

Direct Application of Phosphate Rock on Acidic Soils May Save Money for Farmers

Phosphate May Be More Limiting Than Nitrogen or Potash in the Future. IFDC and IAEA Develop Phosphate Rock Decision Support System to Predict Feasibility.

World prices for all fertilizers are soaring—but prices of phosphate fertilizers are rising faster than fertilizers based on nitrogen or potassium, the two other primary nutrients for plant growth.

Phosphate rock (PR), the raw material used to manufacture all conventional phosphate fertilizers, is mined, and is a non-renewable resource, Dr. Amit Roy, IFDC President and CEO, points out.

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Six African countries have 50% of the world's known phosphate resources. But most of the phosphate rock, like that extracted from this mine in Togo, West Africa, is exported and does not directly benefit African farmers.

"The world may have only enough phosphate reserves to maintain us for 100 to 120 years if we continue to use our current technology and application rates," Roy says. "As the easily available reserves dwindle, phosphates could become the most limiting chemical resource for agricultural production.

"That's why improvement of the efficiency of crop uptake of phosphorus is an IFDC objective. We hope to make directly applied phosphate rock as effective as the more expensive water-soluble fertilizers."

Conversion of PR to water-soluble phosphate fertilizers such as diammonium phosphate (DAP) is costly, requiring high energy use and large quantities of sulfuric acid.

Dr. Upendra Singh, IFDC Senior Scientist—Systems Modeling (Soil Fertility), says that some PRs—those that are reactive or have relatively high solubility—can be applied directly to crops on acidic soils with no further processing beyond grinding.

“Direct application of PR without expensive chemical processing can be especially effective on acidic soils because they slowly release available phosphorus to the plants,” Singh says. PR use as a natural phosphate source could open future markets either for export or domestic use that could benefit developing countries economically, especially in Sub-Saharan Africa and South America.

Dr. S. H. Chien, former IFDC Principal Scientist—Soil Chemistry, says, “The tropics and subtropics have large areas of land that are moderately to strongly acidic. Such soils tend to be phosphate-deficient and often have high phosphate-fixing capacity that can utilize phosphate rock when applied directly.

“Direct application of reactive PR has been found cost-effective in areas of Malaysia, Indonesia, Brazil, and New Zealand. There are also small markets for use of indigenous PR deposits in India, Colombia, Nigeria, Tanzania, Mali, and Burkina Faso.”

New Web Tool for Decisions on Phosphate Rock Use

A new web-based Phosphate Rock Decision Support System (PRDSS) to predict feasibility of PR for direct application to crops has been developed by IFDC scientists in collaboration with the International Atomic Energy Agency (IAEA). PRDSS is available, identified as “Direct Application of Phosphate Rock,” on the FAO/IAEA Web site: <http://www-iswam.iaea.org/dapr/srv/en/resources>.

Singh says the PRDSS was developed after 25 years of evaluation of PR applied to crops in Latin America, Asia, and Sub-Saharan Africa. The PRDSS uses minimal information inputs—soil pH, PR source, crop species, and farm gate prices—to determine if farmers can use PR or conventional phosphate fertilizers more economically. The PRDSS also has the capability to predict residual effects of PR application.

To develop the PRDSS, IFDC and IAEA standardized the characterization of PR through field trials and analyses of soil samples taken in PRDSS validation field trials in Burkina Faso, Tanzania, Malaysia, Vietnam, Brazil, and Argentina.

“The PRDSS is user-friendly and easy to navigate,” says Dr. Henk Breman, IFDC Principal Scientist. “I have used PRDSS on the web site to compare PR from Burundi and Tanzania. “Even as a layman, I was able to obtain answers.”

Phosphate Rock Workshop

More than 100 international researchers from 30 countries shared agronomic research information on PR use in various soil types and cropping systems at an IFDC-sponsored workshop in Malaysia in 2001. Proceedings are available from IFDC (SP-37, at http://www.ifdc.org/New_Layout/Publications_Catalog/Special_Publications/index.html

Analysis

The cost of exploiting PR resources will probably rise as the world exhausts the more readily available deposits. Phosphate will probably be a greater concern than nitrogen or potassium in the future.

Direct application of PR may become more efficient and economical than using conventional phosphate fertilizers as energy costs continue to escalate.

Solutions

Research is needed to improve the efficiency of directly applied PR. Marketing systems to directly use PR from mines should be developed.

PRDSS can be effectively used to assess the agronomic and economic feasibility of direct PR application. But more field trials are needed to validate and refine the PRDSS model and improve its predictability.

New technology is needed to reduce energy costs of mining and use of PR including its beneficiation, transport, distribution, and marketing.