中国磷肥应用研究现状与展望学术讨论会

论文集

PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON PHOSPHORUS FERTILIZER USE IN CHINA

中国植物营养与肥料学会
加拿大钾磷研究所(PPI/PPIC)中国项目部 主编

中国农业出版社

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图书在版编目（CIP）数据

中国磷肥应用研究现状与展望学术讨论会论文集/中国植物营养与肥料学会，加拿大钾磷研究所（PPI/PPIC）中国项目部主编. —北京：中国农业出版社，2005.1
ISBN 7-109-09567-3

Ⅰ.中… Ⅱ.①中…②加… Ⅲ.磷肥-应用-中国-学术会议-文集-汉、英 Ⅳ.TQ442-53

中国版本图书馆 CIP 数据核字（2004）第 136651 号

中国农业出版社出版
（北京市朝阳区农展馆北路 2 号）
（邮政编码 100026）
出版人：傅玉祥
责任编辑 贺志清

中国农业出版社印刷厂印刷 新华书店北京发行所发行
2005 年 4 月第 1 版 2005 年 4 月北京第 1 次印刷

开本：787mm×1092mm 1/16 印张：12.75
字数：280 千字 印数：1～1 000 册
定价：30.00 元
（凡本版图书出现印刷、装订错误，请向出版社发行部调换）

前言

肥料是作物的“粮食”，是作物生产的物质基础，在农业持续发展中发挥着重要作用。磷作为植物正常生长所必需的大量营养元素之一，对作物产量和品质的形成至关重要。因此，自20世纪60年代初磷肥在我国开始应用以来，磷肥的施用量和产量均发展很快，现在，我国已是磷肥生产和施用的大国。磷肥与其他肥料的合理配合施用提高了作物产量，改善了作物产品品质，保证了种植业的持续发展，同时也带动了我国磷肥工业的发展。

进入新世纪，我国农业和农业科技发展面临许多新的挑战，在土壤磷素状况和磷肥应用方面也有许多问题需要进一步研究和明确。为此，中国植物营养与肥料学会和加拿大钾磷研究所（PPI/PPIC）于2001年11月20日在广西南宁市联合召开了“中国磷肥应用研究现状与展望”学术讨论会。国内外有关土壤磷素研究、磷肥生产、使用、管理等方面的专家学者，中国植物营养与肥料学会理事会的全体理事，共200多人参加了会议。大会邀请国内外磷肥使用和生产方面的知名专家和有关管理部门的领导，就我国土壤磷素状况、磷肥施用、磷肥生产和需求的现状和前景等进行了深入的研讨。

“中国磷肥应用研究现状与展望学术讨论会”是中国植物营养与肥料学会为配合国家西部大开发战略举行的一

次重要性学术会议，也是中国—加拿大两国政府间合作“中国农业持续发展中的养分与肥料管理”（NMS）项目的计划内容。会议得到了中国农业部（MOA）、对外经济贸易合作部（MOFTEC）、中国农业科学院（CAAS）、加拿大国际发展署（CIDA）、加拿大钾磷研究所（PPI/PPIC）及其会员单位、中国植物营养与肥料学会、广西农业科学院、广西土壤学会等单位的大力支持。

为了本论文集的编辑和出版，加拿大钾磷研究所前任副总裁 Sam Portch 博士做了大量的审阅和修订工作，吴荣贵博士对文章的修改部分进行了修订和翻译，何萍博士参与了文章的编辑和排版工作。

由于工作上安排的种种原因，现在才将本论文集奉献给大家，但是本书中关于我国土壤磷素状况及其演变规律、我国磷肥应用中存在的问题及其对策、我国磷肥生产和需求前景分析等重要见解，仍然很有参考价值。在编辑出版过程中存在的不足之处，请大家指正并谅解。

金继运

2004 年 11 月

Forward

As the "food" of crop and the material base of crops production, fertilizer plays a vital role in sustainable agricultural production. Phosphorous (P), as one of the essential nutrients for crop normal growth, is of great importance to crop production and quality formation. P fertilizer was first applied in China in the early 1960's and then the consumption and production of P fertilizer have developed rapidly. Today China is the large country in P production and consumption. The balanced fertilization of P and other essential nutrients enhanced crop yield, improved crop quality, as well as maintained sustainable development of crop production, and therefore promoted P industry in China.

Entering new century, we are facing many new challenges in Chinese agriculture and agricultural production, and various issues existed in soil P status and P fertilizer uses need to be solved. To this end, the international symposium on Phosphorus Fertilizer Use in China, jointly organized by Chinese Society of Soil Science and Fertilizer Science and Potash and Phosphate Institute/Potash and Phosphate Institute of Canada (PPI/PPIC), was held in Nanning, Guangxi municipality on November 20, 2001. More than 200 national and international delegates attended the symposium, including scientists working on soil P research, P fertilizer producer, manager and user, and the council members from Chinese Society of Plant Nutrition and Fertilizer Science. Scientists and government leaders exchanged their opinions on current P situation, P

fertilizer application, production, demand and future outlook in China.

The international symposium on Phosphorus Fertilizer Use in China, held by Chinese Society of Soil Science and Fertilizer Science to cooperate the national strategy on western exploitation, is also the joint program of Sino-Canada Government Cooperation Project "Strategy on Nutrient and Fertilizer Management in sustainable agricultural development in China". The symposium received strong supports from many native and foreign organizations, such as Ministry of Agriculture (MOA), Ministry of Foreign Trade and Economy Cooperation (MOFTEC), CAAS, CIDA, PPI/PPIC and its member companies, Chinese Society of Plant Nutrition and Fertilizer Science, Guangxi Academy of Agricultural Science, Guangxi Society of Soil and Fertilizer Science, let me express the deep appreciation for their supports to the symposium.

Acknowledgement is extended to Dr. Sam Porch, former vice president of PPIC, for his contribution in reviewing and editing of the papers. English translation and revision was carried out with great efforts of Dr. Wu Ronggui. Sincere thanks to Dr. He Ping for her great effort in papers-editing and publishing.

Important opinions on soil P status, existing problems in P fertilizer use, P fertilizer production and perspective analysis in this proceeding have great reference values.

Finally, I hope the proceedings will be useful to the readers.

Jin Jiyun

Nov. 2004

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中国磷肥应用研究现状与展望学术研讨会

开 幕 词

林 葆

中国植物营养与肥料学会理事长

尊敬的主席先生、女士们、先生们：

早上好！

中国植物营养与肥料学会很高兴有机会与加拿大钾磷研究所（PPIC）一道，在广西南宁市共同召开“中国磷肥应用研究现状与展望学术讨论会”，我谨代表中国植物营养与肥料学会，对参加这次会议的各位外国朋友和来自全国各地的各位代表表示热烈的欢迎，对广西壮族自治区人民政府、广西农业科学院和广西土壤学会对这次会议的支持和帮助表示衷心的感谢。

在我国的农业生产中，磷素营养和磷肥是仅次于氮素和氮肥的第二大营养元素和肥料。根据全国第二次土壤普查的结果，我国耕地缺磷的面积很大，而磷肥的供应还不能满足农业生产的需要，讨论我国磷肥应用的现状和发展前景，是一个十分有意义的问题。

中国化肥生产和使用的发展与欧洲是不同的。西欧发达国家生产过磷酸钙已经有一个半世纪，大量使用磷肥已经有 60 多年的历史。继磷肥之后开始生产和使用钾肥。而合成氨和氮肥的生产和使用是 20 世纪的事。长期以来磷、钾肥的产量和用量超过氮肥。到 20 世纪中叶，氮肥的产量和用量才赶上并超过磷、钾肥。由于施肥，土壤中积累了大量的磷素。20 世纪 80 年代，英国、德国等国开始减少化肥的用量，首先是减少磷肥的用量，但作物产量并没有下降，而是继续增加。中国化肥的发展是从氮肥开始的，然后是磷肥。氮肥发展快，磷肥发展慢，钾肥更慢，长期以来土壤中磷、钾养分是不断消耗的。虽然从 20 世纪 80 年代以来，全国大部分地区磷的投入大于产出，对缩小我国耕地的缺磷面积和减轻缺磷的严重程度起了很好的作用，但是，远远没有达到可以少施或不施磷肥的程度。而且近年随着种植业结构的调整，经济作物和果树、蔬菜面积增加，林业、草业也开始施用化肥，这都需要更多的磷肥供应。

参加这次会议的国内外磷肥生产、营销和使用的各方面专家，通过大家相互切磋，定将会促进我国磷肥应用的进一步发展。

预祝大会圆满成功。

Opening Remarks at International Symposium on Phosphorus Fertilizer Use in China

Lin Bao

Chinese Society of Plant Nutrition and Fertilizer Sciences

Dear Chairman, Ladies and Gentlemen:

Good morning!

I am very pleased to be here today to participate this joint meeting on Phosphorus Fertilizer Use in China held by Chinese Society of Plant Nutrition and Fertilizer Sciences and PPI/PPIC. On behalf of Chinese Society of Plant Nutrition and Fertilizer Sciences, I would like to extent my warm welcome to all participants and scientists coming to this meeting, and give my deep appreciation to the supports from Guangxi Government, Guangxi Academy of Agricultural Sciences and Guangxi Society of Soil and Fertilizer Sciences.

In agricultural production in China, phosphorus (P) nutrition and P fertilizer are the 2nd most important nutrient and the 2nd most important fertilizer, after nitrogen and nitrogenous fertilizer. The results of nation-wide network of the second soil survey revealed that P deficiency is still a spreading problem in many areas of China and there is a continuous need for applied P in China. Therefore it is of great significance to discuss current situation and future outlook of P fertilizer use at this meeting.

Fertilizer production and use in China is different from European countries. Single super phosphate (SSP) was first manufactured in Western European about 150 years ago, and its use in large scale has been more than 60 years, and then followed by manufacture and use of potash fertilizer. Production of N fertilizers using the synthetic ammonia method started in twentieth century. The production and consumption of N lagged behind P and K fertilizers until mid of 1950's. The consumption of P fertilizer in European developed countries like UK and Germany have declined since 1980's, but the crop yield didn't drop with the decrease of P, due to the residual effect of P in the soils. China went through different path in fertilizer use, with N fertilizer applied first, and followed by P fertilizers. Nitrogen fertilizer industry developed very rapidly in China, while P fertilizer production developed slowly, with K fertilizer production far behind. As the result, P and K in soils have been depleted continuously. This situation changed in 1980's, when P fertilizer input was more than crop removal in most crop production areas in China. This positive balance of P in soil and crop system helped in alleviation of P deficiency in China, but in general

soil P supply capacity is still far from enough, and still need good attention for P fertilizer use. Moreover, with cropping structure reforming, fertilizer demand including P fertilizer increased with expanding area for cash crops, fruit trees, vegetables, forage/grassland, and commercial forestry plantations.

I am very pleased to see so many experts from China and abroad in P fertilizer production, distribution and use gathered here in Beijing. The discussion in this symposium will certainly help further development of P fertilizer use in China.

Wish the symposium a great success.

中国磷肥应用研究现状与展望学术研讨会

欢 迎 词

章力建

中国农业科学院副院长

尊敬的主席、Dr. Stauffer 博士、林葆理事长、各位外宾、各位理事、女士们、先生们：

早上好！

非常高兴参加这次加拿大钾磷研究所和中国植物营养与肥料学会联合召开的“中国磷肥应用研究现状与展望”和“实施西部开发战略和农业结构调整的土壤肥料问题”学术研讨会。首先，请允许我代表中国农业科学院，对来自国内外的代表和科学家表示热烈的欢迎，对广西壮族自治区政府、广西土壤学会和广西农业科学院对这次会议的大力支持，表示衷心的感谢。

多年来，在农业部的组织和协调下，我院土壤肥料研究所和有关兄弟单位与加拿大钾磷研究所在土壤肥料领域开展了卓有成效的合作，取得了显著的进展，推动了我国农业生产上肥料的科学使用。中国植物营养与肥料学会自成立以来，在推动土壤肥料领域的科技进步发挥了重大作用。广大的土壤肥料科技工作者以我国农业发展的需要为主要目标，结合生产实际，在土壤肥料领域的科学研究上取得了巨大的进展，推动了土壤养分科学管理和肥料的科学使用，取得了显著的社会、经济和环境效益。在此，我代表中国农业科学院，对中国植物营养与肥料学会、加拿大钾磷研究所，对全国土壤肥料界的专家表示衷心的感谢。

土壤是作物生产的基础，肥料是作物的粮食，土壤肥料科学技术的进步对我国农业的持续发展有重要的影响，在我国西部大开发战略中占有重要的地位。这次加拿大钾磷研究所和中国植物营养与肥料学会联合召开的两个学术研讨会，将针对我国土壤磷素状况、磷肥生产和应用的现状和前景，以及我国西部大开发中土壤肥料方面的有关问题开展广泛的学术交流和研讨。会议的成功召开将对我国土壤肥料科学的发展和技术的进步产生重大而深远的影响。

加入 WTO，我国的农业将面临新的机遇与挑战。在这种机遇与挑战面前，要求我们认真思考，积极发现我国农业生产中存在的问题，适时地调整研究方向，为科学技术的进步，为我国农业的持续发展做出贡献。

最后，预祝本次会议圆满成功。

谢谢大家。

Welcome Speech at International Symposium on Phosphorus Fertilizer Use in China

Zhang Lijian

Vice President, CAAS

Chairman, Dr. Stauffer, Dr. Lin Bao, Distinguished foreign guests, directors, Ladies and gentlemen:

Good morning!

It is a pleasure to be here today to participate this joint meeting on Phosphorus Fertilizer Use in China / Soil & Fertilizer Sciences in Developing China's Western Region held by Chinese Society of Plant Nutrition and Fertilizer Sciences and PPI-PPIC. On behalf of Chinese Academy of Agricultural Sciences (CAAS), I would like to extent my warm welcome to all participants and scientists coming to this meeting, and give my deep appreciation to the supports from Guangxi government, Guangxi Society of Soil Science and Guangxi Academy of Agricultural Sciences.

Organized and harmonized by Ministry of Agriculture, fruitful cooperation and great achievements have been made by scientists from Soil and Fertilizer Institute of CAAS, related brother units, and PPIC, promoting scientific use of fertilizer in China agriculture production. Chinese Society of Plant Nutrition and Fertilizer Sciences has played a central role in promoting advancement in soil and fertilizer science since its formation. Aiming at the requirements of Chinese agriculture, great achievement has been made by soil and fertilizer scientists, influencing significantly on society, economy and environment. Therefore, on behalf of CAAS, I greatly appreciate Chinese Society of Soil Science, PPIC and Chinese soil and fertilizer scientists for their excellent work.

Soil is the base of crop production, and fertilizer is the food of crop. Advancement of soil and fertilizer science influences greatly on Chinese sustainable agriculture and western exploitation. Extensive communication and discussion on phosphorus situation, phosphorus production, application and consumption, both current and projected, and some issues existed in Chinese western exploitation will be carried out in this joint meeting. The success opening of this meeting will bring deep influence on development and advancement of soil and fertilizer science in China.

Facing new opportunities and challenges after entering WTO, we are required to think over and find out the existed issues in Chinese agriculture production, and adjust directions

timely to contribute Chinese sustainable agriculture.

Wish the symposium a great success.

Thank you.

在中国磷肥应用研究现状与展望学术研讨会上的讲话

Mark D. Stauffer

加拿大钾磷研究所

广西壮族自治区副主席，中国植物营养与肥料学会理事长林葆研究员，农业部陈植新先生，中国农业科学院章力健（博士）副院长，广西农业科学院李阳瑞（博士）院长，参加会议的各位尊敬的来宾，农业战线的朋友们：

非常高兴和荣幸能够在这里与大家一起讨论肥料应用的进展，尤其是在平衡施肥、高产和高效作物生产系统和效益农业的概念中也讨论磷的问题。平衡施肥、高产和高效作物生产系统和效益农业这三个方面要一起考虑，才能同时提高国家的粮食供应和中国农村的经济发展，与此同时保持农业赖以生存的土壤和水资源。科学将把发展引向优势的制高点。

虽然我必须承认在 1997 年访问广西后这次再来，但有人告诉我这次会址选在广西并非偶然。中国中央和省级政府，以及一些国际组织如加拿大国际开发署目前的工作重心，就是把在中国其他部分发展起来的肥料管理原则和技术带到西部来，以缩小东西之间的经济差距。虽然我们在座的都知道，土壤科学和农学在解决中国的粮食和经济发展问题上是非常重要的，但我还想说正因为如此，你们才做了如此巨大的工作。

植物营养与肥料学会及其成员和 PPI－PPIC 面临的挑战，就是利用肥料科学与作物—土壤管理体系，来发展能够解决面向不同农业区的特殊需求的技术。比如说在四川省的坡地上，植物篱种植和平衡施肥就能相互受益。考虑到所有的因素——农田面积小、农民一年下来的收入、环境对地形的敏感性、农业生产的粮食需求、农民的收入水平——PPI－PPIC 的中国科学家设计了一种种植方式，该种植方式不仅种植粮食作物，还种植一些高附加值作物，这样既稳定受侵蚀的土壤，还能增加农民的收入。这种种植方式是实实在在的持续农业系统。

这只是我们合作工作进展中共同和相互受益的一个例子。长期的合作才能促成发展。这次会议为我们将来更大的发展打下了良好的基础。

面对挑战，需要明确的目标。关于中国磷肥应用研究学术讨论会，我们建议集中在以下领域：

- 明确土壤中磷的状况；
- 弄清磷肥的生产、应用和消费现状及前景。

现在回过头来看 1996 年举办的肥料与农业发展国际学术讨论会，那次会议提供了很多优势和机遇。中国农业部、中国农业科学院、省级土壤肥料研究所、学会和 PPI－PPIC