

Proceedings of the  
IPI-OUAT-IPNI International Symposium  
Bhubaneswar, Orissa, India  
5-7 November 2009

Volume I: Invited Papers

**Potassium Role and Benefits in Improving  
Nutrient Management for Food Production,  
Quality and Reduced Environmental Damages**

Edited by  
MS Brar  
SS Mukhopadhyay



Potassium Role and Benefits in Improving Nutrient Management for  
Food Production, Quality and Reduced Environmental Damages, Vol. I

2010

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ISBN 978-3-905887-05-1  
DOI 10.3235/978-3-905887-05-1

# Proceedings of the International Symposium

**IPI-OUAT-IPNI**  
**International Symposium on**  
*Potassium Role and Benefits in Improving Nutrient*  
*Management for Food Production, Quality and*  
*Reduced Environmental Damages*

Bhubaneswar, 5-7 November 2009

Volume I: Invited Papers

Edited by: MS Brar  
130-B, Rajguru Nagar  
Ludhiana - 141012  
India  
e-mail : brarms@yahoo.co.in

SS Mukhopadhyay  
Electron Microscopy & Nanoscience Lab  
Punjab Agricultural University  
Ludhiana - 141004  
India  
e-mail : ssmukho@pau.edu

Published by IPI, Horgen/Switzerland and IPNI, Norcross/USA.  
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ISBN 978-3-905887-05-1  
DOI 10.3235/978-3-905887-05-1

***Plant and Soil (Vol. 335; 2010) journal has published nine papers that are included in this volume with their permission.***



Organized by:

International Potash Institute (IPI), International Plant Nutrition Institute (IPNI), and Orissa University of Agriculture & Technology (OUAT)

Co-sponsored by:

Bangladesh Fertilizer Association (BFA), Fertilizer Association of India (FAI), Indian Council of Agricultural Research (ICAR), and Pakistan Agricultural Research Council (PARC)



**INTERNATIONAL POTASH INSTITUTE**

Baumgärtlistrasse 17  
P.O. Box 569  
CH-8810 Horgen, Switzerland  
Tel.: +41 43 810 49 22  
Fax: +41 43 810 49 25  
ipi@ipipotash.org  
www.ipipotash.org



**INTERNATIONAL  
PLANT NUTRITION  
INSTITUTE**

3500 Parkway Lane, Suite 550  
Norcross, GA 30092  
USA  
Tel.: +1 770 447 0335  
Fax: +1 770 448 0439  
info@ipni.net  
www.ipni.net

Printer : Swami Printers,  
Ludhiana, India.

## Foreword

Worldwide, improving crop production is of increasing importance. With a rising population and steadily increasing demand of food per capita, India faces a particular challenge in meeting these needs and in improving its crop production. Moreover, increasing crop productivity is not just about the science of new technologies or management of crops as environmental sustainability is of vital importance. The complexity of the issues now faced make improving crop productivity a more challenging task. Managing inputs is a crucial issue. Water, fertilizers, crop protection inputs, and professional advice all need to be managed in the most effective way, not only because of their high costs, but also due to diminishing availability and increasing competition over use. Optimal use of resources, including land availability, is becoming more complicated as the rate of production increases, and requires enhanced science and improved application by farmers.

Food security is measured mainly by the production of cereals. However, as the income of the urban population increases, the demand for meat, vegetables, fruits and oil increase at a much faster rate than the production of cereals; the food of the poor - causing policymakers much concern. In recent years, as in other regions, growth rates of cereal production in India have decreased; a trend that must be reversed if food security is to prevail.

Balanced fertilization is an important tool in achieving improved crop production. The relatively low levels of potash fertilizer application in Indian agriculture leads to mining of potassium (K) from the soil, which results in a multitude of negative impacts, including preventing full utilization of applied nitrogen and phosphorus fertilizers that limit yields, decrease farmers' income, and hence jeopardize the future food security of the country. Indian farmers and their advisors need to adopt advanced tools for potash fertilizer applications, and state research institutes need to update K recommendations according to the latest scientific findings. We are encouraged that a number of papers included in these proceedings discuss the issue of efficient and balanced use of nutrients; others present latest findings on improving productivity in common cropping systems of the region. Several papers are focused on the quality aspects of agricultural produce, while others discuss issues of fertilization and environmental stewardship.

This publication, which is a result of the IPI-OUAT-IPNI International Symposium on "Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Reduced Environmental Damages", which took place on 5-7 November, 2009 in Bhubaneswar, Orissa, India, contains all voluntary papers that were presented in the Poster Sessions at the event. The

journal; Plant and Soil accepted nine invited papers from the Oral Presentation sessions at the symposium for publication and, with the journal's permission, these are included here. The proceedings are intended to provide the reader with up-to-date knowledge of aspects related to nutrient management in Indian and South Asian agriculture, as well as their application for wider audiences, with a particular emphasis on potassium.

We thank Dr. MS Brar and Dr. SS Mukhopadhyay for editing this volume.

**Hillel Magen**  
Director, IPI

**Adrian Johnston**  
Vice President, IPNI

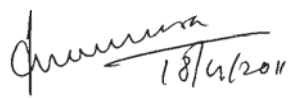
## Foreword

India has achieved foodgrain production of 234 million tons (the highest quantity achieved so far), but set a target of 276 million tons within the next 10 years, which has to be doubled to 450 million tons by 2050 to feed her burgeoning population. The situation is same for all Asian countries, which are home for more than four billion people. Apart from foodgrain production, agriculture is stressed to produce more fruit, more fibre, more bio-fuel, and more amount of industrial raw materials. This stress, if seen at the backdrop of declining per capita availability of cultivable land and renewable fresh water resources and a ever-increasing threat of global warming and increasing uncertainty of climate is truly worrisome. In the past decade, there was a strong demand of food and bio-fuel, which would likely to rise further as nations come out of recession. Together, they will put more pressure on scarce natural resources, and threaten to further accelerate in the extent and severity of the human-induced soil degradation (1.94 billion ha globally and increasing at the rate of 5–10 million ha annually).

Editors of Nature in 2009 identified seven parameters: climate change, ozone depletion, ocean acidification, biodiversity, freshwater use, the global nitrogen and phosphorus cycles, and change in land use for the biophysical processes that determine the Earth's capacity for self-regulation. They warned that we must stay within the boundaries in order to avoid catastrophic environmental change. Each one of these global issues are rooted in agriculture, which highlights the urgent need of reorienting our agricultural research to focus on fundamental issues of improving quality of ecosystems services and the environment. This is not an easy task, seeing that large number of our researchers, especially in developing countries, engaged themselves into nutrient management research in its most primitive form. At the same time our farm service providers lack skills and power to communicate the farmers need of balanced use of nutrients in environmentally sustainable manner, and for choice of right crop, and right nutrients and right management practices for a profitable farming. Yes, farming in these countries can be profitable, if these issues are taken care of. It is important to remember that fertilizer subsidy can't continue for long and rising food prices can become the single most threat to peace. Therefore, we need to be innovative in our approach in understanding agricultural production system alongside socio-economic compulsions to overcome current crisis in agriculture. Our new tools like newer models, breakthroughs in genomes, advancements in understanding in root system in crops to name a few, and a synergy between nanotechnology, biotechnology and information technology must be strategically incorporated into our nutrient management research to address these issues. It is also important for the nutrient-management researchers to use concepts like Fuzzy logic and remote sensing techniques to transfer experimental field results to the farmers' fields.

Similarly, response of nutrient application is never linear, and there is a need to interpret it by applying concepts of the non-linear dynamical system, so that proper crop-specific protocol is developed in the interest of farmers, and climate related constraints and stress can be addressed to facilitate profitable farming. I will also strongly advocate the use of precision farming in nutrient management research so that farmers can use inputs judiciously for most economical and profitable farming while protecting the environment and scarce natural resources.

I congratulate IPI and IPNI for holding this important global event in India and highlighting the plight of nutrient management, especially for populous countries like China, India, Bangladesh, Pakistan, and Sri Lanka. I am sure, IPI and IPNI will steer farming into new millennium's challenges for the future as well.



**(JS Samra)**

CEO, National Rainfed Area Authority  
NASC Complex  
New Delhi

## Preface

The International Symposium entitled, “Potassium Role and Benefits in Improving Nutrient Management for Food Production, Quality and Environmental Damages” was held at the Orissa University of Agriculture and Technology, Bhubaneswar-751003, India from 5-7 November 2009. During the symposium, 34 invited speakers presented papers covering different aspects of balanced fertilization. Present volume consists of 30 papers including 9 papers published earlier in the Plant and Soil (Vol. 335; 2010) journal. The 'Extended Abstracts' of papers that were presented by the volunteered participants during the symposium were already published in the companion Volume II.

The symposium treated role of potassium nutrition to plants holistically – from fundamental aspects (Romheld; Kirkby; Lambers) to outreach activities (Raviprasad and Adhikari), and from pedosphere to human health (Stein; Bhaskarachary). It covered importance of soil fertility mapping through GIS (He et al.), role K plays in alleviating water stress (Srinivasarao et al.; Rengel), salt stress (Singh et al.), acid or iron stress (Panda; Mitra et al.), and climate change (Clair and Lynch; Snyder and Johnston). Potassium's contribution to quality of the produces (Lester et al.; Mitra and Dhaliwal; Ebert) was given due emphasis. Potassium does not work in isolation, but improves use efficiency of many other nutrients both for production of crops and environmental safety (Zhang et al.). Ecosystems apart from field crops and horticulture also get benefitted from K applications. Two papers – one on forest ecosystem (Smethurst), and other on grass rotation (Oborn et al.)-dealt with that. Three papers wrapt issues of demarking of the K deficient sites in some areas that were earlier thought well-supplied with available K (Buresh et al.; Sanyal et al.; Benbi and Brar). These sites could be chosen for laying K-response demonstrations for farmers. This volume includes seven papers that analyzes situation of K-centric balanced fertilization in soils with focus on the geographic regions within South Asia (Timsina et al.), especially India (Samra and Sharma; Subba-rao and Reddy; Satyanarayana and Tewatia; Singh and Bansal), Pakistan (Ahmed and Mian), and Bangladesh (Islam).

Editorial Board places on record deep sense of gratitude to the International Potash Institute, the International Plant Nutrition Institute and the Orissa University of Agriculture and Technology for organizing and bearing financial liability of the august event. We are also indebted to the Indian Council of Agricultural Research, Fertilizer Association of India, Bangladesh Fertilizer Association and Pakistan Agricultural Research Council for their sponsorship. We thank NBARD for partly financing publications of the proceedings. We are grateful to His Excellency Shri MC Bhandare, Honorable Governor of Orissa for

gracing the Inaugural Function. We acknowledge with thanks for the kind support extended by Dr. N Panda, Chairman, WODC and Prof. DP Ray, Vice-Chancellor, OUAT. We admire Dr. D Jena for untiring work as Organizing Secretary, and for providing leadership. We are obliged to the chairpersons of the sessions for making our work plausible. We are indebted to the authors for copy right transfer and for allowing us to publish their papers.

#### Editors

## Contents

	<b>Page</b>
<b>Foreword</b>	<b>5</b>
<b>Preface</b>	<b>9</b>
<b>Food security - Indian scenario</b> JS Samra • PD Sharma	<b>15</b>
<b>Global impacts of human mineral malnutrition</b> AJ Stein	<b>45</b>
<b>The opening of Pandora's Box: Climate change impacts on soil fertility and crop nutrition in developing countries</b> SB St. Clair • J Lynch	<b>83</b>
<b>Implications of soil fertility to meet future demand: The Indian scenario</b> A Subba-Rao • KS Reddy	<b>109</b>
<b>Particular issues in plant production under acid soils: The Orissa scenario</b> N Panda	<b>137</b>
<b>Potassium nutrition of crops under varied regimes of nitrogen supply</b> F Zhang • J Niu • W Zhang • X Chen • C Li • L Yuan • J Xie	<b>147</b>
<b>Mineral nutrition under salt stress</b> AK Singh • A Qadar • NPS Yaduvanshi	<b>173</b>
<b>Role of potassium in water stress management in dry land agriculture</b> Ch Srinivasarao • KPR Vittal • B Venkateswarlu	<b>199</b>
<b>Characterization of iron toxic soils of Orissa and ameliorating effects of potassium on iron toxicity</b> GN Mitra • SK Sahu • RK Nayak	<b>215</b>
<b>Role of nutrient management in reduction of greenhouse gases</b> CS Snyder • AM Johnston	<b>231</b>
<b>Forest fertilization: Trends in knowledge and practice compared to agriculture</b> PJ Smethurst	<b>259</b>

<b>Role of nutrients in human health: New insights</b> K Bhaskarachary	291	<b>Increasing crop productivity through judicious use of potash in Pakistan</b> Z Ahmad • SM Mian	537
<b>Impact of potassium nutrition on postharvest fruit quality: Melon (<i>Cucumis melo</i> L) case study</b> GE Lester • JL Jifon • DJ Makus	303	<b>Rice-maize systems of South Asia: Current status, future prospects and research priorities for nutrient management</b> J Timsina • ML Jat • K Majumdar	545
<b>Effect of potassium on fruit quality and their storage life</b> SK Mitra • SS Dhaliwal	327	<b>Role of industry initiatives in extension activities in India</b> G Raviprasad • M Adhikari	575
<b>Field-specific potassium and phosphorus balances and fertilizer requirements for irrigated rice-based cropping systems</b> RJ Buresh • MF Pampolino • C Witt	343	<b>Research on potassium in agriculture: Needs and prospects</b> V Römheld • EA Kirkby	583
<b>Site specific potassium management in rice based cropping systems in India</b> SK Sanyal • MS Gill • K Majumdar	389	<b>Crop mineral nutrition under drought conditions</b> Z Rengel	627
<b>GIS based soil fertility mapping for SSNM at village level in China: A case study in Shanxi province</b> P He • H Wang • Jiyun Jin	407	<b>Phosphorus acquisition efficiency: Root morphology and physiology</b> H Lambers	633
<b>Potassium management for crops in soils of Orissa</b> D Jena • AK Pal • KK Rout	417	<b>Potassium nutrition and its effect on quality and post harvest properties of potato</b> G Ebert	637
<b>Quantifying uptake rate of potassium from soil in a long-term grass rotation experiment</b> I Öborn • AC Edwards • S Hillier	437		
<b>State-wise approach to crop nutrient balances in India</b> T Satyanarayana • RK Tewatia	467		
<b>Analysis of crop productivity, partial factor productivity, and soil fertility in relation to nutrient management in the Indo-Gangetic plains</b> H Singh • SK Bansal	487		
<b>Evaluation of soil fertility and nutrient balances under intensive agriculture</b> DK Benbi • MS Brar	499		
<b>Challenges for nutrient management in Bangladesh</b> MS Islam	519		