

## **Beijing Consensus on Sustainable Nutrient Management for Improved Fertilizer Use Efficiency**

The International Symposium on Improvement of Nutrient Use Efficiency under Zero Growth of Chemical Fertilizers in China, sponsored and organized by The International Plant Nutrition Institute (IPNI), the Institute of Agricultural Resources and Regional Planning of the Chinese Academy of Agricultural Sciences, and the Chinese Society of Plant Nutrition and Fertilizer Science, was successfully held in Beijing, March 16 to 18, 2016. The conference was attended by 300 participants, representing government, academic, extension and industry representatives. The following consensuses were formed based on the discussions during the meeting:

1. Fertilizer use has improved food security in China over the past 3 decades. The adoption of nutrient best management practices should be embraced to ensure progress toward future food security, economic viability on farms and environmental protection.
2. More recently the inefficient use of chemical fertilizer in certain locations in China has become an issue of public concern. This inefficient use is leading to environmental problems such as eutrophication of surface water, increase in greenhouse gas emissions and soil acidification. Inefficient nutrient use also impacts crop yields and farming profitability. While overuse of chemical fertilizers exists to differing degrees in the main agricultural production areas, especially fruit and vegetable production, there are some areas of crop and grassland in China, which are not receiving adequate nutrients.
3. Organic nutrient sources, such as animal manure and crop residues, have not been fully used and returned to cropland. New types of fertilizers such as crop specific fertilizers, slow/controlled release fertilizers, water-soluble fertilizers and bio-fertilizers are limited and not commonly used. Traditional methods of fertilizer application such as broadcasting and surface topdressing are still popular, while mechanization of fertilization requires further promotion.
4. The main approaches to improve nutrient use efficiency by developed countries are: (1) establishment of nutrient management guidelines at national level, and implementation of 4R nutrient management (i.e. to apply fertilizer with the right fertilizer at the right rate, right time and right place); (2) promoting the application of livestock manure, and returning the crop straw into soils; (3) development of

new fertilizers, i.e. compound fertilizer, crop specific fertilizer, slow/controlled release fertilizer, water soluble fertilizer; and (4) development of intelligent high efficiency fertilization techniques, such as precision fertilization, fertilizer deep application with machinery, fertigation, etc.

5. There is a need at this time to develop a set of research and development tasks to address this challenge. We propose the following:

The major research tasks include:

- a) The first research task is to focus on improvements in nutrient use efficiency within modern cropping system, ensuring that this work be carried out fully integrated with plant genetics, pest management and mechanization. The goal is to establish easy to use fertilizer recommendation methods for macro, secondary and micronutrients in grain crops, cash crops, vegetables and fruits. It is critical that these nutrient management guidelines be made available for a wide variety of important crops across all regions in China.
- b) The second research task is to develop a strategy on organic nutrient substitution for chemical fertilizers. This requires the study of the characteristics of organic sources of manure, crop residues and biological products, and their capacity to substitute for chemical fertilizers, thus promoting integrated plant nutrient and soil fertility management.
- c) The third research task is to create innovative new high efficiency fertilizer types, such as effective crop specific fertilizers, slow/controlled release fertilizers and water-soluble fertilizers. This work also needs to rapidly address the potential for fertigation systems (combining drip irrigation with soluble fertilizer delivery) to improve nutrient use efficiency in fruit and vegetable production.

The major development tasks are to promote technology transfer to end users, which include:

- a) Integrate 4R Nutrient Stewardship (right source, rate, time and placement) with fertilizer use in agriculture. This involves mechanical application, precision application, rapid nutrient diagnosis, in-situ nutrient monitoring and integration of fertigation in irrigated areas.
- b) Promotion of field validated fertilizer recommendation tools (such as soil testing and Nutrient Expert fertilizer recommendations) that are adapted for use by the public and private extension system in China.
- c) Finally, there is a serious need to advance 4R Nutrient Stewardship education to both farmers and extension workers in China, and its integration into University education. An advanced focus on the role that efficient

management of nutrients can play in future food security is critical.

The objective of these research and development tasks is to provide an effective pathway to an improvement in chemical fertilizer management so as to achieve a future with safe and secure food supplies, a clean environment and economically viable farming operations and to provide important scientific and technological support to zero growth of chemical fertilizers in China by 2020.

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