, and thus where further research is needed. As a case study, Chap. 10 presents and discusses published and unpublished data on phosphorus forms and mineralization potential in Alabama cotton soils amended with poultry litter and managed as no-tilled, tilled, and mulch-tilled practices, showing poultry litter applied to soils affected many of the soil phosphorus fractions, dynamics and uptake. Chapter 11 reviews the use of iron/aluminum- and calcium/magnesium-based industrial by-products as manure amendments to reduce soluble phosphorus concentrations, and discusses the function of the chemistry of both the phosphorous sorbing materials and the receiving manure. Chapter 12 examines the effects of using bauxite residue, a by-product from the aluminum refinery industry, to modify nutrient characteristics of animal manure and manure-affected soils. Data compiled in Chap. 12 demonstrate that bauxite residues could be used as a potential amendment for reducing phosphorus and other contaminant losses in animal manures and manure-affected soils. Chapter 13 reviews fundamental basis and current state of knowledge on compound-specific isotopic effect during hydrolysis of organic phosphorus compounds. While the compound-specific isotopic study for organic phosphorus compounds is still in its infancy, Chap. 13 predicts that the future expansion of this research will develop a holistic approach to integrate transfer and transformation of organic and inorganic phosphorus and will eventually lead to sustainable agriculture and healthy ecosystem.

The last four chapters highlight impacts of animal manure and other amendments on soil and plant growth based on field experiments. Recent development in blueberry markets under organic certification has stimulated interest in production of composts specifically tailored to its edaphic requirements. Chapter 14 reports data from initial screening studies conducted in western Oregon USA to assess growth response of highbush blueberry to composts derived from diverse feedstocks and to link the response to compost chemical characteristics. An arable land in the subarctic Alaska, USA, was developed in 1978 by clearing native forest, and part of the arable land was later converted to grassland through a Conservation Reserve Program. Chapter 15 systematically presents and discusses the quantity, distribution, and features of soil water extractable organic matter as affected by the land uses to increase the understanding of soil organic matter biodegradability for new aspirations on agricultural production in the subarctic regions. The accumulation of heavy metals in biosolids amended soils and the risk of their uptake into different plant parts is a topic of great concern. Chapter 16 summarizes the accumulation of several heavy metals and nutrients in soils and in plants grown on biosolids applied soils and the use of remote sensing to monitor the metal uptake and plant stress. Research has been conducted in the southern and southeastern regions of the US to encourage the utilization of poultry litter as a row crop fertilizer away from the traditional application to pastures around chicken houses. Chapter 17 reviews results of the research on the effectiveness of poultry litter as cotton fertilizer and environmental concerns associated with its land application. Data presented in Chap. 17 demonstrate that, if effectively integrated into the cropping systems of the region, poultry litter should benefit not only cotton and other row crop farmers but also the poultry producers in the regions.

Chapter contribution was by invitation only. Each chapter that covers a specific topic was selected and decided after extensive communications between editors and chapter contributors. All chapter manuscripts were subject to the peer reviewing and revision processes. Positive comments from at least two reviewers were required to warrant the acceptance of a manuscript. We would like to thank the reviewers for their helpful comments and suggestions which certainly improved the quality of the book. These reviewers include: Nadia Carmosini, University of Wisconsin-La Crosse; Luisella Celi, Università degli Studi di Torino, Italy; Courtney Creamer, CSIRO Land and Water, Australia; Warren Dick, Ohio State University; Syam K. Dodla, Louisiana State University; Xionghan Feng, Huazhong Agricultural University, China; Thomas Forge, Agriculture and Agri-Food Canada; Mingxin Guo, Delaware State University; Fengxiang Han, Jackson State University; Donald A. Horneck, Oregon State University; Deb P. Jaisi, University of Delaware; Michael F. L'Annunziata, the Montague Group, Oceanside, CA; Philip Larese-Casanova, Northeastern University; B. Maruthi Sridhar, Texas Southern University; Daniel N. Miller, USDA-ARS; Jagadeesh Mosali, The Samuel Roberts Noble Foundation; Yvonne Oelmann, University of Tübingen, Germany; Paulo Pagliari, University of Minnesota; Po Pan, Kunming University of Science and Technology, China; John Paul, Transform Compost Systems Ltd., Canada; Chad Penn, Oklahoma State University; Thilini D. Ranatunga, Alabama A&M University; Zachary Senwo;

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