ABOUT IMPHOS

IMPHOS is a non-profit making Institute founded in 1973 by the world's principal producers of phosphate rock. Its primary mandate is to collect and disseminate scientific data to support the rational use of phosphates to both increase and sustain agricultural production to meet the food requirements of humankind worldwide.

Among its objectives it seeks to promote, in both developed and developing countries, the efficient use of phosphates, according to the principles of integrated plant nutrient management. It also seeks to improve farming techniques for productive and sustainable crop production, whilst minimizing environmental risks. Technical research includes the synthesis of phosphorus compounds and processing technologies.

In phosphorus deficient soils such as in Africa and Asia, IMPHOS is conducting several projects to demonstrate the need to supply phosphate to increase and sustain the food production. In phosphorus enriched soils, such as in Europe, the focus is made on using phosphorus efficiently to both maintain productivity and minimize environmental risk.

To optimize the use of published research on phosphates, IMPHOS makes its expertise available, not only to member companies but also to research organizations, consumers and appropriate agencies. It also periodically organizes international conferences and regional seminars.

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IMPHOS TODAY

Workshop on environmental cadmium in the food chain: sources, pathways and risks

From Brussels, the capital city of Belgium and the headquarters of the European Union, IMPHOS co-sponsored the workshop on cadmium in the food chain, that was organized by SCOPE (the Scientific Committee on Problems of the Environment) from 13-16 September 2000.

Acting from a belief that planned regulations on cadmium lack adequate scientific basis and do not take into account all relevant aspects of phosphate fertilizer use, IMPHOS requested the assistance of SCOPE in preparing a workshop that deals more specifically with concerns and uncertainties relating to environmental cadmium. It was the occasion to :

1. Review the state of knowledge of environmental cadmium from the geochemical, agronomic, ecotoxicological and human health's standpoint, with particular emphasis on the outputs of previous workshops and reports.

2. Identify the needs and opportunities for further work based on this review.

About 46 participants representing various scientific disciplines as well as the phosphate industry and decision-making bodies attended the workshop.

In addition to covering the major topics through 33 papers given in five sessions, the workshop participants were divided into 4 working groups to discuss more specific issues :

- Is soil cadmium balance achievable ?
- Cadmium in tropical agricultural systems.
- Bioavailability of cadmium in food.
- Susceptibility of humans to cadmium toxicity.
- Temporal and spatial issues relative to cadmium inputs and balances.
- Soil-plant-animal transfers.
- Aquatic ecosystems.
- Renal impairment and/or proteinuria.

Recognizing that cadmium is an *(continued on p. 2)*

Fertigation for efficient use of water and phosphate fertilizers

Developing countries need to boost the economic status of resource-poor farmers. Crop production can be increased through the adoption of new technologies that make optimal use of scarce land, water and plant nutrient resources.

Micro-irrigation technologies such as drip and sprinkler irrigation systems with their documented advantages can play a vital role in increasing both water and fertilizer use efficiency. Drip irrigation systems in particular have proven to be big successes in terms of water saving and parallel yield increases under a wide range of agronomic and horticultural crops. Indeed, the yield increase reported in literature ranges from 20 to 100 %. In India for example, there was reported a yield increase of 100 % for banana, 40 to 50 % for sugar cane, tomato and chilies and around 25 to 30 % for grapes, cotton and groundnut.

Furthermore, use of drip irrigation on all these crops prompted considerable water *(continued on p. 2)*

CONTENTS

*B.A.T : Best Available Technology in fertilizer produdion
B.M.P. : Best Managment Pradices in fertilizer use.

Workshop on environmental cadmium in the food chain: sources, pathways and risks *(continued from p. 1)*

environmental issue, the workshop drew the following major conclusions and recommendations in a final panel discussion :

1. Cadmium inputs are mainly from atmospheric deposition, application of biosolids, use of phosphate fertilizer and from effluents from cadmium using and recycling industries.

2. There are significant data gaps related to bioavailability and food chain transfers, particularly under tropical conditions.

3. Caution is needed in generalizing exposure estimates from the existing epidemiological studies, because of substantial differences between occupational exposure (primarily inhalation) and public exposure (primarily ingestion), as well as between cultures with different diets and perhaps susceptibilities.

4. The most sensitive human health endpoint of concern for human food chain exposure is damage to the proximal tubule of the kidney with resulting proteinuria.

5. There remain significant data gaps in the area of ecological risk assessment, particularly at the ecosystem level (rather than single species).

6. In addition to the uncertainties concerning food chain and biomedical issues, there remain uncertainties regarding the benefits, costs and potential risks associated with various cadmium management scenarios.

7. The growing populations imposing increasing energy demand and the limited arable land (much with low natural fertility) of developing countries in tropical regions require special attention with regard to risk balancing.

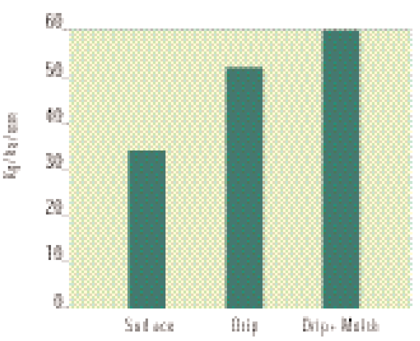
The conclusions from the report are available in the SCOPE web site (www: icsu-scope.org), while the proceedings of the workshop including papers, working groups reports, and conclusions and recommendations will be soon published.

In addition to IMPHOS, the Royal Academy of Sciences of Belgium and the US National Institute of Environmental Health Sciences provided financial support for the workshop.

Fertigation for efficient use of water and phosphate fertilizers *(continued from p. 1)*

savings ranging from 40 to 50 per cent, compared with the conventional irrigation method. Surface flooding resulted in an economic yield per unit water of 34 kg/ha/mm, while drip irrigation and drip irrigation plus mulch resulted in 52 and 60 kg/ha/mm, respectively (Figure 1).

Figure 1 : Water Use Efficiency of bananas grown on fine textured heavy soil in India



In Cyprus, water application efficiencies at farm level were 75-80 % higher by conventional sprinkler, 80-90 % by mini-sprinkler, and 85-95 % by drip irrigation, provided that the farmers follow the recommendations and irrigate according to the crop water requirement.

The ever increasing water scarcity problems and the recurring droughts in many parts of the world should encourage the adoption of micro-irrigation systems.

The saving of water would enable further expansion of irrigated land, hence increasing agricultural production. However, given the limitation to further expansion of irrigated land in most countries, a large part of future food requirements will need to be covered from a more efficient and sustainable use of irrigation water and fertilizers beside other inputs. Improving water use and fertilizer use efficiencies can contribute considerably to increased food supply.

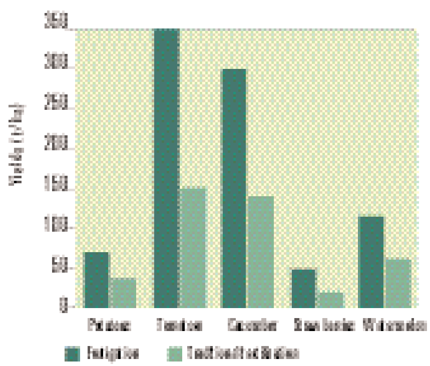
The potential phosphorus uptake efficiency by a given crop will vary depending on irrigation systems. In general, the higher the water use efficiency of the irrigation system, the higher is the phosphate uptake efficiency. With a well-designed irrigation system and good irrigation planning, the crop uptake of all fertilizer macronutrients is largely improved, as pointed in Table 1.

Table 1: Crop Uptake of P Fertilizer as Influenced by the Irrigation System (in % of P applied)

Irrigation system	Phosphorus
Furrow	10-20
Sprinkler	15-25
Micro-irrigation	25-35

Thus, drip and other micro-irrigation systems are not only highly efficient methods for water application; they are also ideally suited for application of phosphate fertilizers (fertigation). Because water-soluble phosphate fertilizers at the concentrations required by crops are conveyed via the irrigation stream to the wetted volume of soil, the distribution of phosphate fertilizers in the irrigation water will place them in the desired location (the root zone). This will improve considerably the use efficiency of phosphate fertilizers. Continuous application of orthophosphates through irrigation water has been shown to be superior to applying P in adequate quantities as basal fertilization (Figure 2).

Figure 2: Yields of some crops irrigated with pressurised micro-irrigation systems as influenced by fertigation and traditional-fertilization



This superiority stems from the fact that both P adsorption and P precipitation, which reduce P concentration in the soil, are time-dependent reactions. Due to frequent P application via the water, the residence time of P in the soil is reduced appreciably, and P concentration in the soil solution between successive fertigations is considerably higher than that expected from adsorption and precipitation equilibrium considerations. On this aspect, it has been shown that the rate of P movement increased 5 to 10 folds when P is applied through drip system, compared to this movement when P is applied in uniform manner.

For a fertilizer to be appropriate for fertigation, it must be water-soluble. However, due to their low solubility, most of the common P fertilizers are not convenient for fertigation. Moreover, it has been shown that the traditional application of P fertilizers to soil before planting is not sufficiently effective and appropriate for modern irrigation agriculture.

Very frequent phosphorus fertigation increases substantially P concentration in the soil solution above that expected from pure P solubility considerations. Thus the need for the use of the soil as storage reservoir for water and phosphorus nutrient is minimized (Table 2). By placing phosphate fertilizer in the soil volume where roots are most active, frequent P application via drip irrigation stream was particularly effective for crops that require local P concentration in the soil solution to exceed the concentration that is needed under other conventional irrigation methods in order to compensate for reduced root weight per plant. It has been reported that P application with drip irrigation is a promising means to achieve high, good-quality crop yield, because it is possible to maintain P concentrations at required levels during all the critical growth stage period without excess or undue losses.

Different sources of P fertilizers may be affected by soil and irrigation-water pH. High pH values (>7.5) in the irrigation water are undesirable. Ca and Mg carbonate and orthophosphate precipitations may occur in the tubes and the drippers. In addition, high water pH may reduce Zn, Fe and P availability to plants. The desired pH is below 7 and the range favored by most cultivated crops is 5.5 - 6.5. The pH of the irrigation water could be reduced or controlled by using acid or acid based P fertilizers like urea phosphate (UP) and mono- ammonium phosphate (MAP). Di-ammonium (DAP) applications under calcareous soil and high water-pH conditions is not recommended. Besides being less effective, it may create problems of clogging in the irrigation system and the fertigator. The UP and MAP, due to good solubility, are good sources of P for fertigated crops (Figure 3). Besides their good solubility, UP and MAP are acid fertilizers, a characteristic that makes these fertilizers particularly attractive for fertigation in areas where water and soil pH is high. Acid fertilizers prevent chemical clogging of the micro-irrigation and fertigation systems.

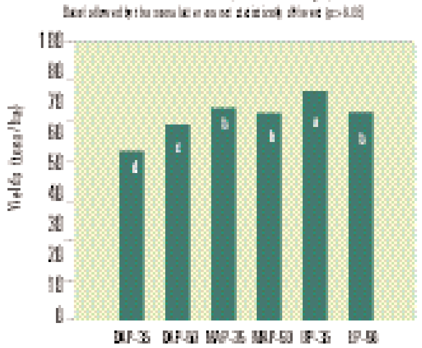
Table 2: Percentage phosphorus uptake derived from fertilizer, as affected by once and for all P application at planting of french beans, or application through fertigation at various rates and frequencies.

Treatment	% P Uptake derived from fertilizer
P soil (180 mg/pot)	5.28 a
P_1: 15 mg P/l with every irrigation (180 mg P/pot)	10.54 b
P_2: 45 mg P/l following the third irrigation (180 mg P/pot)	6.74 c
P_3: 90 mg P/l following the sixth irrigation (180 mg P/pot)	4.66 d
P_4: 45 mg P/l with every third irrigation, starting from the first irrigation (180 mg P/pot)	10.19 b
P_5: 90 mg P/l with every sixth irrigation, starting from the first irrigation (180 mg P/pot)	13.06 a

Data followed by the same letter are not statistically different ($p > 0.05$)

Figure 3: Yield of sweet pepper as affected by DAP, MAP and UP applied at low concentrations (25 and 50 mg/l)

Data followed by the same letter are not statistically different (p>0.05)



CONCLUSIONS AND RECOMMENDATIONS

Modern irrigation has developed very rapidly from an experimental technique into a commercially significant technology. The ability to carefully control water application not only offers improved efficiency in the use of an increasingly scarce natural resource for agriculture, but also opens the door to new and more efficient ways to manage fertilizers and other agricultural chemicals. However, the role of modern irrigation/fertigation for sustaining agriculture on environmentally sound bases will depend in the future on a number of factors to which particular attention should be placed:

1. Availability and cost of micro-irrigation/fertigation systems should not be considered any more as a real constraint since reliable and relatively cheap equipment is available in most countries.

2. The micro-irrigation systems must operate properly, since any failure and/or losses of water also cause losses of fertilizers and other chemicals applied with the irrigation water. In this respect, design and operation of the micro-irrigation systems must be proper to ensure uniform water distribution without losses.

3. Sound irrigation using modern irrigation technology must rely on adequate background information on crop water requirements. There are indications, however, that under micro-irrigation systems, crop water requirements are changing. Therefore, research on this aspect could be of particular help to further improve water application efficiency.

4. In order to be able to get the highest possible benefits out of the use of modern micro-irrigation technology, fertigation should be considered as an indispensable component of the system.

5. Research on fertigation should be intensified since any nutrients application through irrigation water that is not based on crop requirement might create serious environmental problems.

6. Intensification of irrigated agriculture, which means increased fertilizer application, should be considered as the main road to increasing yield in order to meet the pressing demand for more food supply.

7. There is no problem finding the required P-fertilizer for fertigation as good and convenient fertilizers are largely available.

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Balanced fertilization in Pakistan

Fertilizer consumption in Pakistan has steadily increased over the past five decades, from a total of 10.2 tons of exclusively N fertilizer nutrients in 1955 to 1.079 million ton-nutrients (N+P205+K20) in 1980, and 2.413 million tons in 1999. Since late eighties, however, increasingly imbalanced fertilizer use with N: P205 ratio currently reaching 4:1 is becoming detrimental to the sustainable agriculture development in Pakistan.

This article considers the benefits associated with balanced fertilization of main crops in Pakistan. It presents data and information largely drawn from work carried out in Pakistan since 1988 with IMPHOS assistance and in close collaboration with FAO and NFDC (National Fertilizer Development Centre, Pakistan).

TRENDS IN FERTILIZER USE AND CEREAL PRODUCTION

Among agricultural inputs, increasing fertilizer use (figure1) boosted production of the major crops grown in Pakistan. Total wheat and rice production increased from 4.3 million tons in 1955 to 9.5, 15.6, 19 and 22.6 million tons, in 1970, 1980, 1990, and 1999, respectively. Over these spans of time, average wheat yields increased from 0.7 ton per hectare to 1.18, 1.56, 1.82, and 2.16 tons per hectare over the same periods (figure 2).

The rather limited wheat and rice production in the last decade (19 % increase between 1990 and 1999 compared with the 64 % increase between 1970 and 1980) seems to be largely due to the imbalanced use of nutrients as illustrated by the massive use of nitrogen to the detriment of phosphorus.

FERTILIZER APPLICATIONS BY PROVINCE

In Pakistan, agriculture account for 24% share of the national income, employs nearly 50 % of economically active population, and is directly responsible for 70 % Pakistan's exports. The cultivated land is about 21 million hectares spanning four provinces-Punjab, Sindh, NWFP, and Balochistan-whose shares in Pakistan yearly fertilizer consumption amount to 71.0, 21.7, 5.9, and 1.4 %, respectively. The level of nutrient use per hectare and average N: P ratios in these provinces in 1998 are given in table 1.

Although fertilizer applications per hectare vary widely among provinces and crops, the imbalance in applied nutrients is widespread in the whole country, with the result that the average nationwide N: P ratio was 1: 0.21 in 1998.

BALANCED FERTILIZATION

During the period 1985/1986 to 1995/1996, the four major crops, wheat, rice, cotton and sugar cane, showed rather limited yield increases despite the growth in nitrogen use. The potential gain in agricultural productivity from increased nitrogen use could not be realized due to low phosphate and potassium uses. Indeed, because of this poor management, fertilizer use efficiency proved to be very low at farm level, as demonstrated by hundreds of on-farm trials conducted every year since 1988 by the FAO and NFDC network of trials. They covered the four provinces, and were implemented under the IMPHOS project: «Balanced Fertilization Through Phosphate Promotion at Farm Level».

Crops tested extensively under this experimental network included irrigated and rainfed wheat, irrigated and lowland rainfed rice, maize, cotton, sugar cane, and onions. From these trials, good volume of data were collected and presented at the NFDC symposium in Pakistan, or other regional or international meetings. Recent data obtained in 1998/1999 in Punjab and Sindh, the two most important crop production provinces, are reported in table 2-a, and 2-b.

The average N: P205: K20 fertilizer ratio used in the conducted trials on the three major cereal crops, wheat, rice, and maize, was 1:0.70:0.50, which is higher than the average for each ratio of the four provinces.

As illustrated in tables 2-a and 2-b, yield increases due to more P balanced fertilization vary from 25% with respect to cotton in Sindh to 69% for sugarcane. In contrast, additional crop yield increases from K application (comparison of yield increments in response to NP and NPK) were in general less than 10 %, reaching a maximum of 17 % with respect to sugar cane. This fact indicates that balancing N application with adequate P dose is the key to increasing crop production and promoting sustained agricultural growth in Pakistan.

The current national average wheat yield of 2 tons per hectare shows a gap of about 80 % compared with the yield levels obtained from farm trials (table 2). This means a wide potential for increasing wheat yield that could be generalized to almost all other crops under consideration. It clearly demonstrates how further P fertilization is needed to boost crop productivity in Pakistan.

Figure 1 : Trends in fertilizer consumption in Pakistan

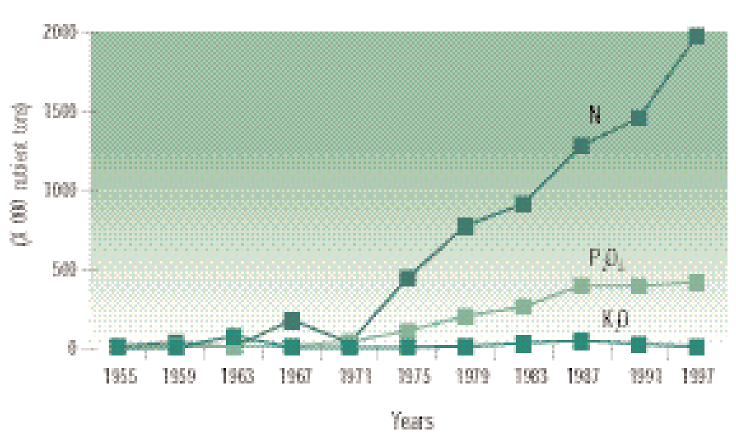

Figure 2 : Wheat and rice production and average yields

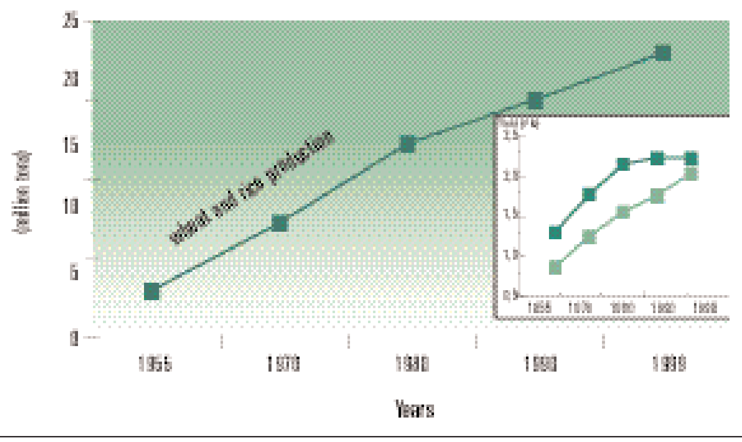

Table 1: Fertilizer use and nutrient ratio by province in Pakistan

Provinces	1998	
	Kg / ha (nutrients)	N : P ratios
Punjab	106	1: 0.22
Sindh	154	1: 0.19
NWFP*	61	1: 0.18
Balochistan	48	1: 0.13

*NWFP: North Western Frontier Province

Table 2-a: Crop responses to NPK applications in Punjab, Pakistan, 1998.

Crop	$N:P_2O_5:K_2O$ application (kg/ha)		Yield (kg/ha)	Increased yield over control (kg/ha)	(%)
Irrigated	Control	0	1521	-	
Wheat	N:	120	2707	1186	78
	$N: P_2O_5$	120-90	3907	2386	157
	$N: P_2O_5: K_2O$	120-90-60	4204	2683	176
Paddy rice		0	1981	-	
(Basmati)		120	2790	809	41
		120-60	3574	1593	80
		120-60-100	3728	1747	88
Maize		0	1852	-	
		120	3815	1963	106
		120-90	5704	3852	208
		120-90-60	6222	4370	236
Cotton		0	1245	-	
		150	1628	383	31
		150-60	2074	829	67
		150-60-100	2303	1058	85

Table 2-b: Crop responses to NPK applications in Sindh, Pakistan, 1998

Crop	$N:P_2O_5:K_2O$ application (kg/ha)		Yield (kg/ha)	Increased yield over control (kg/ha)	(%)
Irrigated	Control	0	1223	-	
Wheat	N:	150	2775	1552	127
	$N: P_2O_5$	150-100	3736	2513	205
	$N: P_2O_5: K_2O$	150-100-60	4041	2818	230
Paddy rice		0	2010	-	
(Basmati)		150	3707	1697	84
		150-90	5683	3673	183
		150-90-60	6023	4013	200
Maize		0	29867	-	
		275	56500	26633	89
		275-100	95667	65800	220
		275-100-150	111667	81800	274
Cotton		0	963	-	
		150	2214	1278	136
		150-50	3039	2103	225
		150-50-100	3127	2191	234

CONCLUSION

Balanced fertilization practices clearly show after more than 10 years of continuous testing, in opposition to current farmers' practices, the benefit and the need to promote nationwide balanced fertilization schemes in Pakistan. Although the use of potassium and micronutrients is still required in some production areas, improved nitrogen and phosphorus ratios, which basically translates into increased P fertilizer use, is the overriding condition for sustainable growth of agricultural production in Pakistan.

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The Role of agricultural biotechnology in the developing countries

Biotechnology is any technique that uses a living organism or substances from those organisms to make a product, improve plants or animals or develop microorganisms for specific uses. In late eighties, biotechnology was perceived as a true miracle for the developing countries. Because plants were made resistant to cold, drought and major diseases, it was incorrectly predicted that crop yields would be multiplied and the problems of food supply would be largely resolved.

Still, the 1990's have seen dramatic advances in understanding the functioning of biological organisms at the molecular level and new abilities to analyze, understand and manipulate DNA molecules, the biological material from which the genes in all higher organisms are made. Molecular breeding of rice, for example, helped improve the disease resistance of this crop.

THE GENE REVOLUTION

Genetic modification(GM) presents a major prospect of helping the poor. Insertion of genes against aluminium toxicity into Mexican wheat, and of virus-resistant genes into Colombian potatoes and Kenyan sweet potatoes are striking examples of genetic modification. Rice hybrids can enhance yields in China. Beta-carotene enriching 'golden rice' has characteristics of huge value to millions of children at risk each year of blindness from vitamin A deficiency. But it will be important to turn these consumer gains into active consumer demand in order to give incentives to farmers to adopt such varieties(1).

CONCERNS

While it does show promise for reducing pesticide application, genetic engineering has not yet produced higher-yielding strains for the small farmer. What the poor farmers do want is genetic modification to raise yields, or to permit good plant types to grow in formely recalcitrant environments. While some researchers think that biotechnology will be able to pack more protein and minerals into cereal grains, D[r] Norman Borlaug dismisses any impact on yield: «Unless there is one master gene for yield, which I am guessing there is not, engineering for yield will be very complex. It may happen eventually, but through the coming decades we must assume that gene engineering will not be the answer to the world's food problems»(2).

THE PUBLIC SECTOR AS DRIVING FORCE

The few striking examples of agricultural biotechnology achievements in developing countries come mostly from the public sector. Who will be concerned with future research, apart from the public sector, to enhance the nutritional quality of food staples, or the resistance of African maize cultivars to moisture stress? Without a substantial public sector role in agricultural biotechnology research, it is unlikely that much attention will be given to the crops and cropping systems most relevant to poor farmers and consumers.

There is grotesque concentration of GM private sector research, as of medical research, on the often-peripheral preferences of the wealthy, to the neglect of public goods as well as of the basic needs of the poor. It is well known that the three crops that still dominate Genetically Modified plants in the field are maize, soybean and cotton. Unfortunately the yellow-maize varieties and the soybean, grown with GM, are almost all fed to animals rather than being used as staples for poor people. Besides, the adopters of GM crops in developing countries(Argentina and Brazil) have been mainly large farmers, often seeking herbicides-resistant crops.

BIOTECHNOLOGY IN PLANT AND ANIMAL NUTRITION(3)

Some companies are developing biofertilizers that are microorganism-based products to improve nutrient cycling. By coating seeds(inoculation) with a) a bacterium called rhizobium to make legume crops more productive at lower cost, or b) a fungus called Penicillium bilaji to make an organic acid that dissolves the phosphate in the soil so that the roots can use it, scientists and companies who create such biofertilizers claim that they make use of nutrients available in the air and soil more efficiently. However, they do not believe that such bio-fertilizers will replace mineral fertilizers.

One of the major developments that will impact the feed phosphate in the near-term is the development of low phytate grains and /or use of phytase enzymes. These can be added to rations or inserted genetically to increase P availability to non-ruminant animal. Research indicates that phytase supplementation effectively increases P utilization and availablity of other minerals in both animal and human diets. In some European countries, it will be mandated that phytase be added to feed for swine and poultry, a practice that is already well established. But will these practices find their way to developing countries?

CONCLUSION

There is considerable debate in both the media and academic circles about the risks and benefits of modern agricultural biothechnology. Most of this debate relates to the commercial cultivation of genetically modified crop varieties in the industrialized world. So far, very little attention has focused on the role that biotechnology might play in the developing countries, or how it might benefit poor farmers and consumers in those countries.

As with many other challenges and opportunities in agriculture, progress in biotechnology will be made through knowledge gained through relevant, well-directed research to fill in the gaps.

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Africa Could Feed Itself and Export Food

The International Policy Council on Agriculture, Food and Trade-IPC, an independent organization dedicated to developing policies that support an efficient and open global agricultural system, met in Zimbabwe on October 13-15, 1999 to examine Africa's future in world agricultural trade.

The IPC noted that, while Africa is the one continent that has experienced declining per capita food production for the past three decades, there are encouraging signs that Africa's farmers and food industry are responding to market opportunities. The council found that African agriculture has under-performed relative to its potential in the post-colonial period. There is no reason that Africa cannot efficiently produce more of its food supply and generate export earnings as well. However, for that to occur, African governments, which often tax their farmers heavily, must give higher priority to agricultural development, and high-income countries must stop burdening poor countries with the adverse spillover effects of their subsidy programs. Africa contains many of the world's poorest countries, and the majority of its poverty is in rural areas. In many African countries, 70 percent or more of the population are farmers, and they generate substantial fractions of their countries' GDP and export earnings.

Acknowledging the large amount of development assistance that has gone into Africa, and the continuing extent of poverty on that continent, the IPC concluded that expanded trading opportunities would help Africa more than aid. The same can be said for the special and differential treatment for low-income countries that past trade agreements have provided. Foreign assistance to low-income countries should be focused on increasing their competitiveness to take advantage of market opportunities.

However, developing countries often confront protectionist barriers in high-income countries for the very products that they can produce most efficiently, such as sugar and textiles. The IPC calls for special attention to be given to expanding access to high-income country markets for exports from low-income countries. There is a need to reduce further the tariff rates charged and, when agricultural imports are constrained by quotas, expand the volumes admitted at these reduced rates. Non-tariff barriers to Africa's food exports that have little basis in science should be dismantled.

The IPC is concerned that the common practice in the European Union and the United States of subsidizing agricultural production and then subsidizing exports of the resulting production - both directly and as food aid - is particularly harmful to farmers and the food industry in the low-income countries that receive those products. While this practice may help keep the price of food in the cities of the recipient countries, it depresses returns to their farmers, who are usually the lowest income members of society in poor countries. The IPC calls for continued reduction in subsidies linked to agricultural production and the export of specific commodities.

African governments also have an important role to play in encouraging development of their agriculture. Agricultural development will only occur if there is a stable macro-economic environment in which agriculture is not taxed more heavily than other sectors of the economy.

There is a need to be investments in rural roads and communications to link farms efficiently into the national and international economies. Governments need to create an enabling environment for private sector development in agricultural product and input markets, including both large and small farmers in growth opportunities. And governments need to break down the administrative barriers to freer movement of goods within the region.

Developing countries need investments - from both international assistance and foreign direct investment - that improve their competitiveness to ensure that as greater market access occurs, they will be in a competitive position to take advantage of those opportunities. This includes infrastructure, research, human resources and know-how, and laboratories to ensure that exporters can meet the food safety quality standards required by the international market.

■ SOURCE:

Excerpt of a press release from the International Policy Council on Agriculture, Food and Trade, October 18,1999. Internet : www.agritrade.org

Ways to control phosphorus losses from agricultural land In western europe

Control of phosphorus losses from agricultural land can be achieved in the following ways:

■ NUTRIENT MANAGEMENT:

• Apply phosphate fertilizers according to crop demand. Avoid risk of run-off with heavy applications of water-soluble phosphates during the winter.

• Use a mineral budgeting or nutrient management plan to record phosphorus inputs and outputs on a field-by-field and farm basis. The information needed is the inputs of feeds, fertilizers or manures used and crop yield records, and from these phosphorus output can be calculated. This will help identify any tendency for phosphorus to accumulate unnecessarily.

• When there is a risk of heavy rainfall and therefore surface run-off, delay wherever possible applications of phosphate fertilizers and especially livestock manures. Furthermore, incorporate wherever possible, livestock manures after or during application.

■ LAND MANAGEMENT:

• Establish winter crops early, leave seedbeds or stubbles rough by disking over and cultivate across slopes to reduce the risk of soil erosion.

• Avoid surface compaction and poaching of grassland as this can lead to increased surface runoff.

• In minimal cultivation systems, occasionally plough. This will reduce phosphorus enrichment of the surface soil layer as well as controlling weed growth.

• Use a grass buffer strip alongside watercourses to trap any horizontal movement of soil particles. The strip can be quite narrow, around 2m, and short grass is effective.

■ SOURCES: Excerpt from an article published by FACTS-TIS that is derived from reports submitted by ADAS to MAFF in England.

Fertilizer production and consumption in the CIS

Almost a decade passed since the initiation of economic reforms in the Community of Independent States[1] (CIS). Since then, agriculture production has fallen drastically and exports have increased dramatically.

The fertilizer sector of CIS is in as much, if not more, disarray than the agriculture sector. Over the past decade, politically induced economic instabilities, not only in the fertilizer industry but in the overall economy, combined with a privatization of the CIS fertilizer industry have resulted in a significant decline in CIS.

The current agricultural crisis in Russia or the Ukraine is not sustainable. Between 1991 and 1999, crop production in Russia fell by 40%. The financial situation of farmers is very bad: farm debt amounts to one hundred and seventy billion dollars. About 80% of farmers could not make profit in 1998. Many difficulties are due to the low purchasing power of agricultural producers. The devaluation of the Rouble and the financial turmoil of August 1998 reduced the purchasing power of the population by 30%. Yields of main agricultural crops are not increasing and remain at very low level (grain yields averaged 1170 kg/ha in 1999).

From 1987 through 1999, the total CIS grain area (wheat and coarse grains combined) declined by 11 million hectares, a 25.6 % decrease. Both Russia and Ukraine account for 6.6 million hectares- 60% of the overall decline.

This decline is compounded by a lower total grain yields in the CIS, including Russia and the Ukraine. Average grain yields dropped from 1.52 to 1.17 tons per hectare from 1987 to 1999, a decline of 23%. Yields in the Ukraine dropped from 3.25 to 2.18 tons per hectare, a decline of 33%.

A major factor contributing to the decline of grain yields in the CIS has been the drastic drop in domestic fertilizer production. Besides, the Russian fertilizer industry shifted from being an industry that produces primarily for the domestic market to one that now exports the bulk of its output. Economic constraints resulting from privatization of the fertilizer sector is largely responsible for the decline in CIS fertilizer production and consumption (fig.1,2). Since 1988, production and consumption of nitrogen dropped by 53 and 80% respectively. Similarly, production and consumption of phosphate dropped by 73% and 90%, respectively, while corresponding figures for potash are 52% and 88%.

(1) The Community of Independent States is a free association of sovereign states formed in 1991 and comprising Russia and eleven other republics that were formerly part of the Soviet Union: Russia, Ukraine, Belarus, Kazakhstan, Kyrgyz tan, Tajikistan, Turkmenistan, Uzbekistan, Armenia, Azerbaijan, Georgia and Moldavia.

Figure 1 : Production and consumption of phosphate fertilizers in Ukraine

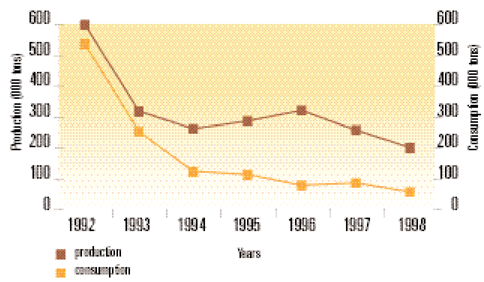
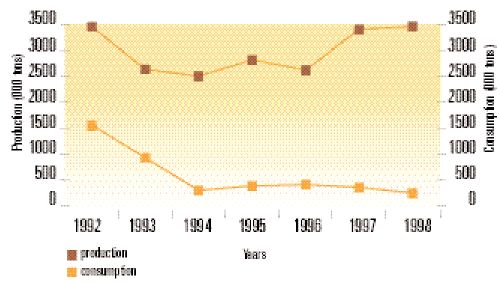


Figure 2 : Production and consumption of phosphate fertilizer balance in the Russian Federation



Worse yet, as production and domestic consumption of fertilizers have decreased since 1988, exports of the three macronutrients increased respectively by:

- 96% : For nitrogen ;
- 372% : For phosphorus ;
- 3% : For potash.

As expected in the absence of imports, lower production combined with increased exports, leaves less fertilizer available for domestic use. In fact, ammonia available for domestic consumption has declined by 32% in Russia and 39% in Ukraine (fig.3 and 4).

Figure 3 : cereal production vs fertilizer consumption in Ukraine

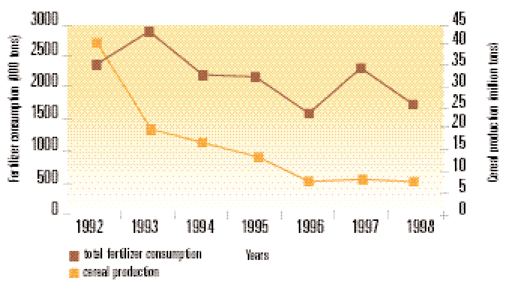
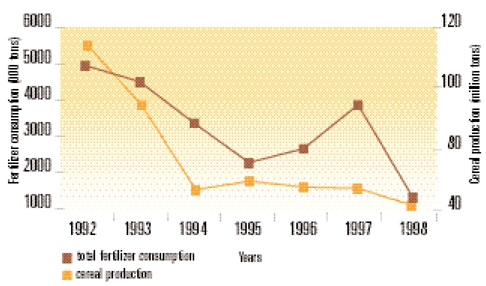


Figure 4 : cereal production vs fertilizer consumption in the Russian Federation



Combined, declining acreage and yields have reduced overall CIS grain production since 1987 by a total of 39.4 %. During the same period, total grain production in both Russia and Ukraine declined by about 40.7%. Domestic consumption of coarse grains in the CIS declined 58% between 1987 and 1999. In Russia alone, the coarse grain consumption during the same period has dropped a dramatic 61%. Similarly, in the Ukraine, domestic consumption of coarse grains has declined a total of 47.5%. In Russia and the Ukraine, wheat consumption has also declined.

With regards to exports, Russia has been a net exporter of coarse grains in three of the last six years and Ukraine has been a net exporter of both coarse grains and wheat since 1993.

Declines in production and use of grains have resulted in the coarse grains stocks-to-use ratio declining to 4% in Russia during 1999. This is down from the average (since 1987) stocks-to-use ratio of 9.3%. In Ukraine, the stocks-to-use ratio for grains is only slightly better than in Russia. The average stocks-to-use ratio level for coarse grains is anticipated to be 7% for 1999, down from over 22% since 1987. Restoring the total grain stocks-to-use ratio to a more comfortable 20% in both Russia and Ukraine would require the import of 13 million tons of wheat and coarse grains.

At present, agriculture is the most backward and conservative sector in the CIS economy. The current agricultural policy of CIS Governments is aimed at stopping the fall in production and stimulating its growth by supporting the fertilizer industry and subsidising transport and marketing of fertilizers.

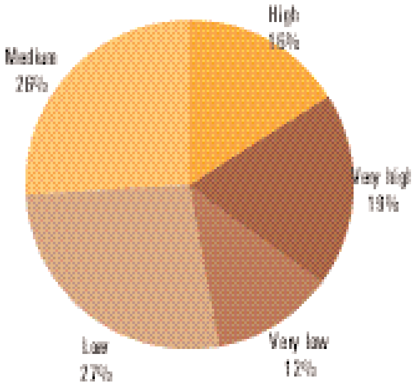
REFERENCES :

- The State of Agricutlure in Russia : Present and Future By N. Andreyeva, IMEMO-Russia
- IFDC Study from TFI, EFMA, IFA and CFI
- IFA, FAO statistics.

Soil phosphorus status in Poland

Soils in Poland are commonly acid. About 58 % of the cultivated soils are acid to very acid (pH less than 6.0) and inherently low in plant nutrients.

Plant-available phosphorus in cropped lands is generally low. The fact that 65 % of the cultivated soils have very low to medium soil phosphorus status indicates the crucial need for P fertilizer use in this country.



Available background information on soil phosphorus status in this country are very helpful in selecting relevant areas where more focus is needed to initiate and develop P fertilizers use to boost crop production.

■ SOURCES:

M. Fotyma and S.Gosek. 2000. General Characteristics of Agriculture in Poland. In Fertilizer and Fertilization. Document N°1(2), Rok II, published by IPI/Switzerland, and the Institute of Soil and Plant Cultivation /Poland.

The Role of fertilizers in the green revolution

If the high-yielding dwarf wheat and rice varieties are the catalysts that have ignited the Green Revolution, then chemical fertilizer is the fuel that has powered its forward thrust.

New tested varieties not only responded to much heavier fertilizer dosages than the older ones, but they also used them more efficiently.

In India and Pakistan, consumption of nitrogen and phosphorus fertilizers, the two most largely used plant nutrients, increased as indicated in the table.

A large part of the fertilizer being used was for wheat. Using the base Green Revolution crop year 1964-1965, wheat production in Pakistan increased from the base figure of 4.6 million tons, to 6.5, 6.7 and 7.3 million tons, in 1968,1969 and 1970 respectively.

Trends of fertilizer consumption

	INDIA		PAKISTAN	
	N fertilizers	P fertilizers	N fertilizers	P fertilizers
Years	(tons nutrients)		(tons nutrients)	
1950-51	58,000	26,000	1,000	n
1964-65	555,000	150,000	84,147	1,029
1969-70	1,350,000	400,000	272,566	33,801

n: negligible

Indian wheat production rose from 12.3 million tons in 1964-65 to 16.5, 18.7, and 20.0 million tons in 1968, 1969 and 1970, respectively.

From 1964-65 to 1969-1970, N and P fertilizer use in India increased by about 140% and 160 %, respectively, which resulted in 60 % increase in wheat production, besides positive effects on other crops,.

■ SOURCES:

(1). Norman E. Borlaug. The Green Revolution: Peace and Humanity. A speech delivered on the occasion of the awarding of the 1970 Nobel Peace Prize in Oslo, Norway, on December 11, 1970.

(2). FAOSTATS, 1998.

Balanced fertilization of rapeseed and other oilseed crops

«Current Problems of Balanced Fertilization in Oil Rapeseed and other Oil Crops» was the topic of a 2-day workshop organized by the Agricultural University of Poznan in Poland in collaboration with the World Phosphate Institute and the International Potash Institute. Held in Poznan - Sielinko, Poland, on 16 and 17 May 2000, the workshop was attended by about 150 participants from Poland, constituting mainly extension workers, farmers, scientists, and decision-makers.

In addition, delegates from IPI and IMPHOS, and representatives from Germany, Czech Republic, Belarus, Russia and Slovak Republic also participated in the workshop.

The workshop addressed the state and prospects for oilseed crops in Poland and neighboring countries. It covered subjects ranging from genetics and breeding of rapeseed, organic and inorganic fertilization practices, and rapeseed diseases.

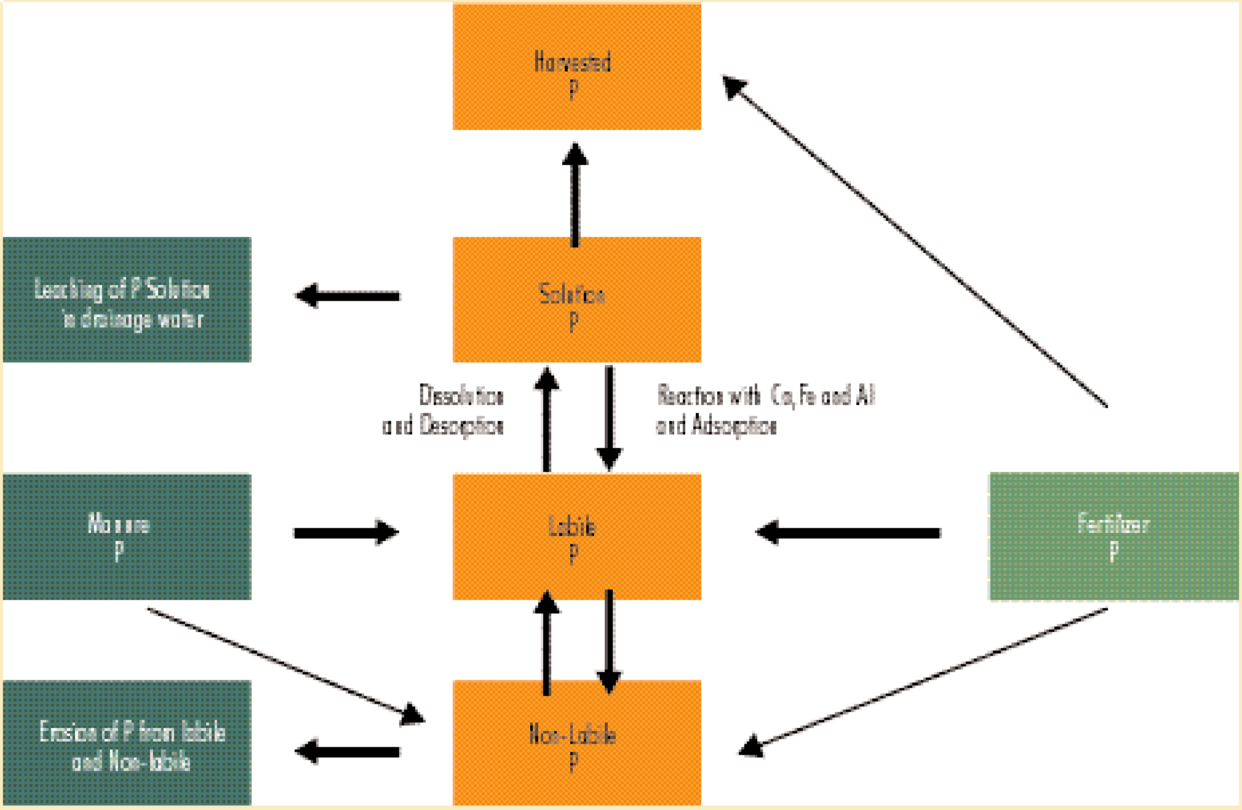
Rapeseed yields are currently rather low in Poland compared to the potential yield of this crop. Average rapeseed yields ranges from 2.5 to 3 t/ha while the «theoretical potential yield» is 9 t/ha. The main reason for this big discrepancy is the high sensitivity of rapeseed to physiological stresses caused by natural and agro-technical factors such as light, rainfall, and nutrient availability during plant reproductive and mature stages.

Fertilizer use in Poland is not only below crop requirements, but it is also unbalanced. For instance, the average phosphate fertilizer rate applied to rapeseed in 1993 was 53 kg P2O5/ha while the total uptake was estimated at 125 kg P2O5/ha; as seeds remove 75 kg P2O5/ha. The negative P balance induces soil P mining and reduces soil P supply to the following crop. Consequently, crop yields are declining as N and K fertilizer use by crops become less and less efficient. The result is a financial burden for the farmers and an environment burden for the public

The workshop was an opportunity to demonstrate to farmers the benefits associated with balanced fertilization and to inform decision-makers on the implications of unbalanced fertilizer practices for soil fertility and crop yield sustainability.

Fertilizer costs were also a topic for discussion and it was pointed out that the fertilizer accounted for more than 40% of direct crop production costs. In order to reduce these costs, research is currently underway to assess the potential and benefit of partially acidulated phosphate rocks, as P fertilizer sources. Preliminary results from this research showed that phosphate rocks partially acidulated at 50 % are as efficient as totally water-soluble phosphates.

The Phosphorus Cycle



Leaching: Loss of dissolved P during downward movement of water through the soil is usually thought to occur only at very high levels of available soil P.

Desorption : Reverse of adsorption involving release of adsorbed P into solution.

Erosion: Main route by which P can be lost from agricultural land, it involves movement of very small amounts of soil across the surface.

Non-labile P: P that is present in the soil but which enters solution only very slowly. There is no clear distinction between labile and non-labile P, instead there is continuum from readily soluble to almost completely insoluble forms of P.

Solution P: P in soil solution in the form of HPO_4^{2-} - or PO_4^{3-} ions that can be taken up by plants.

Adsorption: Process by which P in solution becomes attached to the clay minerals or organic matter in soils.

Adsorbed P forms part of the labile fraction.

Lock - up: Reactions between P and calcium (favored at high Soil pH) or iron and aluminum (favored at low soil pH) that result in a reduction in P solubility.

Labile P: P that is not in solution but which can dissolve readily.

REFERENCE Excerpt from an article published by FACTS-TIS that is derived from reports submitted by ADAS to MAFF in England.

COMING EVENTS :

Fore more information about the upcoming fertilizer related events 2001, Please contact directly the following organizers :

19 - 24 Feb. : IFDC - International Training program on Agricultural Input Marketing
International Fertilizer Development Center, Ghana
Fax : + 1 256 381 7408
Email : hrd@ifdc.org - ***Web :*** www.ifdc.org

3 - 6 March : International Fertiliser Society Symposium
Fertiliser resource Management for Food Security, Quality and the Environment
Lisbon, Portugal
Fax : + 44 1904 492 700
Email : secretary@fertiliser-society.org
Web: www.fertiliser-society.org

25-27 March : 12th Fertilizer Latin America Conference & Exhibition
British Sulphur - Miami, Florida, USA
Tel : + 44 20 7903 2402/2444 - fax : + 44 20 7903 2432
Email : sbeattie@cruint.tcom.co.uk
web : www.britishsulphur.com

21 - 24 May : IFA 69th Annual Conference
Sydney, Australia
Web : www.fertilizer.org

28 - 29 May : Fertilizer Industry Federation of Australia Conference
Gold Coast, Australia
Fax : + 61 7 3251 0115E
Email : drmcg@ozemail.com.au - ***Web :*** www.fifa.asn.au

3 - 6 June : International Fertilizer Society Study Tour and General Meeting
South - West France
Fax : 44 1904 492 700
Email : secretary@fertiliser-society.org
web : www.fertiliser-society.org

18 - 29 June : IFDC - United States Study Tour on Advances in Agricultural Production and Fertilization
International Fertilizer Development Center, USA
Fax : +1 256 381 7408
Email : hrd@ifdc.org - ***web :*** www.ifdc.org

25 - 26 June : IAMA 11th World Food and Agribusiness Forum
Sydney, Australia
Fax : + 1979 862 1487
Email : iama@tamu.edu - ***Web :*** www.ifama.org

16 - 20 July : IFDC - International Meeting on Direct Application of Phosphate Rock and Related Appropriate Technology, Latest Developments and Practical Experiences
International Fertilizer Development Center, Malaysia
fax : + 1 256 381 7408
Email : hrd@ifdc.org - ***web :*** www.ifdc.org

28 July - 3 Aug : 14th International Plant Nutrition Colloquium
Hannover, Germany
Fax : + 49 511 762 3611
Email : ipnc@mbox.uni-hannover.de

3 - 9 Aug : 12th CIEC World Fertilizer Congress
International Scientific Centre of Fertilizers (CIEC) - Beijing, China
fax : + 49 531 596 377
email : CIEC2001@pb.fal.de
Web : www.pb.fal.de

13 - 22 Aug : IFDC - Fertilizer Recommendations for Optimum Crop Production
International Fertilizer Development Center, Malawi
Fax : + 1 256 381 7408
Email : hrd@ifdc.org - ***Web :*** www.ifdc.org

12-15 Sept : IFA Production and International Trade Conference
Quebec, Canada
Web : www.fertilizer.org

10 - 28 Sept : IFDC - Modern Techniques in Fertilizer Distribution and handling
International Fertilizer Development Center, Europe
Fax : + 1 256 381 7408
Email : hrd@ifdc.org - ***Web :*** www.ifdc.org

14 - 17 Oct : Sulphur 2001
British Sulphur - Marrakech, Morocco
Tel : + 44 20 7903 2402 / 2444
fax : + 44 20 79032432
Email : sbeattie@cruint.tcom.co.uk
web : www.britishsulphur.com

15 - 26 Oct : IFDC - International Training program on Computer Simulation for Crop Growth and Management Responses
International Fertilizer Development Center, South Amercia
Fax : + 1 256 381 7408
Email : hrd@ifdc.org - ***Web :*** www.ifdc.org

11 - 13 Nov : IFA 27th Enlarged Council Meeting
Cairo, Egypt
Web : www.fertilizer.org

5 - 16 Nov : IFDC - International Fertilizer Marketing Training Program
International Fertilizer Development Center, Indonesia
Fax : + 1 256 381 7408 -
Email : hrd@ifdc.org - ***Web :*** www.ifdc.org

3 - 5 Dec : International Symposium - «Importance of Potassium Nutrient management for Sustainable Crop Production in India»
International Potash Institute (IPI) and the potash Research Institute of India
New Delhi, India
Fax : + 91 124 634 1792 - ***Email :*** priin@bol.net.in
Fax : + 41 61 2612925 - ***Email :*** ipi@iprolink.ch

10 - 14 Dec : IFA regional Conference for Asia and the Pacific
Hanoi, Vietnam
Web : www.fertilizer.org