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II IPI-EMBRAPA Solos Symposium on "Potash in Agricultural Systems of Tropical Savannas of South America: Adequate Fertilizing Practices in Areas with Poor Soils", Bonito MS, Brazil 19-21 September 2006.

A. Naumov, IPI Coordinator for Latin America.

Country	Local Name of Region/Landscape	States/Provinces/Departments	% of Land Area
Argentina	Región Norte	Santa Fé, Santiago del Estero, Chaco, Formoza, Córdoba* (Chaco forests); Corrientes (Campos)	
Bolivia	Llanos	Beni, Santa Cruz, Chuquisaca, Tarija	50
Brazil	Campos, Campos cerrados (cerrados), Campos limpos	Mato Grosso, Mato Grosso do Sul, Goiás, Tocantins, D.F., Bahia*, Maranhão[1], Piauí*, Minas Gerais*, São Paulo[1], Roraima*	24
Colombia	Llanos Orientales	Meta, Arauca, Casanare, Vichada	29
Paraguay		Amambay, Concepción, San Pedro, Canindeyú, Alto Paraná, Caaguazú, Cordillera, Guairá, Caazapá	25
Venezuela	Llanos de Orinoco	Apure, Barinas, Portuguesa, Cojedes, Guárico, Anzoátegui, Monagas, Delta-Amacuro*	33

Table 1. Savannas in South America (*Source:* A. Naumov).

* Only part of state/province under savanna vegetation.

The symposium, organized by Latin America Coordination of International Potash Institute (IPI) and National Soils Research Center of the Brazilian Corporation for Agricultural Research (EMBRAPA), was a satellite event of FERTBIO – Congress of Soil Fertility and Plant Nutrition, the major biannual event on these topics in Brazil. The 2nd half-day sessions of the symposium which included 9 presentations were attended by more than 200 participants of FERTBIO who took part in discussions. The symposium was opened by welcoming speeches from Mr. Hillel Magen, IPI Director, and Dr. Aluisio Andrade, R&D Chief of the National Soils Research Center of EMBRAPA.

Participants of IPI-EMBRAPA Solos symposium, 19-21 September 2006.

Dr. Alexey Naumov, Coordinator of the Latin American program of IPI and Associate Professor of Moscow State University, Russia, spoke about the geography and agricultural development of tropical savannas regions in South America. Savanna landscapes occupy a large area at this continent, belonging to Brazil, Colombia, Venezuela, Bolivia, and Paraguay (Table 1). Areas with similar climatic characteristics are also found in subtropical parts of the Northern Argentine. Most of the savannas are suitable for agriculture because of the hot and wet climate, plain relief, and good physical conditions of the soils. But the savannas soils are acid, contaminated with Al and Fe oxides, and poor in nutrients, which limits their agricultural development. Colonization of the huge land reserves, available in the savanna areas, is thus dependent on soil correction and fertilization. Dr. Naumov reviewed the current situation in agriculture and prospects for its further development in savanna areas of Colombia (Llanos Orientales), Venezuela (Llanos de Orinoco), Bolivia (Oriente), Paraguay, Brazil (Cerrado) and of the northern provinces of Argentina. In conclusion, he spoke about joint research activities of IPI and EMBRAPA with special focus on field experiments, carried out since 2001 in different parts of Brazilian Cerrado. See presentation titled "Tropical Savannas Regions in South America: Geography and Agricultural Development" (in English) at http://www.ipipotash.org/speech/.

Dr. Rachel Bardy Prado (EMBRAPA National Soil Research Center, or EMBRAPA Soils) presented provisional results of research, which aimed to map potash balance in Brazilian soils (Fig. 1). The balance between data on potash application on the one hand and export with the main commercial crops on the other was already mapped on a national scale 2 years ago. The next step had been to compare these balances with data on potash availability from 2600 soil profiles collected by EMBRAPA Soils. For major geographical coverage, soil profile data were extrapolated to landscape contours. These extrapolations allowed the design of maps of potash availability in areas of Latossolos (Ferralsols, or Oxisols, according to FAO and U.S. classifications, respectively). Currently, the research is focused on detailed (large-scale) mapping of the Southeast of Goias state. During the AGRISHOW agricultural fair at Rio Verde, Goias in April 2006, many local farmers registered as volunteers to provide data for mapping. Soil analysis data of COMIGO cooperative land properties were also included. Collected information was stored in a data bank. In

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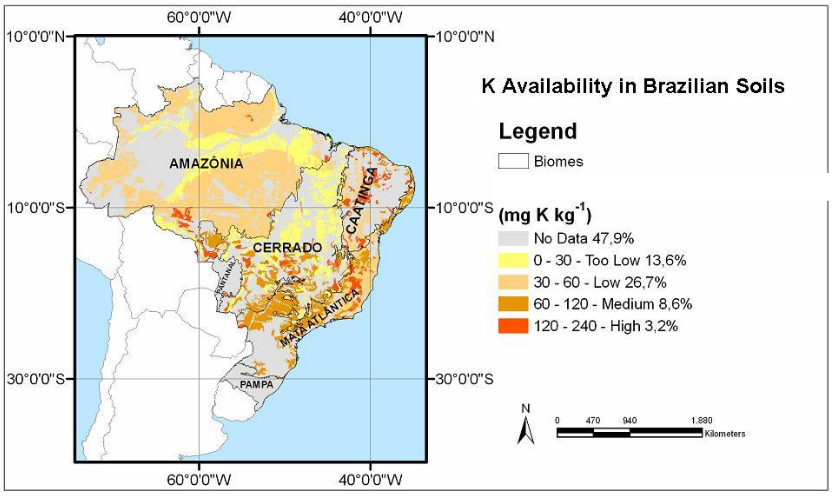

Fig. 1. Mapping of K availability in soil, based on soil profile data (Latossolos and Argissolos; landscape type as mapping unit) (*Source:* R. Prado).

addition, soil samples were gathered for validation. Relief and soil maps, satellite images are also being used for the design of a 1:250,000 map of potash balance in Goias state.

See presentation titled "Proposal for Mapping of Potash Availability in Soil for Southwest of Goias State" (in Portuguese) at http://www.ipipotash.org/speech/.

Dr. Joao Kluthouski (EMBRAPA Rice and Beans Center) focused on integration between crop planting and cattle grazing as a decisive measure for sustainability of Brazilian agriculture. Since 1980, costs for agricultural machinery and fertilizers, in relation to market price of soybeans, rice and other cereals in Brazil had grown very significantly. I.e., in 2005, the cost of 1 t of fertilizer (NPK) was equal to 41 sacks of soybean or 65 sacks of rice (sack = 60 kg), whereas in 1980 these figures were 15 and 13 sacks respectively. Production costs were growing along with colonization of the Brazilian Cerrado, where originally poor soils were being converted from pasturing to agriculture crop production. *Dr. Kluthouski* stressed that more than 40 million ha of pastures in Brazil are degraded. As a measure for improving land use, he proposed different ways of combining planting and grazing. Planting combined with pasturing reduces costs of production because of organic fertilizer application, intensification and diversification of land use (forage and commercial crops grown in rotation). For grazing, benefits are the recuperation of degraded pastures, forage production between main harvests, and possibilities for genetic improvement of husbandry. One of the integrated systems, designed and recommended for the Cerrado by EMBRAPA, is the so-called "Santa Fe" (maize, sorghum, rice, sunflower, combined with tropical forage grasses) (Fig. 2). This system is highly demanding for K and other nutrients. Experimental data provide proof of such advantages of integrated systems, which includes rapid decomposition of harvest residues and mineralization of organic matter (5 times faster than conventional systems) and faster recycling of nutrients.

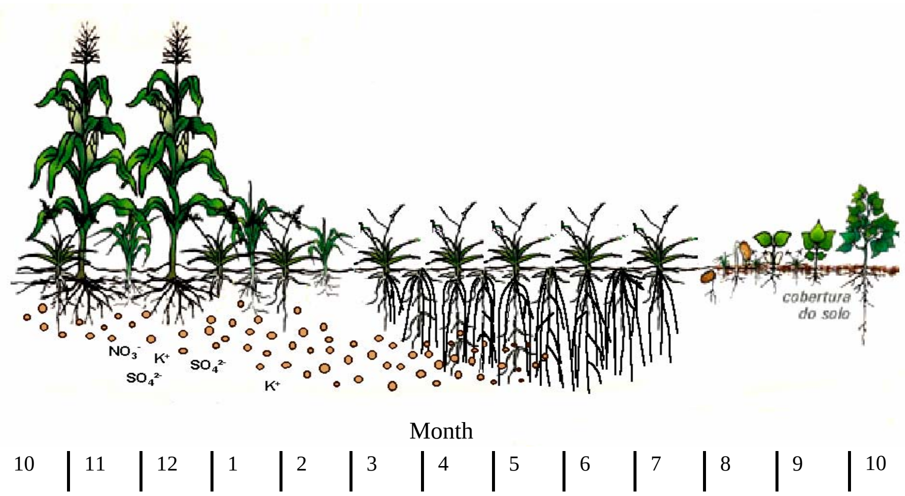

Fig. 2. Dynamic of nutrients in "Santa-Fe" system of integrated planting of grains (months and forage grasses (*Source:* J. Kluthouski).

Dr. Pedro Machado (EMBRAPA Rice and Beans Center) devoted his presentation to precision agriculture techniques with special focus on potash fertilizing in a high productivity soybean planting specialized no-till system. His presentation was based on results of research carried out in Carambei, Parana state (Brazil) where a no-till system has been in practice since 1983. Experimental sites are relatively small – 13 ha of soybeans, planted in rotation with wheat, maize and black oat. The soil is the *Latossolo Vermelho* (tropical red soil). Digital mapping of the field was based on a 40 x 40 m network. Soil analysis showed the following average of exchangeable K expressed as mg dm^{-3} decreasing at depth from 160 at 0-5 cm, to 87 from 5-10 cm to 66 from 10-20 cm. Fertilizing recommendations, depending of K availability, oscillate between 80 to 120 kg K_2O/ha. The results of the experiment did not show a significant response in yield to K application; productivity of soybean was more influenced by physical characteristics of the soil.

See presentation titled "Integration of Planting and Cattle Grazing in No-Till: Decisive Solution for Sustainability of Brazilian Agriculture" (in Portuguese) at http://www.ipipotash.org/speech/.

Roger Taboada Paniagua (CIAT –

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International Center for Tropical Agriculture, Santa Cruz de la Sierra, Bolivia), spoke about the main crops and fertilizing practices in tropical savannas of Bolivia. Two thirds of Bolivian territories are lowlands, at altitudes below 1,500 m in height. One third of this territory is part of the Amazon basin, and a quarter is tropical savanna. 250,000 ha of savannas are included in the department of Santa Cruz, and 130,000 ha in the department of Beni. The principal commercial crops are soybean, maize, rice and sugarcane in summer, and soybean, sunflower, sorghum and wheat in winter. Fertilizing is mostly carried out with "triple 15" (NPK 15:15:15). For rice and wheat, planted in rotation with soybean, farmers apply N as urea (50-150 kg/ha); sugarcane plantations also receive high applications of N.

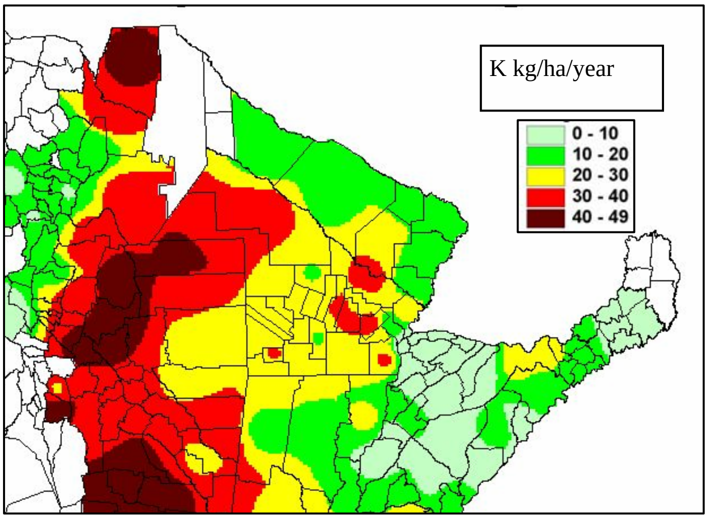

Fig. 3. Export of potash (K/ha) in North Argentina (*Source:* R. Melgar).

Monitoring the soil during a 3 year period of continuous planting showed a decrease of nutrients (15% organic matter, 19% P, 12% K), which could be partially made up for after 1 year of pasturing on the same area. After 3 years of pasturing, nutrient contents increased significantly.

See presentation titled "Main Crops and Fertilization Practices in the Tropical Savannas of Bolivia" (in Spanish) at http://www.ipipotash.org/speech/.

Dr. Ricardo Melgar (INTA – Instituto Nacional de Technologia Agropecuaria, Argentina), spoke about Potash in agricultural systems of northern Argentina, a region of recent expansion of agriculture. Historically, these lands were used for pasturing. Fertilizers (mostly P) were used for cotton, rice and soybean planting, with application rates which were equal in amount to the export of this nutrient with the crop. Crops receive only low applications of potash; lack of K is also a limiting factor for cattle productivity. The K concentration in 34% of samples of forage, taken in the Northern provinces, was found to be lower, than that required by cattle during lactation. Total potash consumption in two parts of northern Argentina – Northeast and Northwest — amounts to 21,000 t K_2O, mostly for tobacco, citrus, grains and vegetables. This is less than potash export with a yield estimated as 53,200 t per year. The soils of 6 million ha in an area to the West of the Parana River are potash deficient (Fig. 3). In the Northeast, 75% of soils contain <150 ppm, available K; in 30% the figure is <100 ppm. In this region, soybean shows good economical response to K fertilization, especially when combined with P. Cotton shows a linear response to K. Recommended rates of potash, in K_2O kg per ha, are: for rice – 50, yerba mate and tea – 70. In the Western provinces of the North, or *Chaco* region, soils are originally more fertile and contain more potash. But in sugarcane plantations, high yields (>90 t/ha) may be obtained only if 100 kg/ha of N and 100 kg/ha of K are applied (Potassium nitrate). In the *Salta* province, which has a 5% annual growth rate of increase in area for soybean production, the limiting factor for the application of fertilizers is their high cost (350 US$ per t of KCl). According to Dr. Melgar, insufficient fertilization will be a negative factor for productivity of Argentinean soils in the mid-term future.

Dr. Aluisio Andrade, R&D Chief of the National Soils Research Center of EMBRAPA (left), Mr. Hillel Magen, Director IPI (middle) and Dr. Alexey Naumov, Coordinator Latin America, IPI (right) signing the continuation of the joint research programs between EMBRAPA and IPI for the period 2006-2009.

See presentation titled "Potash in Agricultural Systems of the Argentinean North" (in Spanish) at http://www.ipipotash.org/speech/.

Dr. June Faria Scherrer Menezes (Department of Agronomy, Federal University of Rio Verde, Goias state, Brazil) devoted her presentation to potash fertilization of soybeans in a no-till system in the Southwest of Goias state. This region is one of major producers of soybeans (0.5 million t per year) and maize (400,000 t). Soil is mostly *Latossolo*, with high Al, originally poor in potash. Potash fertilizers are used for soil correction and for soybeans and maize production. *Dr. Menezes* discussed information from associates of the COMIGO ag-coop, and the GAPES associate group of research, taken from findings from 83 fields in 2001/2002, and 359 fields in 2005/2006. Only 24% of soils had enough exchangeable K, and 23% were rich in K. In this region, farmers usually apply 350 to 400 kg/ha of NPK 02-20-18. It is considered that it is necessary to apply 50-100 kg/ha K_2O for corrective fertilization, and 80-100 kg/ha for row application at planting. Members of the GAPES group historically applied 150 kg KCl/ha as a pre-plant (basal) dressing. These fertiliser rates were sometimes higher, than required, which

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caused disequilibrium of nutrients, waste of K, and economic loses.

See presentation titled "Potash Fertilization of Soybean in No-Till System in the Southwest of Goias" (in Portuguese) at http://www.ipipotash.org/speech/.

Dr. Alberto C. de Campos Bernardi (EMBRAPA Southeast Cattle) spoke about potash fertilization in intensive systems of pasture management. Brazilian cattle ranching is characterized by low intensity (204 million animals grazed on 220 million ha; or 0.6 animal units of 450 kg per ha). The country has about 100 million ha of cultivated pastures, a half of which are in the Cerrado. Of these Cerrado pastures 85% are planted with Brachiaria, and 11% with *Panicum maximum*. 70% of cultivated pastures are degraded, and one of the main factors of degradation is the absence of fertilizer use. Fertilizing pastures helps to improve productivity and quality of forage crops, and allows rotation of pastures. Compared with the conventional system, "rotation" pasturing capacity increases up to 10 animal units per ha (on irrigated pastures), meat production grows up to 600 kg/ha (conventional pasturing – 50 kg), and milk to 20,000 kg/ha. In Brazil, fertilizers are scarcely applied to pastures (average 6 kg/ha per year) because of a lack of knowledge and technical assistance to the producers. Fertilizers are important for seeded pastures at planting (mostly P), and for maintenance (N and K). *Brachiaria brizantha* and *Panicum maximum* grasses are very demanding for K, and alfalfa has a particularly high demand (28 kg K_2O per t of dry matter); to produce 10 t of dry matter 340 kg/ha of K_2O are needed. Dr. Bernardi spoke about criteria for determining rates of potash fertilization, which are exchangeable K in soil, and the K/(Ca+Mg) ratio. For seeded pastures in the *Cerrado*, 20-60 kg K_2O/ha is needed for planting, and 50 kg/ha for maintenance (when K<30 mg/dm^3). Experiments, established at EMBRAPA Southeast Cattle, showed the necessity for applying 150 kg/ha K_2O for alfalfa, which resulted in a linear response of productivity of dry matter (8 t/ha). According to Dr. Bernardi, intensification of pasturing requires: an increase in base saturation to 70% (Ca – 55-60%; Mg – 15-20% CTC), an increase in P from an initial 10 to 30 mg dm^{-3} (10 kg/ha P_2O_5 = 1 mg dm^{-3}), an increase in K from an initial 4% to 6% CTC (100 kg/ha K_2O = 1 mmol$_c$ dm^{-3}), and the application of S. To avoid losses by lixiviation, application of K together with N is recommended as a cover dressing.

See presentation titled "Potash Fertilization in Intensive Pastures Management Systems " (in Portuguese) at http://www.ipipotash.org/speech/.

Fertbio 2006 attracted hundreds of researchers to the beautiful city of Bonito. This event is an excellent opportunity to meet current research in Brazil.

Dr. Jose Carlos Polidoro (EMBRAPA National Soil Research Center) presented joint experiments of EMBRAPA and IPI on potash fertilizing of cover crops before soybean planting in a no-till system. Potash fertilizer (KCl) makes up 7% of the total production cost of soybean and farmers are willing to optimize fertilization and reduce costs. According to common practice, in Southeast Goias, farmers use a formula of NPK blend added in the row at planting. K_2O application rates for millet as a cover crop are 100-300 kg/ha. Experiments have been established at the Technological Center of COMIGO ag-coop. with different cover crops (millet, *Brachiaria bryzantha*, *Brachiaria ruzizenses*, *Stylosanthes*, Niger grass) in which a maximum of 120 kg K_2O/ha is applied at planting, and 40 kg/ha as a cover dressing. Cover crops, it was anticipated, would utilize the K applied efficiently and make it available for the next crop. However, the problem with cover crops is that on one hand, the biomass also absorbs the K from sub soil to be used by the main crop, and on the other that K leaching can be very fast and then it is even lost by the cover crop. Another experiment has been established on sandy soils (available K 60 mg dm^{-3}) with an optimal application rate of 80 kg K_2O/ha. A suggested recommendation is also to synchronize potash application with the precipitation regime.

Sugarcane field in Brazil. Brazil is now a world leader in harvesting energy through biofuel production from sugarcane.

See presentation titled "Potash Fertilization of Cover Crops Anticipating Soybean Planting in No-Till System" (in Portuguese) at http://www.ipipotash.org/speech/.

Edited by E. A. Kirkby.

More presentations that were made during the IPI-EMBRAPA Solos symposium are available on our website at http://www.ipipotash.org/speech/.

Lateral move system installed with sprayers irrigate large scale plots in many Brazilian farms. Photo by H. Magen.