

## Steel Industry Byproducts

### 775. Agronomic Implications of Converter Basic Slag as a Magnesium Source on Acid Soils.

Peregrina, F.; Mariscal, I.; Ordonez, R.; Gonzalez, P.; Terefe, T.; and Espejo, R.

*Soil Science Society of America Journal* 72(2): 402-411. (Mar. 2008-Apr. 2008)

NAL Call #: 56.9 So3; ISSN: 0361-5995

**Descriptors:** slags/ magnesium fertilizers/ magnesium/ soil amendments/ acid soils/ industrial byproducts/ industrial wastes/ plant growth/ dry matter accumulation/ phosphogypsum/ gypsum/ limestone/ aluminum/ phytotoxicity/ Xerults/ Triticum aestivum/ Spain

**Abstract:** The feasibility of using converter basic slag (CBS) as a source of Mg for gypsum-amended acidic soils was studied in a Plinthic Palexerult from western Spain. An experimental farm was established and the Ap horizon of the soil was amended with limestone (L), phosphogypsum (PG), or red gypsum (RG) to alleviate Al toxicity. The PG and RG were supplied at 8.0 and 8.8 Mg ha<sup>-1</sup>, respectively. In addition, the gypsum-amended plots received either CBS at 0.9 Mg ha<sup>-1</sup> or limestone at 1.1 Mg ha<sup>-1</sup>. We studied the effects of the treatments on the exchange complex, soil solution, and the biomass production of 'Jabato' wheat (*Triticum aestivum* L.) under field and greenhouse conditions. The CBS proved highly effective in replenishing Mg lost from the soil through application of gypsum amendments. In the field experiment, only the RG + CBS treatment resulted in a statistically significant increase of biomass production relative to the control. In the greenhouse experiment, all treatments resulted in significantly increased production relative to the control, the largest (26 times) by RG + CBS. The PG + CBS and RG + CBS treatments resulted in significantly increased production relative to PG + L and RG + L, which testifies to the favorable effect of the Mg supplied by CBS. Also, the treatments including RG resulted in significantly increased production with respect to those including PG; the increased productivity is tentatively ascribed to a potential toxic effect of Al-F ion pairs, which were more abundant in the soil solution of PG-treated soil.

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### 776. Application of basic slag iron-chromium in soil in nutritional state and dry matter production of passion fruit seedlings.

Prado, R. de M. and Natale, W.

*Revista Brasileira de Fruticultura (Brazil)* 26(1): 140-144. (Apr. 2004)

NAL Call #: SB354 .R48; ISSN: 0100-2945.

**Notes:** Original title: Efeitos da aplicacao da escoria de siderurgia ferrocromo no solo no estado nutricional e na producao de materia seca de mudas de maracujazeiro. 7 illus.; 24 ref. Summaries (En, Pt).

**Descriptors:** passiflora-edulis/ residues/ liming/ growth/ dry-matter-content/ Sao Paulo/ biological-development/ Brazil/ passiflora/ passifloraceae/ proximate-composition/ soil-management/ South America

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### 777. Application of basic slag iron chromium in the reaction of a Dark Red Latosol.

Prado, R. de M.; Leal, R M.; Franco, C. F.; and Braghirolli, L. F.

*Revista de Agricultura Piracicaba* 80(2): 228-241. (2005); ISSN: 0034-7655.

**Notes:** Original title: Aplicacao da escoria de siderurgia ferro cromo na reacao de um Latossolo Vermelho distrofico.

**Descriptors:** application rates/ base saturation/ calcium/ chromium/ iron/ magnesium/ red latosols/ slags/ soil acidity/ soil chemical properties/ soil ph/ soil types/ chemical properties of soil

**Abstract:** A study was conducted to evaluate the application of basic slag iron-chromium at different times of incubation on the chemical properties of a Dark Red Latosol. The treatments include: five basic slag rates (0, 0.375, 0.750, 1.125 and 1.500 g/dm<sup>3</sup>) and five incubation times (1, 2, 3, 4 and 7 months). The application of slag was efficient in neutralizing soil acidity; pH increased followed by the reduction in potential acidity. Calcium and magnesium contents increased as well as the sum of bases and base saturation in the soil. After three months of incubation, a residual effect on soil chemical properties was observed especially at higher rates.

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### 778. Application of steel making slag and converter sludge in farm manure enrichment for corn nutrition in greenhouse conditions.

Melali, A. R. and Shariatmadari, H.

*Journal of Science and Technology of Agriculture and Natural Resources* 11(42(B)): 505-514. (2008); ISSN: 1028-7655

**Descriptors:** byproducts/ copper/ crop yield/ field capacity/ growth/ industrial wastes/ iron/ maize/ manganese/ organic matter/ plant nutrition/ slags/ sludges/ soil amendments/ uptake/ vermicompost/ waste utilization/ zinc/ corn/ Mn

**Abstract:** Application of slag and converter sludge, major byproducts of Esfahan Zob Ahan factory, Iran, to enrich two organic amendments for maize (*Zea mays*) nutrition, was investigated. Farm manure and its vermicompost mixed with different rates of slag and sludge were incubated in 3 kg pots at field capacity moisture and home temperature for three months. The applied rates of slag and sludge were 0, 5 and 10 percent (w/w) of pure iron from these compounds to the organic amendments. Iron sulfate with the above ratios was also examined for comparison. Sub-samples of the incubated materials were taken after 0, 10, 25, 45, 65 and 90 days of incubation and examined for DTPA extractable Fe, Mn, Zn and Cu. After the incubation, the enriched amendments were applied to a soil sample to grow maize. Three kg soil samples, taken from Chah Anari experimental farm, Esfahan University of Technology, were mixed with 17 g of the amendments (50 tonnes/ha) placed in 3 kg pots. In each pot, two maize seeds (single cross 704) were planted and after 70 days crop yield and

concentration of Fe, Mn, Zn, Cu in the plant tissues were determined. Results showed that the use of iron sulfate strongly increased DTPA extractable Fe and Mn of the amendments. In enrichment by converter sludge, the best result was obtained in the mixture of 10% pure iron with the vermicompost on 60 days of incubation. Treatment of 5% pure iron from slag mixed with the manure increased DTPA extractable Fe and Mn with the time, but the 10% treatment was not much effective in this regard. The highest rates of iron uptake by the plants occurred in the iron sulfate and 10% converter sludge treatments, respectively. However, the highest rate of the plant Mn uptake was observed in 5% iron from converter sludge mixed with vermicompost. In general, 10% pure iron from converter sludge was the most effective enrichment treatment, increasing the plant uptake of Fe, Mn, Zn and Cu micronutrients.

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**779. Assessment of basic slag as soil amelioration and their effects on the uptake of some nutrient elements by radish plants.**

Abou Seeda, M.; El Aila, H I; and El Ashry, S.  
*Bulletin of the National Research Centre Cairo* 27(4): 491-506. (2002); ISSN: 1110-0591

*Descriptors:* calcium/ growth/ iron/ leaves/ magnesium/ nitrogen/ nutrient availability/ nutrient uptake/ organic acids/ organic matter/ phosphorus/ plant nutrition/ potassium/ radishes/ recycling / roots/ slags/ soil amendments/ soil fertility/ soil ph/ waste management/ waste utilization/ zinc/ Capparales

*Abstract:* In Egypt, tremendous mass of slag has been produced from iron steel industries. To overcome this problem, a series of laboratory and greenhouse experiments were conducted to evaluate the agricultural recycling of Helwan slag. The application of slag increased the pH of the soil. The extractable fraction of Fe by  $\text{CaCl}_2$  increased with organic matter addition due to increasing the solubility through complexation of Fe with soluble organic acids. Organic matter addition changed the inorganic precipitates of Fe to organic complexes. The order of the sequential extraction was organically bounded > occluded > adsorbed > exchangeable+soluble. Increasing rates of slag increased the mobile fractions of P, K, Ca and Mg during the incubation period. The addition of organic matter to Helwan slag at any rate increased the availability of nutrients. The application of slag stimulated the growth of radish plants, that was gradually increased with organic matter addition. The application of slag enhanced the nutrient uptake by radish plants. Slag with organic matter added at different rates stimulated the accumulation of nutrients (N, P, K, Fe and Zn) in both leaves and roots of the radish plant, due to the regulation of nutrients release from slag combined with organic matter, which play an important role for ensuring efficient utilization of nutrients. Reproduced with permission from the CAB Abstracts database.

**780. Availability of silicon from several sources as determined by chemical and biological methods.**

Gascho, G. J. and Korndorfer, G. H.  
*Proceedings Soil and Crop Science Society of Florida* 58: 109-113. (1999); ISSN: 0096-4522

*Descriptors:* basic slag/ calcium silicate/ cerrado/ deficiency / iron/ rice/ silicon fertilizers/ soil/ sugarcane/ paddy

*Abstract:* The value of silicon (Si) application for rice (*Oryza sativa*) and sugarcane (*Saccharum* spp.) has been demonstrated when soil soluble Si is low. In south Florida, calcium silicate slag is applied to most muck soils and associated sands that are to be planted to rice and sugarcane. There is a need to investigate the availability of silicon in sources which are potentially available for those crops in the Cerrado of Brazil, where response to Si is also being demonstrated. Total Si and Si extracted by 0.1 M citric acid were measured for five sources. An incubation experiment was conducted with four important soil groups cropped in the Cerrado and a greenhouse experiment with rice was conducted using the soil most likely to show response to added Si, based on its low soluble Si content. Experiments included five sources and several rates of silicon. After 60 days incubation, Si extracted by 0.5 M acetic acid ranged from 2.5 to 22 mg/kg for the four soils. Calcium silicate slag, wollastonite, and thermo-phosphate increased soluble Si significantly. A basic slag and magnesium metasilicate provided little soluble Si. In the greenhouse experiment, increasing the rate of wollastonite increased Si concentration in rice. Calcium silicate slag, wollastonite, and thermo-phosphate application resulted in erect leaves, while rice plants that received no Si or other Si sources had droopy leaves. But, when applied at high rates, sources that supplied Si to rice plants also induced Fe deficiency, resulting in reduced dry weight. In addition to calcium silicate slag, thermo-phosphate - a fertilizer product that provides Si, P, and Mg - appears an excellent source for use in the Cerrado.

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**781. Basic slag as a liming material to ameliorate soil acidity in Alfisols of sub-tropical India.**

Bhat, J. A.; Mandal, Biswapati; and Hazra, G. C.  
*American-Eurasian Journal of Agricultural and Environmental Science* 2(4): 321-327. (2007); ISSN: 1818-6769

*Descriptors:* acid soils/ acidity/ alfisols/ analysis/ basic slag/ calcite/ crop production/ exchange acidity/ farmyard manure/ grain/ incorporation/ lime/ liming/ liming materials/ manures / mineral uptake/ nitrogen/ nutrient availability/ nutrients/ organic matter/ poultry/ poultry manure/ soil/ soil acidity/ soil types chemical/ straw/ subtropics/ treatment/ uptake/ wheat/ domesticated birds/ FYM/ poultry litter/ subtropical zones

*Abstract:* Crop production on acid soils can be improved greatly by adjusting the pH to near neutrality. While soil acidity is commonly corrected by calcite, there is evidence that use of basic slag as an amendment can increase the pH of acid soils. The effect of calcite and basic slag ( $\text{CaSiO}_3$ ) with different doses on soil acidity, nutrient availability and grain yield was determined in the experiments. Fourteen field experiments were conducted during the rabi season of 2003-2004 and 2004-2005 in Alfisols of Midnapur West and Purulia districts of West Bengal, INDIA. Besides liming materials, locally available organic resources e.g. farmyard manure (FYM) and poultry manure (PM) were also used along with basic slag to

increase its efficacy. The treatments used were as follows: No lime, 1/5th LR (basic slag), 1/5th LR (calcite), 1/10th LR (basic slag), 1/10th LR (calcite), 1/5th LR (basic slag + FYM @ 5t/ha) and 1/5th LR (basic slag + PM @ 3t/ha). Results showed that both calcite and basic slag increased the grain yield of wheat. They were effective when applied @ 1/5th LR dose than 1/10th LR. On an average, calcite and basic slag caused an increase in grain yield to the extent of 21.9 and 31.0% over the no lime treatment, respectively. Results also showed that increase in the yield of wheat was more with basic slag 1/5th LR than with calcite. Incorporation of organic sources of nutrients particularly FYM and PM caused a further increase in yield, the magnitude being 56.2 and 60.2% respectively over the no lime treatment. Results of straw yield also showed the similar trend of change. Uptake of N and P by wheat plants showed that liming caused significant increases in their uptake. There was no significant increase in concentration of K with lime application. Organic matter addition enhanced the uptake of the nutrient elements viz., N, P and K. Results of the analysis of residual soil showed that total acidity, exchange acidity and hydrolytic acidity recorded a decrease upon liming.

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#### 782. **Basic slag as a liming material to ameliorate soil acidity in Alfisols of West Bengal.**

Bhat, J A and Hazra, G C

*Research on Crops* 8(3): 575-581. (2007); ISSN: 0972-3226

*Descriptors:* acid soils/ Alfisols/ application rates/ calcite/ crop yield/ farmyard manure/ nitrogen/ nutrient availability/ nutrient uptake/ phosphorus/ potassium/ poultry manure/ slags/ soil acidity/ soil amendments/ soil types/ straw/ wheat/ wheat straw/ FYM/ poultry litter

*Abstract:* Crop production on acid soils can be improved greatly by adjusting the pH to near neutral. While soil acidity is commonly corrected by calcite, there is evidence that use of basic slag as an amendment can increase the pH of acid soils. The effect of calcite and basic slag ( $\text{CaSiO}_3$ ) with different doses on soil acidity, nutrient availability and grain yield was determined in the experiments. Fourteen field experiments were conducted during the rabi seasons of 2003-2004 and 2004-2005 in Alfisols of Midnapur West and Purulia districts of West Bengal, India. Besides liming materials, locally available organic resources e. g. farmyard manure (FYM) and poultry manure (PM) were also used along with basic slag to increase its efficacy. The treatments used were as follows: No lime, 1/5th LR (basic slag), 1/5th LR (calcite), 1/10th LR (basic slag), 1/10th LR (calcite), 1/5th LR (basic slag+5 tonnes FYM/ha) and 1/5th LR (basic slag+3 tonnes PM/ha). Results showed that both calcite and basic slag increased the grain yield of wheat. They were effective when applied at 1/5th LR dose than 1/10th LR. On an average, calcite and basic slag caused an increase in grain yield to the extent of 21.9 and 31.0% over the no lime treatment, respectively. Results also showed that increase in the yield of wheat was more with basic slag 1/5th LR than with calcite. Incorporation of organic sources of nutrients particularly FYM and PM caused a further increase in yield, the magnitude being 56.2 and 60.2%, respectively, over the no lime treatment. Results of straw yield also showed the similar trend of change. Uptake of N and P by wheat plants

showed that liming caused significant increases in their uptake. There was no significant increase in concentration of K with lime application. Organic matter addition enhanced the uptake of the nutrient elements viz., N, P and K. Results of the analysis of residual soil showed that total acidity, exchange acidity and hydrolytic acidity recorded a decrease upon liming.

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#### 783. **Beneficial reuse of stainless steel slag and its heavy metals pollution risk.**

Zhang XiangYu; Zhang Hua; He PinJing; Shao LiMing; Wang RuYi; and Chen RongHuan

*Research of Environmental Sciences* 21(4): 33-37. (2008); ISSN: 1001-6929

*Descriptors:* aluminium/ calcium/ carbon/ chromium/ heavy metals/ iron/ magnesium/ oxygen/ pollutants/ pollution/ risk/ risk assessment/ silicon/ stainless steel/ aluminum/ environmental pollution/ hazardous wastes

*Abstract:* The feasibility of beneficial reuse of two kinds of stainless steel slag, electric arc furnace (EAF) slag and argon oxygen decarburization furnace (AOD) slag, and their pollution properties of heavy metals were studied. The results indicate that the majority of the slags were sized <5 mm. The main elements (mass content >1%) in the EAF slag were Ca, Si, Mg, Al, Fe, O, and Cr, existing as  $\text{Ca}_2\text{SiO}_4$  and  $\text{Ca}_3\text{Mg}(\text{SiO}_4)_2$ , while the AOD slag was mainly composed of Ca, Si, Mg, C, and O, and the main minerals were  $\text{Ca}_2\text{SiO}_4$ . The slags were suitable for beneficial reuse. The leaching mass concentrations of all heavy metals except Cr by the leaching test were lower than or close to the detection limit. The leaching mass concentration of Cr was <0.2 mg/L, far lower than the limit values of Identification Standards for Hazardous Wastes (GB5085.3-1996). Most of the heavy metals existed as stable speciation. The availability leaching test results show that Cr could be leached out at the "worst scenario", but mainly as the less hazardous Cr (III), which was confirmed by the XRD analysis results. Therefore, the pollution risks of the heavy metals in the stainless steel slags were low. Reproduced with permission from the CAB Abstracts database.

#### 784. **Capacity of soil amendments in lowering the phytoavailability of sludge-borne zinc.**

Mench, Michel J.; Manceau, Alain; Vangronsveld, Jaco; Clijsters, Herman; and Mocoquot, Bernard  
*Agronomie (Paris)* 20(4): 383-397. (2000); ISSN: 0249-5627

*Descriptors:* soil amendments/ phytoavailability/ sludge/ zinc/ basic slags

*Abstract:* One way to reduce the phytoavailability of an excess of metals such as zinc in soil is through the addition of amendments. The effectiveness of inorganic materials such as basic slags, magnetite, maghemite, hematite, birnessite, hydrous manganese oxide, steel shots, and beringite, was evaluated in a pot experiment with a coarse sandy soil contaminated by sludge-borne zinc. Zinc extractability and phytoavailability were investigated using single soil extraction by 0.1 M calcium nitrate and vegetation experiments with dwarf bean (*Phaseolus vulgaris* L.) and ryegrass (*Lolium multiflorum*). A phytotoxicity test based on the activities of enzymes involved in the stress metabolism caused by toxic Zn

concentrations in the primary leaves of dwarf beans was also performed. Based on the addition rate, birnessite (10 gcnctdotkg-1 soil, dry weight DW) resulted in the maximum decrease in extractable Zn from the contaminated soil. Beringite gave similar results but at 50 gcnctdotkg-1 soil DW. Birnessite and beringite treatments were the most effective to reduce Zn assimilation by dwarf bean, and in consequence phytotoxicity. Subsequent harvests of ryegrass confirmed the beringite effect on Zn uptake 5 months following the soil treatment. For birnessite, Zn availability to ryegrass shoots increased however at the third harvest and reached the level of the untreated Zn-contaminated soil.

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#### 785. The characteristic of phosphorous adsorption on different substrates used in constructed wetland.

Cui, L. H.; Zhu, X. Z.; Luo, S. M.; Zhu, Y. C.; and Ma, M. *Journal of Agro-Environment Science* 26(3): 894-898. (2007)

NAL Call #: S589.75 .N86; ISSN: 1672-2043

*Descriptors:* adsorption/ artificial wetlands/ artificial wetlands/ coal/ gravel/ mathematical models/ nutrients (mineral)/ phosphates/ phosphorus/ phosphorus removal/ phosphorus removal/ sand/ soil/ substrates/ turf grasses/ wetlands/ sandy soils/ turf

*Abstract:* Nine substrates (three substrates of artificial soil) used as media in the vertical-flow constructed wetland were measured under isothermal adsorption experiment, and the data obtained in this study was fitted to both Freundlich and Langmuir isothermal adsorption equations. To simulate the equilibrium P adsorption data, the Langmuir equation was better than the Freundlich equation. When phosphorous concentration in solution was 100 similar to 500 mg times L super(-1), the maximum phosphate adsorption of substrates predicted by Langmuir equation was in the following order: turf (4 242.48 mg times kg super(-1)soil) > artificial soil of blast furnace slag (BFAS, 2 115.65 mg times kg super(-1)soil) > blast furnace slag (BFS, 1 597.92 mg times kg super(-1)soil) > artificial soil of coal bum slag (CBAS) > top soil > coal burn slag (CBS) > artificial soil of mid-sized sand (MSAS) > gravel (494.42 mg times kg super(-1)soil) > and mid-sized sand (MSS, 403.11 mg times kg super(-1)soil). When phosphorous concentration in solution was 5 mg times L super(-1), the order of phosphorus removal rate by these nine substrates was: turf (92.0%) > CBAS (57.3%) > CBS (55.7%) > top soil (40.7%) > BFAS (24.1%) > BFS (20.6%) > MSS (18.9%) > MSAS (11.8%) > gravel (3.06%).

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#### 786. Consequences of basic slag on soil pH, calcium and magnesium status in acid sulfate soils under various water contents.

Khan, M. H. R.; Bhuiyan, M. M. A.; Kabir, S. M.; Blume, H. P.; Oki, Y.; and Adachi, T.

*Journal of Biological Sciences* 7(6): 896-903. (2007); ISSN: 1727-3048

*Descriptors:* acid sulfate soils/ calcium/ drying wetting cycles/ field capacity/ magnesium/ saturated conditions/ slags/ soil fertility/ soil ph/ soil types/ soil water content/ acid sulphate soils/ soil quality/ thionic soils

*Abstract:* Consequences of Basic Slag (BS) on soil pH, Ca and Mg status in acid sulfate soils under various water contents were studied for 30 months. The four doses of BS at the rates of 0, 10, 20 and 30 t ha-1 and three levels of water contents such as: (a) moisture at field capacity (50% water), (b) moisture at saturated condition (100% water) and (c) wetting-drying cycle (from saturation versus field capacity) were considered for this incubation study. Basic slag at 30 t ha-1 was found to be the best dose in order of the increment in soil pH, followed by the lower doses of BS<sub>20</sub> BS<sub>10</sub>. The BS<sub>30</sub> treatment increased the soil pH values by about 1.0, 1.5 and 1.2 units more compared with the control in the Sarisabari soil and 2.0, 1.7 and 1.5 units more in the Purbapukuria soil under the conditions of field capacity, saturated and wetting-drying cycle, respectively. Apart from the water contents and soil conditions, the values of soil pH were also increased significantly ( $p < 0.05$ ) at different periods of incubation compared with the control. Like soil pH, almost similar to and significant ( $p < 0.05$ ) increased levels of Ca and Mg were determined in both the soils; regardless of water contents and incubation time. The striking changes were recorded for the rate of increments of Ca and Mg, which were 4 to 5 times higher for Ca and more than 2 times higher for Mg compared with the control after 2 months of incubation. These results suggest that the application of basic slag not only increased the Ca to the higher amount than the increment of Mg in the soils but also improved one of the important criteria of imbalance between Ca and Mg status in the soils.

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#### 787. Converter slag as a liming agent in the amelioration of acidic soils.

Ali, M. T. and Shahram, S. H.

*International Journal of Agriculture and Biology* 9(5): 715-720. (2007); ISSN: 1560-8530

*Descriptors:* acid soils/ electrical conductivity/ iron/ liming/ manganese/ mineral uptake/ nutrient uptake/ phosphorus/ plant nutrition/ potassium/ rice/ shoots/ slags/ soil amendments/ soil ph/ tea/ zinc/ Mn/ paddy

*Abstract:* Amelioration of acid soils with liming materials is a common practice. Some industrial byproducts are also being used as liming agent. The most important byproduct in amending acid soils is steelmaking basic slag. In this research, the possibility of using converter slag, as a soil amendment was investigated in three acid soils. Slag compound contains 52.8% CaO and 2.2% MgO plus large amounts of other elements such as Fe, P, Si, and Mn. First stage was incubation phase and treatments were 0, 0.5, 1, 2, 4, 8 and 16% (w/w) of converter slag kg-1 soil and soil moisture content was adjusted closer to field capacity. The changes in pH, EC and AB-DTPA-extractable Fe, Mn, Zn, P and K were determined after 1, 10, 30 and 60 days. Second phase was a greenhouse study that treatments with due attention to incubation results were determined on maize. Treatments were 0, 0.5, 1 and 2% w/w and 0, 1, 2 and 4% w/w of slag in rice field and tea orchard soils, respectively. Slag increased soil pH and the rate of increase was proportional to the amount of slag used. The slag decreased Fe availability at pH range of 7.4-8.5 but increased at higher pH, while use of slag proportionately increased the P and Mn availability. In greenhouse studies the application of 1 and 2% (w/w) of slag in tea garden soil

and 0.5, 1 and 2% slag in rice field soil increased plant shoot dry yield and P and Mn uptake. Fe and K uptake increased in rice field, K uptake decreased in tea garden soil and Fe uptake was not changed. In conclusion, the converter slag was a suitable amendment for acid soils. Reproduced with permission from the CAB Abstracts database.

**788. Decomposition of *Avicennia marina* on an iron smelting slag substrate.**

Dick, T. M. and Streever, W. J.

*Austral Ecology* 26(2): 127-131. (2001); ISSN: 1442-9985

*Descriptors:* carbon/ chemical composition/ decomposition/ forest litter/ iron/ mangroves/ mineral content/ nitrogen/ nutrient content/ phosphorus/ plant composition/ sand/ trees/ wetlands/ woody plants/ chemical constituents of plants/ duff

*Abstract:* The present study, conducted near Newcastle, New South Wales, Australia, used a blocked analysis of variance experimental design to compare initial nutrient concentrations and decomposition rates of *Avicennia marina* (grey mangrove) grown on sand and rock blast furnace slag. There were no significant differences (ANOVA;  $P > 0.05$ ) in mean initial nutrient concentrations of total C, N and P for plants grown on the sand and slag substrates. A litterbag technique was used to estimate decomposition rates. After 360 days of incubation, repeated measures analysis did not identify significant differences between the substrates for the interaction term substrate x time or the term substrate alone for percentage weight loss or for C, N and P remaining. *A. marina* on both substrates had nutrient characteristics and decomposition rates comparable to those found in the literature. Results suggest that initial nutrient concentration and decomposition rates are not dramatically influenced by the presence of slag.

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**789. Direct and residual effect of combined application of basic slag with green leaf manure on soil available nutrients and yield of rice.**

Mohandas, S. and Appavu, K.

*Madras Agricultural Journal* 87(1/3): 53-56. (2000)

NAL Call #: 22 M262; ISSN: 0024-9602

*Descriptors:* alfisols / calcium/ green manures/ magnesium/ nutrient availability/ phosphorus/ residual effects/ rice/ rice straw/ slags/ straw/ Madras/ paddy

*Abstract:* Field experiments were conducted on sandy clay loam soil (Udic Haplustalf) at Central Farm of Agricultural College and Research Institute, Madurai, Tamil Nadu, India, to study the effect of added levels of basic slag with green leaf manure on ADT 36 rice. Addition of graded levels of basic slag viz., 500, 750 and 1000 kg/ha significantly increased the soil available P, Ca, Mg, Fe, Si and the grain and straw yield of rice. Application of 1000 kg of basic slag with 12.50 or 18.75 t/ha of green leaf manure recorded the highest soil available nutrients as well as grain and straw yield of rice over the rest of the treatments. The residual crop yield was also significantly increased over NPK treated control by conjunctive use of basic slag with green leaf manure at higher level (1000 kg of basic slag with 18.75 t/ha of green leaf manure). The superiority of

basic slag with green leaf manure in increasing the soil available nutrients was proved only at higher doses. Reproduced with permission from the CAB Abstracts database.

**790. Dynamics of soil solutions of submerged acid sulfate soils under rice as influenced by various treatments.**

Khan, H. R.

*International Journal of Tropical Agriculture* 16(1/4): 81-95. (1998); ISSN: 0254-8755

*Descriptors:* acid sulfate soils/ ammonium/ basic slag/ calcium / calcium carbonate/ electrical conductivity/ inceptisols/ iron/ leaching/ lime/ magnesium/ manganese/ nutrients/ phosphorus/ phosphorus fertilizers/ potassium/ rice/ rice soils/ soil/ soil amendments/ soil pH/ soil solution/ submergence/ sulfates/ sulfur/ zinc/ acid sulphate soils/ elemental sulphur/ Mn/ paddy/ phosphate fertilizers/ sulphates/ sulphur/ thionic soils

*Abstract:* The composition of the soil solutions (leachates) was studied as influenced by P (45, 60 mg kg<sup>-1</sup>), lime (5, 7.5 g CaCO<sub>3</sub> kg<sup>-1</sup>), basic slag (7.5, 12.5 g kg<sup>-1</sup>), MnO<sub>2</sub> (50, 75 mg kg<sup>-1</sup>) and leaching (1.8 litre kg<sup>-1</sup>) treatments, of a submerged acid sulfate soil (Sulfic Haplaquept) under rice cultivation in Bangladesh, with an initial low pH (4.2, field), high electrical conductivity (ECe, 1.54 S m<sup>-1</sup>), and high water soluble SO<sub>4</sub> 2-S (3.33 cmol kg<sup>-1</sup>). The results showed that the various treatments significantly ( $P = 0.05$ ) raised the pH (3.2 to 7.2) of soil solutions over the control treatment. The submergence alone increased the pH from 3.2 to 4.8. Basic slag at 12.5 g kg<sup>-1</sup> increased the pH to 7.2. The leaching treatment decreased the EC values from 1.54 to 0.25 S m<sup>-1</sup>. With the amendments, the ammonium concentrations in the soil solutions increased during the first 30 days and then decreased steadily with the time of submergence and plant age. The highest ammonium (22 mg kg<sup>-1</sup>) concentration was observed with the highest dose of lime after 90 days of submergence. The submergence and different amendments increased the concentrations of P in the soil solutions. The sulfur concentrations in the solutions were increased in the earlier periods of submergence and then decreased sharply with time. All the treatments, except for leaching and Mn application, increased the concentrations of K, Ca and Mg and decreased those of Fe, Mn and Zn, leading to favourable nutrient concentrations in the soil solutions.

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**791. Effect of application of basic slag and superphosphate on herbage yield and on soil and herbage concentrations of phosphorus in organic grassland.**

MacNaoidhe, F. S.

*Biological agriculture and horticulture: an international journal* 19(3): 231-245. (2001)

NAL Call #: S605.5.B5 ; ISSN: 0144-8765 [BIAHDP]

*Descriptors:* grasslands/ organic production/ superphosphate/ yields/ mineral content/ phosphorus/ slags/ soil fertility/ application rate/ Irish Republic/ dry matter/ biomass production

*Abstract:* The experiment was carried out at an organic farm in 1996 and 1997. The purpose of the experiment was

to test the effectiveness of basic slag (7% P) as a P fertilizer on an organic perennial ryegrass/white clover sward. Superphosphate (16% P) was used as a standard comparison. There was no difference between fresh weight or dry matter yields of grass or clover or of total herbage yields in plots treated with different rates of basic slag or superphosphate in the first harvest at the end of July 1996. In the second harvest, recorded at the end of August 1996, increasing rates of P gave increased yields. P source had no effect on herbage fresh weight or dry matter yield. P source and rate of P application had no effect on herbage yield in 1997. The percentage dry matter in herbage was unaffected by P source. Increasing rates of basic slag and superphosphate had no effect on the percentage dry matter in the herbage. There was no difference in the soil P concentrations obtained with basic slag or superphosphate when these were applied at equivalent rates. Increasing rates of P, when applied as basic slag or superphosphate at rates of 7, 14 and 28 kg ha<sup>-1</sup>, gave an increase in soil P concentration at 128 days after application. No increase was recorded at 531 days after application.

Superphosphate gave the largest initial increase in herbage concentrations of P but was no more effective at raising the soil and herbage concentrations of this element than equivalent rates of basic slag over a two year period. This citation is from AGRICOLA.

**792. Effect of application of iron materials on methane and nitrous oxide emissions from two types of paddy soils.**

Furukawa, Y. and Inubushi, K.

*Soil Science and Plant Nutrition* 50(6): 917-924. (2004)

NAL Call #: 56.8 SO38; ISSN: 00380768 [SSPNA]

*Descriptors:* global warming/ greenhouse gas/ prevent/ slag/ suppression

*Abstract:* Iron oxide is the most important electron acceptor in paddy fields. We aimed to suppress the methane emission from paddy fields over the long term by single application of iron materials. A revolving furnace slag (RFS; 245 g Fe kg<sup>-1</sup>) and a spent disposable portable body warmer (PBW; 550 g Fe kg<sup>-1</sup>) were used as iron materials. Samples of a soil with a low iron level (18.5 g Fe kg<sup>-1</sup>), hereafter referred to as "a low-iron soil" and of a soil with a high iron level (28.5 g Fe kg<sup>-1</sup>), hereafter referred to as "an iron-rich soil," were put into 3 L pots. At the beginning of the experiment, RFS was applied to the pots at the rate of 20 and 40 t ha<sup>-1</sup>, while PBW was applied at the rate of 10 t ha<sup>-1</sup> only, and in the control both were not applied. Methane and nitrous oxide emissions from the potted soils with rice plants were measured by the closed chamber method in 2001 and 2002. When RFS was applied at the rates of 20 and 40 t ha<sup>-1</sup> to the low-iron soil, the total methane emission during the cultivation period significantly decreased by 25-50% without a loss of grain yield. Applied iron materials clearly acted as electron acceptors, based on the increase in the amount of ferrous iron in soil. However, the suppressive effect was not evident in the iron-rich soil treated with RFS or PBW. On the other hand, nitrous oxide emission increased by 30-95%. As a whole, when the total methane and nitrous oxide emissions in the low-iron soil were converted to total greenhouse gas emissions expressed as CO<sub>2</sub>-C equivalents in lime with the global warming potential, the total greenhouse gas emissions decreased by about 50% due to the application of RFS. © 2009 Elsevier B.V. All rights reserved.

**793. Effect of blast furnace slag on root growth and yield of rice.**

Carvalho Pupatto, J. G.; Bull, L. T.; Crusciol, C. A. C.; Mauad, M.; and Silva, R. H. da

*Pesquisa Agropecuaria Brasileira* 38(11): 1323-1328. (2003)

NAL Call #: S15 .P452 ; ISSN: 0100-204X.

*Notes:* Original title: Efeito de escoria de alto forno no crescimento radicular e na produtividade de arroz.

*Descriptors:* crop yield/ growth/ industrial wastes/ rice/ roots/ silicon/ slags/ soil chemical properties/ chemical properties of soil/ paddy

*Abstract:* Agricultural use of industrial residues as fertilizers is due to the need of reducing nutrient accumulation in the centres of production. A study was carried out in Sao Paulo, Brazil, to evaluate the effects of blast furnace slag (at 0, 2550, 5100, 10 200 and 15 300 kg/ha) on the root growth and productivity of highland rice irrigated by sprinkler. The use of the slag improved chemical attributes of the soil, increased root growth and reduced root diameter. It increased the silicon content in the soil and in the plant, resulting in higher yield. Reproduced with permission from the CAB Abstracts database.

**794. Effect of controlling the clubroot disease of sugukina by the application of converter slag for soil amendments.**

Murakami, K. and Goto, I.

*Japanese Journal of Soil Science and Plant Nutrition* 75(2): 233-235. (2004); ISSN: 0029-0610

*Descriptors:* application rates/ control/ crop quality/ plant diseases/ slags/ soil acidity/ soil amendments/ Brassica campestris var neosuguki/ Capparales/ clubroot/ fulsulfamides/ sulfamides

*Abstract:* This experiment was conducted in Kyoto, Japan, in 1992-95, to examine the efficacy of LD steel slag to control clubroot disease on sugukina [Brassica campestris var. neosuguki]. A field that had been damaged badly by clubroot disease was divided in to four plots and treated as follows: (plot 1) LD steel slag 40 t ha<sup>-1</sup> + fulsulfamide 200 kg ha<sup>-1</sup>; (plot 2) LD steel slag only; (plot 3) fulsulfamide only; (plot 4) untreated. The quality of crops were compared. The best quality crops were found in plots 1 and 2. LD steel slag controlled the disease and maintained the acid level in the soil effectively. Reproduced with permission from the CAB Abstracts database.

**795. Effect of graded fertility levels and silicon sources on crop yield, uptake and nutrient-use efficiency in rice (Oryza sativa).**

Sudhakar, P. C.; Singh, J. P.; Singh, Yogeshwar; and Singh, Raghavendra

*Indian Journal of Agronomy* 51(3): 186-188. (2006)

NAL Call #: 22 IN235; ISSN: 0537-197X

*Descriptors:* application rates/ crop yield/ nitrogen fertilizers/ phosphorus fertilizers/ potassium fertilizers/ rice/ silicon/ yield components/ zinc fertilizers/ paddy/ phosphate fertilizers / potash fertilizers

*Abstract:* A field experiment was conducted during the wet seasons of 2001 and 2002 on sandy clay-loam soil (Ustochrept), to assess the influence of graded fertility levels and silicon sources on yield and nutrient uptake by rice. Graded fertility levels up to 160-80-80-32-0.75 kg N-

P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O-S-Zn-EDTA/ha significantly increased grain and straw yields of rice. Similarly, all the yield attributing characters were also significantly increased up to same (F<sub>3</sub>) fertility level but it remained at par with F<sub>4</sub> fertility (200-100-100-40-1.0 kg/ha) level. On the other hand, the highest nutrient uptake was associated with the highest fertility level of 200-100-100-40-1.00 kg N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O-S-Zn EDTA/ha. Among silicon sources, basic slag was superior to other sources as well as the control for yield and nutrients uptake.

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**796. The effect of limestone and iron and steel-making slag on the availability of phosphorus in dark-red latosol, and in quartzose sand.**

Prado, R. de M. and Fernandes, F. M.

*Revista de Agricultura Piracicaba* 74(2): 235-244. (1999); ISSN: 0034-7655.

*Notes:* Original title: Efeito do calcario e da escoria de siderurgia na disponibilidade de fosforo em latossolo vermelho escuro e em areia quartzosa.

*Descriptors:* acid soils/ application rates/ availability/ cerrado/ Ferralsols/ incorporation/ latosols/ limestone/ phosphorus/ sand/ sandy soils/ slags/ soil/ soil amendments/ superphosphate/ triple superphosphate/ tropics/ tropical countries/ tropical zones

*Abstract:* The use of limestone and slag were compared as to their effects on the availability of phosphorus in two acidic soils in the cerrado tropical region of Brazil. A 2 x 2 factorial experiment with 2 levels of application (NA1 and NA2) x 2 corrective agents (calclitic limestone and slag), completely randomized, with 4 replications, was performed in pots with quartzose sand (AQ) and dark-red latosol (LE). All pots received 200 mg P/dmsuperscript 3 as triple superphosphate. After 225 days of incorporation of these products, the soil was analysed to evaluate P content in resin. In the AQ soil, the NA2 level gave a better result than NA1, for both correctives. However, for the LE soil, level NA2 was better than NA1 for limestone, with NA1 being better than NA2 for slag.

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**797. Effect of nitrogen and silicon on blast disease and yield of rice.**

Padasht Dehka Ee, F.

*Iranian Journal of Agricultural Sciences* 30(4): 735-742. (1999)

*Descriptors:* cereals/ crop yield/ diseases/ fertilizers/ nitrogen fertilizers/ plant diseases/ plant pathogenic fungi/ plant pathogens/ plant pathology/ rice/ silicon/ silicon fertilizers/ slags/ paddy/ phytopathogens/ phytopathology

*Abstract:* Effects of nitrogen and silicon on rice blast disease [Magnaporthe grisea] and yield were studied in rice cv. Hassan-Saraie for two years. Rates of N were 0, 60, 90 and 120 kg/ha, while 0, 300, 600 and 900 kg slag/ha were applied as a source of Si (SiO<sub>2</sub> 34%). Number of leaf blast spots on 100-tillers at the stem elongation stage, percentage of panicle blast at the mature grain stage, number of silicified cells in 20 samples of flag leaves, and grain yield, were determined and statistically analysed. Application of nitrogen increased the blast disease and rice yield, but did not affect silicified cells. Silicon (slag obtained

from steel mill) did not affect blast disease or rice yield, but it increased number of silicified cells when applied at 900 kg/ha in the second year.

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**798. Effect of silicon carriers and time of application on rice productivity in a rice-wheat cropping sequence.**

Singh, K.; Singh, R.; Singh, K. K.; and Singh, Y.

*International Rice Research Notes* 32(1): 30-31. (2007) NAL Call #: SB191.R516; ISSN: 0117-4185

*Descriptors:* calcium silicate/ composts/ crop yield/ cropping systems/ fertilizer carriers/ panicles/ rice/ rice straw/ seed weight/ seeds/ silicon/ silicon fertilizers/ straw/ tillers/ wheat/ yield components/ paddy

*Abstract:* A field experiment was conducted in Varanasi, Uttar Pradesh, India, during the 1999/2000, 2000/01, 2001/02 and 2002/03 wet seasons to determine the effect of recycling Si carriers through rice straw compost at different times of Si application on rice productivity in rice-wheat cropping systems. The treatments comprised: control; 100% calcium silicate; 100% basic slag; 100% rice straw compost; 50% rice straw compost + 50% calcium silicate; 50% rice straw compost + 50% basic slag; 50% basic slag + 50% calcium silicate; and 33% rice straw compost + 33% calcium silicate + 33% basic slag. Rice straw compost at 50% + 50% calcium silicate gave the highest number of effective tillers per hill (10.65), grains per panicle (124.5), panicle weight (2.44 g), panicle length (20.57 cm), 1000-grain weight (18.56 g), grain yield (6.4 t/ha) and straw yield (10.0 t/ha).

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**799. Effect of steel metallurgy basic slag on corn (Zea mays L.) cultivated in yellow red dystrophic latosol.**

Prado, R. de M and Korndorfer, G. H.

*Cientifica Jaboticabal* 31(1): 9-17. (2003); ISSN: 0100-0039.

*Notes:* Original title: Efeitos da escoria de siderurgia sobre a cultura do milho (Zea mays L.) cultivado em um latossolo vermelho amarelo distrofico.

*Descriptors:* application rates/ basic slag/ calcium/ crop yield / cultural control/ fungal diseases/ Latosols/ magnesium/ maize/ phosphorus/ plant disease control/ plant diseases/ plant pathogenic fungi/ plant pathogens/ potassium/ silicon/ soil acidity/ soil chemical properties/ soil types/ chemical properties of soil/ corn/ Hyphomycetes/ Phaeosphaeria/ Phaeosphaeria maydis/ Phaeosphaeriaceae/ phytopathogens

*Abstract:* An experiment was conducted on a yellow red dystrophic latosol in Uberaba, Minas Gerais, Brazil, in 1996 to evaluate the effects of basic slag (at 0, 500, 1000, 2000 and 4000 kg/ha) on maize production, disease control and chemical properties of soil, and the efficacy of this slag as a silicon source. Basic slag up to 4000 kg/ha did not affect the maize productivity, and did not promote a significant increase of available P, K, Ca and Mg in the soil. The soil acidity tended to decrease with basic slag addition. Basic slag did not show any effect on the incidence of Phaeosphaeria maydis and Helminthosporium sp. in the field.

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**800. Effects of selected treatments on the production of rice in acid sulfate soils in a simulation study.**

Khan, M. H. R.; Bhuiyan, M. M. A.; Kabir, S. M.; Oki, Y.; and Adachi, T.

*Japanese Journal of Tropical Agriculture* 50(3): 109-115. (2006); ISSN: 0021-5260

*Descriptors:* acid sulfate soils/ aggregates/ application rates/ crop production/ crop yield/ groundwater level/ growth/ Inceptisols/ rice/ simulation/ slags/ soil types/ acid sulphate soils/ paddy/ thionic soils

*Abstract:* The effects of application rate of basic slag (BS<sub>10</sub> and BS<sub>20</sub>: basic slag 10 and 20 t ha<sup>-1</sup>), aggregate size (A<sub>20</sub> and A<sub>30</sub>: aggregate sizes of soils, less than 20 and 20-30 mm) and groundwater level (Gw<sub>0</sub>: no influence of groundwater and Gw<sub>50</sub>: groundwater beneath 50 cm of the soil surface) treatments on growth and yield of rice (*Oryza sativa* cv. BR-3 Mukta) were evaluated through a simulation study in Bangladesh. The plants were cultivated in two pre-leached (leached for a week through tap water to remove excessive acidity and salinity from the soils before transplanting seedlings) acid sulfate soils of Badarkhali (Salidic Sulfaquept) and Cheringa (Typic Sulfic Halaquept) series. Optimum growth and yield of rice were recorded by the treatment combining A<sub>30</sub> Gw<sub>50</sub> BS<sub>20</sub> in both the Cheringa (grain: 6.70 t ha<sup>-1</sup>) and Badarkhali (5.78 t ha<sup>-1</sup>) soils. The application of basic slag (BS<sub>20</sub>) was found to be the most effective among the individual treatments, followed by the BS<sub>10</sub> Gw<sub>50</sub> A<sub>30</sub> treatments. The application of BS<sub>20</sub> increased the grain yield in combination with the Gw<sub>0</sub> treatment by 100% for A<sub>20</sub>, while by 122% for A<sub>30</sub> in the Badarkhali soil. On the other hand, in the case of Gw<sub>50</sub>, these increments were 138 and 246% for A<sub>20</sub> and A<sub>30</sub>, respectively, in the soils. However, the application of BS at the highest rate (BS<sub>20</sub>) to the Cheringa soil was not as effective as the A<sub>20</sub> and A<sub>30</sub> treatments in the Badarkhali soil. On the other hand, the same rate (BS<sub>20</sub>) of basic slag in combination with the Gw<sub>50</sub> treatment increased the grain yield by 152 to 382% in the Cheringa soil compared with 138 to 246% in the Badarkhali soil. Almost similar and significant ( $p \leq 0.05$ ) effects were observed for the other yield components of rice grown in both soil series. The effect of a larger soil aggregate size (20-30 mm) was more significant on the increase of growth and yield of rice during the 4-month growing period of rice, regardless of treatments.

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**801. Effects of the addition of Fe-containing slag fertilizers on the changes in Eh in paddy soil.**

Nozoe, Takuhito; Nishibata, Yoshimaru; Sekiguchi, Tetsuo; and Inoue, Tsunehisa

*Soil Science and Plant Nutrition* 45(3): 729-735. (1999)  
NAL Call #: 56.8 SO38; ISSN: 0038-0768

*Descriptors:* Fe-containing slag/ fertilizers/ oxidation-reduction potential/ Eh/ rice paddy soils

*Abstract:* Flooded soil with the addition of Fe-containing slags (1% to soil) was incubated under laboratory conditions. Five commercial slags were used in this study. The slag samples were numbered from I to V in ascending order of acid-soluble Ca content. The pH of the soil solution increased with the increased in the Ca content of the slags. All the Eh (oxidation-reduction potential) in the presence of the slags were lower than that of the control during the initial 8 d period of incubation. The Eh value in the

presence of slag V which contained the largest amount of Ca was the lowest throughout the incubation period. These findings suggest that the major factor of Eh decrease among others including the increase in pH, dissolution of Fe(III), and production of Fe<sup>2+</sup> was the increase in pH. In the case of slags II, III, and IV, the pH values were below 7.0 during the early stage of incubation. Although the pH values increased with the increase in the Ca content, all the Eh values in the presence of slags II, III, and IV decreased similarly, because the increase in pH enhanced the dissolution of Fe(III) in the pH region of 6 to 7 when slags II, III, and IV were applied under a given condition. This fact was confirmed by the dissolution experiments of slags in the EDTA solution. In this experiment, an EDTA solution was used in place of the soil solution. Slag I consisted of a mixture of slag and crystalline Fe(III) oxide. Although slag I contained a large amount of Fe, the reducible Fe(III) content was small. The pH values changed similarly in the presence of slags I and II, while the Eh value in the presence of slag I was lower than that in presence of slag II, presumably because the amount of reducible Fe(III) of slag I was smaller than that of slag II.

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**802. Effects of the application of basic slag iron chromium to soil on the nutritional state and dry matter production of passion fruit seedlings.**

Prado, R. de M and Natale, W.

*Revista Brasileira de Fruticultura* 26(1): 140-144. (2004)  
NAL Call #: SB354 .R48; ISSN: 0100-2945.

*Notes:* Original title: Efeitos da aplicacao da escoria de siderurgia ferrocromo no solo, no estado nutricional e na producao de materia seca de mudas de maracujazeiro.

*Descriptors:* application rates/ chromium/ dry matter/ dry matter accumulation/ industrial wastes/ iron/ passion fruits/ plant nutrition/ Red Latosols/ seedlings/ slags/ soil ph

*Abstract:* The effects of slag, an industrial waste containing iron and chromium, on soil pH and on the performance of passion fruit (*Passiflora edulis*) seedlings under greenhouse conditions were studied. Passion fruit seedlings were transplanted in pots containing red latosols at 30 days after the incorporation of the slag (0.0, 0.375, 0.750, 1.125 or 1.500 mg/dm<sup>3</sup> of substrate) into the soil. The seedlings were grown in pots for 85 days. The application of slag neutralized the acidity of the soil. However, when applied at a low rate (360 kg/ha), the slag had adverse effects on seedling nutrition and dry matter production.

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**803. Efficiency of liming in controlling the mobility of lead in shooting range soils as assessed by different experimental approaches.**

Levonmaki, M. and Hartikainen, H.

*Science of the Total Environment* 388(1-3): 1-7. (Dec. 2007)

NAL Call #: RA565.S365

*Descriptors:* soil pollution/ military lands/ lead/ leaching/ liming/ liming materials/ calcium carbonate/ furnaces/ slags/ polluted soils/ humic substances/ solubility/ dissolved organic carbon/ laboratories/ soil ph/ leachates/ soil transport processes/ soil microorganisms/ microbial activity/ provenance/ Finland

**Abstract:** Shooting range soils contaminated by lead (Pb) are a great environmental risk. Reducing mobility and leaching of Pb by liming, for example, has produced contradictory results. This laboratory study compares the efficiency of two liming agents differing in their reactivity, CaCO<sub>3</sub> and blast furnace slag (BFS), in diminishing the mobility of Pb. In a batch test, contaminated humic soil samples were incubated in closed vessels without and with liming materials added in quantities to correspond additions of 5 t ha<sup>-1</sup>. Water soluble Pb (Pbw), dissolved organic carbon (DOC), pH and substrate induced respiration (SIR) in soils were monitored for 21 days. In the experiment carried out with freely drained vessels, contaminated humic soil treated without and with liming agents was leached five times during the experimental period of 141 days. Leachates were analyzed for pH, DOC and Pb. At the end of the experiment, soil samples were analyzed for pH, DOC, Pbw, and SIR. In both systems, CaCO<sub>3</sub> raised pH and DOC more than BFS. The liming agents did not significantly differ in their effect on Pb chemistry. Neither had any effect on SIR: however, liming agents markedly reduced the leaching of Pb in the open system, while in the closed system they increased rather than reduced the extractability of Pb. Incubation in a closed vessel proved not to be a suitable experimental system for Pb mobility estimation, since the ionic strength may be raised to abnormal levels, resulting from accumulated reaction products of liming agents. This citation is from AGRICOLA.

**804. Evaluation of blast furnace slag as a means of reducing metal availability in a contaminated sediment for beneficial use purposes.**

Barth, Ed; Sass, Bruce; and Chattopadhyay, Sandip  
*Soil and Sediment Contamination* 16(3): 281-300. (2007)  
NAL Call #: TD878 .J68; ISSN: 1532-0383  
**Descriptors:** blast furnace slag/ reduction of metal availability/ contaminated sediments/ beneficial use  
**Abstract:** An attractive option for the management of dredged sediment involves the use of dredged sediment for beneficial use purposes, such as for fill material. Treatment (chemical amendment) of contaminated sediment may be necessary to limit the environmental and human availability (bioaccessibility, leachability, plant uptake) of heavy metals associated with the contaminated sediment before it is placed. A laboratory study was conducted to investigate the effect of admixing a specific chemical amendment (blast furnace slag) with slightly contaminated fresh-water sediment for reducing metal availability. Initial characterization tests of the un-amended sediment showed that some of the metals analyzed were present in relatively available (non-residual) forms. Although sulfide was present in the un-amended sediment, the amount was not sufficient to bind all of the available metals. A series of metal availability testing methods indicated that the amendment of the sediment with blast furnace slag (4% on a dry weight ratio basis) had the potential to slightly reduce the availability of some, but not all of the available metals associated with the sediment. Results of the column and batch leaching tests showed that leachability of certain metals, such as barium, nickel and zinc, was reduced by the amendment, but the leachability of copper increased. The effect of the amendment for decreasing bioaccessibility for lead and arsenic was not demonstrated. The amended

soil had a detrimental effect on most of the plant species that were evaluated. The metal availability results for the plant uptake tests were also mixed, with slightly lower uptake of certain metals by corn grown within the amended sediment.

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**805. Evaluation of silicate iron slag amendment on reducing methane emission from flood water rice farming.**

Ali, Muhammad Aslam; Oh, Ju Hwan; and Kim, Pil Joo  
*Agriculture Ecosystems and Environment* 128(1-2): 21-26. (Oct. 2008)  
NAL Call #: S601.A34; ISSN: 0167-8809  
**Descriptors:** iron slag/ soil amendment  
**Abstract:** Application of electron acceptors such as ferric iron oxides and hydroxides for controlling methane (CH<sub>4</sub>) emission from wetland rice fields deserves special attention due to its dominant role over all other redox species in wetland soils. Silicate iron slag (hereafter, silicate fertilizer), a byproduct of steel industry containing electron acceptors, was applied in paddy field (Agronomy Farm, Gyeongsang National University, South Korea) at the rate of 0, 1, 2 and 4Mghap# to investigate their effects on reducing CH<sub>4</sub> emissions from flood water rice (*Oryza sativa*, cv. Dongjinbyeon) farming during 2006-2007. CH<sub>4</sub> emission rates measured by closed-chamber method decreased significantly ( $p < 0.05$ ) with increasing levels of silicate fertilizer application during rice cultivation. Soil redox potential (Eh) showed a contrasting response to CH<sub>4</sub> emission rates. The concentrations of dissolved iron materials in percolated water, and the active and free iron oxides in soil significantly increased with the applications of silicate fertilizer, which acted as oxidizing agents and electron acceptors, and eventually suppressed CH<sub>4</sub> emissions during the rice growing seasons. Total CH<sub>4</sub> emission was decreased by 16-20% with 4Mghap# silicate fertilizer application and simultaneously rice grain yield was increased by 13-18%. Silicate fertilization significantly stimulated rice plant growth, especially root biomass, root volume and porosity, which might have improved rhizosphere oxygen concentration, and then partially contributed to reduce CH<sub>4</sub> emission through enhancing methane oxidation. Therefore, silicate fertilizer could be a good soil amendment for reducing CH<sub>4</sub> emission as well as increasing rice productivity in wetland paddy field. This citation is from AGRICOLA.

**806. Evaluation of slag application to decrease methane emission from paddy soil and fate of iron.**

Furukawa, Yuichiro and Inubushi, Kazuyuki  
*Soil Science and Plant Nutrition* 50(7): 1029-1036. (2004)  
NAL Call #: 56.8 SO38; ISSN: 0038-0768  
**Descriptors:** slag application/ methane emission/ paddy soil/ fate/ iron  
**Abstract:** Organic carbon in paddy soil is oxidized to carbon dioxide by reducing electron acceptors for a certain period after submerging. Methane production commences after the reduction of iron oxide which is the most important electron acceptor in the soil. We aimed to study the long-term suppression of the methane emission from the paddy soil by single application of iron slag. A revolving furnace slag (RFS; 248 g Fe kg<sup>-1</sup>) was applied to the potted soil at the rate of 0 (control) or 20 ton ha<sup>-1</sup> in 2000. Rice plants

were successively cultivated on the potted soils for 3 years without further application of the RFS. Methane emissions from the potted soils with rice plants were measured by the closed chamber method during these cultivation periods. Total flux of CH<sub>4</sub> emission from the pot applied with RFS decreased by 5-30% compared with the control. The RFS supplied free iron oxide to the potted soil, and its iron acted as the oxidizing agent as evidenced by the increase in ferrous iron content in the soil. The amount of iron lost from leaching at the bottom of the pots was estimated as 54-59 kg Fe ha<sup>-1</sup> year<sup>-1</sup> at the percolation rate of 20 mm d<sup>-1</sup>. Accordingly, half-life of the iron in the applied RFS was calculated as 42-46 years. Therefore, there is a possibility that the suppressing effect of RFS on CH<sub>4</sub> emission is sustained for a half-century. Contents of heavy metals (Cd, Cu, and Zn) in the brown rice harvested from the pot applied with RFS were not significantly different with those from the control pot.

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**807. Evaluation of the potential for agricultural use of the industrial slag from the iron and steel industry of Boyaca.**

Edith Gonzalez, M. and Castro, H. E.

*Suelos Ecuatoriales* 30(1): 15-20. (2000); ISSN: 0562-5351.

*Notes:* Original title: Evaluacion de la potencialidad del uso agricola de escorias industriales procedentes de la siderurgica de Boyaca S A.

*Descriptors:* application rates/ basic slag/ crops/ lime/ magnesian limestone/ rock phosphate/ slags/ wheat/ yield components/ magnesium limestone/ phosphate rock/ Triticum vulgare

*Abstract:* The fertilizer qualities and possible agricultural use of an industrial slag in Colombia was studied in an experimental design of complete randomized blocks. Eleven treatments were tested including four repetitions and a comparison test or absolute control. The crop indicator was wheat (*Triticum vulgare*), cultivar ICA Hunza. The treatments were: absolute control, as an indicator of the natural fertility of the experimental soil to which no fertilizers were applied; T1: 'regional test' using a common fertilization solution of NPK; treatments T2, T3, T4 and T5 received doses of 500, 1000, 2000 and 4000 kg industrial slag/ha respectively. Treatments T6, T7, T8, T9 and T10 refer to average doses of 1000 kg/ha of conventional materials as dolomitic lime, 'abono Paz del Rio' (another local basic slag), Calfos [calcium phosphate], North Carolina Rock Phosphate and 'Phosphacid-S-B' [phosphoric acid], respectively. The effects of equal doses of materials of different origin and composition were compared. It was concluded that the experimental slag has the characteristics of a fertilizer material and could be used in agriculture in soils of low fertility with properties of those studied. The chemical composition of soluble elements in the industrial slag and the results of yield components obtained by the indicator crop, gave evidence for further research to test at the farming level the validity of the selected doses and their chemical evaluation with liming material containing magnesium, sulfur and trace elements. Reproduced with permission from the CAB Abstracts database.

**808. An experimental assessment of slag as a substrate for mangrove rehabilitation.**

Day, S.; Streever, W. J.; and Watts, J. J.

*Restoration Ecology* 7(2): 139-144. (1999)

NAL Call #: QH541.15.R45R515; ISSN: 1061-2971

*Descriptors:* assessment/ carbon/ flowering/ habitats/ mangroves/ nitrogen/ nutrient content/ plant nutrition/ reclamation/ rehabilitation/ sand/ slags / substrates/ survival/ trees/ woody plants/ anthesis

*Abstract:* This study compared propagule retention, early survival, growth, flowering success, and nutrient concentrations of *Avicennia marina* (grey mangrove) grown on sand, naturally occurring substrate (a mixture of sand and silt), and rock blast furnace slag over two growing seasons (1996-97) at an experimental site near Newcastle, Australia. Nutrient concentrations of experimental plants were also compared with those of naturally occurring plants. Experimental results showed significant differences ( $p < 0.05$ ) in short-term survival, growth over the two growing seasons, and carbon and nitrogen concentrations between plants grown on different substrates. Comparison of plants grown in slag and plants from reference sites suggests, however, that slag does not lead to anomalies in nutrient concentrations of young mangroves. Although the results identified some differences between plants grown on river sand, naturally occurring substrate, and slag substrate, the absence of consistent differences suggests that mangroves planted in slag when rehabilitating habitats are under no greater risk of future failure than mangroves planted in naturally occurring substrate.

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**809. Extractors of available silicon in slags and fertilizers .**

Pereira, H. S.; Korndorfer, G. H.; Moura, W. F.; and Correa, G. F.

*Revista Brasileira de Ciencia do Solo* 27(2): 265-274. (2003)

NAL Call #: S590 .R44 ; ISSN: 0100-0683.

*Notes:* Original title: Extratores de silicio disponivel em escorias e fertilizantes.

*Descriptors:* acetic acid/ ammonium nitrate/ cation exchange resins/ citric acid/ extractants/ fertilizer analysis/ hydrochloric acid/ nutrient availability/ nutrient uptake/ plant nutrition/ rice/ silicon/ silicon fertilizers/ slags/ sodium carbonate/ paddy

*Abstract:* The methods to quantify available silicon (Si) in fertilizers and slags are not yet sufficiently trustworthy. In this study, Si extracted from several sources was analysed. The extractors used were: Na<sub>2</sub>CO<sub>3</sub>+NH<sub>4</sub>NO<sub>3</sub> in varying concentration, time of agitation and of reaction; water; 0.5 mol HCl dm<sup>-3</sup>; 50 g Na<sub>2</sub>CO<sub>3</sub> dm<sup>-3</sup>; 50 g citric acid dm<sup>-3</sup>; 0.5 mol acetic acid dm<sup>-3</sup>; acid cation exchange resin (Amberlite IRC-50, pK 6.1); and the leaching column method. A greenhouse experiment, where 125 kg ha<sup>-1</sup> of total Si from 12 different sources was applied on irrigated rice, was also conducted. For the determination of Si, shaking duration was not essential, although 3 h of shaking entailed a statistically superior result. The concentrations of 10+16 g dm<sup>-3</sup> and 30+48 g dm<sup>-3</sup> of Na<sub>2</sub>CO<sub>3</sub>+NH<sub>4</sub>NO<sub>3</sub> proved to be the most promising for Si extraction. The

smaller concentration (10+16 g dm<sup>-3</sup>) was therefore chosen to evaluate Si sources in relation to settling time. All Si sources increased solubility during the rest time period. The best correlation between Si uptake by the rice plants and Si detected in the various analysed sources was found in the period between day 5 and 9. According to the results, the extractor Na<sub>2</sub>CO<sub>3</sub>+NH<sub>4</sub>NO<sub>3</sub> evaluates Si in fertilizers adequately and can be used as a method to determine the potential Si release in the soil and its availability for plants. The most efficient source for Si solubilization for rice was Rhodia, followed by Wollastonita, while the sources MB-4 and blast furnace slag provided less available Si. The acid extractors were more efficient at extracting Si from blast furnace slags and less efficient with Wollastonita. Water was the extractor that presented the lowest Si recovery rate. The best correlation between Si contents and uptake by the rice crop were achieved by the extractors resin Amberlite and Na<sub>2</sub>CO<sub>3</sub> 10 g dm<sup>-3</sup>+NH<sub>4</sub>NO<sub>3</sub> 16 g dm<sup>-3</sup>, followed by the column-method. Reproduced with permission from the CAB Abstracts database.

#### 810. Feasible suppression technique of methane emission from paddy soil by iron amendment.

Furukawa, Yuichiro and Inubushi, Kazuyuki  
*Nutrient Cycling in Agroecosystems* 64(1-2): 193-201. (2002)

NAL Call #: S631 .F422; ISSN: 1385-1314

*Descriptors:* suppression techniques/ methane emissions/ paddy soils/ iron amendment

*Abstract:* A revolving furnace slag (RFS), which is a by-product of the steel industry, and a spent disposable portable body warmer (PBW), which harnessed the heat of iron oxidation reaction, were used as iron materials. Portions of 4 kg of Coarse and Medium Textured Gley soil were placed into plastic pots (3 L). RFS was added to the pots at the rate of 0 (control), 10, 20, 40, 100 ton ha<sup>-1</sup>, while PBW was added at 10 ton ha<sup>-1</sup> only. Methane flux from the potted soil with rice plants and Eh were measured during cropping seasons in 1999 and 2000. In the 1999 experiment, the RFS treatments showed lower Eh values compared with the control, especially at the early period of cultivation, although the RFS was applied to maintain the soil oxidative. The rapid decrease in Eh under high application of RFS may be due to the high pH of the RFS (pH (RFS:H<sub>2</sub>O = 1:2.5) was 12.2). However, total methane emission during the cultivation period significantly decreased, about 10%, when 10-40 ton ha<sup>-1</sup> of RFS and 10 ton ha<sup>-1</sup> of PBW were applied. The grain yield was significantly increased, about 30%, when 40 or 100 ton ha<sup>-1</sup> of RFS was applied. This was also partly due to the release of inorganic nutrients from RFS and also from soil. The latter, due to effect of the alkaline RFS on soil. In the 2000 experiment, the pots with soils from 1999 were used without further application of iron materials. The influence of high application of RFS on soil Eh disappeared, compared with 1999. Total methane emission significantly decreased, about 35%, at 20 ton ha<sup>-1</sup> of RFS. However, the increase of grain yield caused by RFS in 1999 was diminished, compared with 1999. Production activity of both methane and carbon dioxide at the RFS treatments were decreased, while methane oxidizing activity was increased. The

decrease in total methane emission may be attributed to not only inhibition of methane production but also enhanced methane oxidation. In conclusion, methane emission from paddy soil could be suppressed, over two cropping seasons by single application of RFS without losing grain yield. © Thomson Reuters

#### 811. Iron and steel industry slag and lime for soil acidity correction using sugarcane grown in pots.

Prado, R. de M. and Fernandes, F. M.  
*Scientia Agricola* 57(4): 739-744. (2000); ISSN: 0103-9016.

*Notes:* Original title: Escoria de siderurgia e calcario na correcao da acidez do solo cultivado com cana de acucar em vaso.

*Descriptors:* acid soils/ application rates/ cerrado soils/ Entisols/ Ferralsols/ lime/ lime requirement/ limestone/ Oxisols/ pot experimentation/ slags/ soil acidity/ soil amendments/ soil pH/ soil types/ sugarcane soils

*Abstract:* The neutralizing components of slag are linked with high energy, combined with the presence of several metallic elements; these characteristics interfere in the chemical evaluation of their neutralization power. This study evaluated whether the neutralization power of lime would be compatible with slag, as a function of pH, H+Al, and Ca+Mg contents on acid soils in the Cerrado region of Brazil, for sugarcane cultivation. The study was performed in 20 dm<sup>3</sup> pots in a greenhouse, with Acrustox and Quartzipsamment soils, in two successive cultivations of sugarcane (first cutting and second cutting), each harvested 210 days after amendments incorporation. Treatments constituted of the two corrective agents, limestone and slag, at two levels of application. At the end of each cultivation, soils were sampled and analysed chemically. The reactivity of the slag depended on the soil type. The efficiency of the slag based on the power of neutralization adopted for limestone was not sufficient to allow evaluation of the required amount of the product for the correction of soil acidity.

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#### 812. New applications for iron and steelmaking slag.

Takahashi, T. and Yabuta, K.  
*NKK Technical Review*(87): 38-44. (2002); ISSN: 09150544 [NTERE]

*Descriptors:* blast furnaces/ carbon dioxide/ concrete aggregates/ research and development management/ slags/ iron slag/ steelmaking

*Abstract:* Iron and steelmaking slag is a by-product of the iron and steelmaking process. Slag has traditionally been used as a component of cement and construction aggregate. NKK has led the industry in promoting the effective use of slag. In this paper, fine concrete aggregate, known as Sandy-S, and slag sand-capping material are introduced as new applications of granulated blast furnace slag. Other innovative uses of steelmaking slag are introduced: large carbonated slag blocks, called Marine Blocks, produced by injecting carbon dioxide into slag compact, and potassium silicate fertilizer produced by adding a potassium source to steelmaking slag.

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**813. New evidence for rejuvenation of phosphorus retention capacity in EAF steel slag.**

Drizo, A.; Cummings, J.; Weber, D.; Twohig, E.; Druschel, G.; and Bourke, B.

*Environmental Science and Technology* 42(16): 6191-7. (Aug. 2008)

NAL Call #: TD420.A1E5; ISSN: 0013-936X

*Descriptors:* rejuvenation potential/ phosphorus retention capacity/ electric arc furnace/ steel slag

*Abstract:* The purpose of this research was to investigate phosphorus (P) retention capacity and rejuvenation potential of electric arc furnace (EAF) steel slag from Quebec and New Zealand (NZ) iron melter slag (IMS). Columns filled with slag materials were fed with dairy effluent and subjected to two feeding and one resting cycle(s). P retention capacities and rejuvenation potentials were determined after each feeding cycle. Elemental composition and mineralogical analysis were performed on IMS samples. Finally, chemical fractionation analysis was conducted on both NZ IMS and Quebec EAF steel slags. The results revealed that initiating a resting period in EAF steel slag filters prior to reaching their P saturation point increased the overall filter P retention capacity by 49.5 and 42.4% compared to 28% in a filter which had its resting period initiated after reaching P saturation. The rejuvenation property could play a significant role in full-scale applications by prolonging life expectancy and increasing cost efficiency. P retention and rejuvenation by NZ slag materials was negligible relative to EAF steel slag material from Quebec. Chemical fractionation analysis revealed differences between materials, indicating that the highest quantities of P were bound to Ca and Fe in EAF steel slag and to Ca and Al fractions in iron melter slag. This study also demonstrates that slag's performance is dependent on the source of the material and the steel making practices. Therefore, testing of the P adsorptive capability and, if relevant, the rejuvenation potential of individual steel mill slags, should be a prerequisite prior to their use in field applications.

This citation is from PubMed.

**814. The occurrence and distribution of various forms of silica and zeolites in soils developed from wastes of iron production.**

Sauer, D. and Burghardt, W.

*Catena* 65(3): 247-257. (2006); ISSN: 0341-8162

*Descriptors:* aluminium/ calcium carbonate/ industrial wastes/ iron/ magnesium/ nonclay minerals/ potassium/ saturation/ silica/ silicic acid/ silicon/ slags/ sodium/ soil formation/ soil ph/ soil profiles/ soil properties/ soil salinity/ zeolites/ aluminum/ soil genesis

*Abstract:* Young soils developed in blast furnace slag, slag sand and ash are often alkaline. Under these conditions the solubility of silica increases greatly. In four soil profiles investigated (two in France and two in Germany) we found not only that dissolved silicic acid and amorphous silica occurred, but also that zeolites had developed. We identified several soil properties that may influence the formation of amorphous silica and zeolites. In the blast furnace slag, the formation of amorphous silica seemed to be enhanced by decreasing pH and increasing Mg content, while the amount of zeolites grew with increasing contents

of water soluble Na and K and with decreasing content of CaCO<sub>3</sub>. In the slag sand, Mg also appeared to promote the formation of amorphous silica. In addition, there was a weaker correlation between rising CaCO<sub>3</sub> content and an increasing amount of amorphous silica. Furthermore, in the slag sand the Si<sub>0</sub>:Al<sub>0</sub> ratio decreased with increasing salinity, suggesting that the zeolites were Al enriched. Longer periods of water saturation of the soil, it is suggested, enhance the development of zeolites and inhibit the formation of amorphous silica.

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**815. Plant growth and nutrients uptake as influenced by application of farmyard manure and some natural minerals to sandy soils.**

Wafaa, M. T. E.; Gehan, H. Y.; and Laila, K. M. A.

*Arab Universities Journal of Agricultural Sciences* 14(1): 213-234. (2006); ISSN: 1110-2675

*Descriptors:* ammonium sulfate/ crop yield/ dry matter accumulation/ farmyard manure/ fertilizers/ flowering/ growth/ magnetite/ maize/ manganese/ minerals/ nutrient uptake/ potassium sulfate/ roots/ sandy soils/ shoots/ slags/ soil types/ superphosphate/ wheat/ ammonium sulphate/ anthesis/ corn/ FYM/ Mn/ potassium sulphate

*Abstract:* A field experiment was conducted at the Ismailia Agricultural Research Station, Egypt, during two successive seasons, winter 2001-2002 with wheat (*Triticum aestivum* cv. Giza 168) and summer 2002 with maize (*Zea mays* cv. Giza 10) to study the effect of farmyard manure (FYM) and some natural materials on growth and uptake of nutrients by plants. FYM was applied at 2 and 3% individually or combined with micronutrient sources. Micronutrients were magnetic iron oxide, basic slag and manganese dust, applied alone at 0.07% or in combination with FYM levels of 0.02, 0.05 and 0.07%. The plots received inorganic fertilizers as follows: ammonium sulfate (20% N), superphosphate (15% P<sub>2</sub>O<sub>5</sub>) and potassium sulfate (48% K<sub>2</sub>O) at rates of 100, 30 and 48 kg/ha at N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O, respectively. The results showed that the mineral fertilizers treatment positively affected the dry matter of both shoots and roots of wheat along with contents of nitrogen and potassium in both shoots and roots and shoot-root ratio. At flowering stage, the results showed that applied FYM at the rate of 3% significantly affected the dry matter of both shoots and roots as well as their content of N, P and K. A similar trend was observed for micronutrients uptake at the two indicated growth stages of wheat, which recorded high values when FYM, at a rate of 3%, was applied. The results indicated that applied FYM at the rate of 2% with high rate (0.07%) of each of the used natural minerals and FYM at the rate of 3% in combination with the moderate rate (0.05%) of such minerals recorded high values of the tested parameters. The basic slag gave the highest values, over control, of dry matter content and macronutrients uptake during the studied two growth stages of wheat (vegetative and flowering stages). The agronomic yield components of wheat (straw, grains and weight of 1000 grains) were increased when mineral fertilizer was applied; such significant increases were obtained in maize yield as a result of applied FYM individually or combined with natural minerals.

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**816. Potential of use of slags and other silicon sources in four materials of the savanna soils.**

Pereira, H. S.; Queiroz, A. A.; Martins, M. R.; Camargo, M. S. de; and Korndorfer, G. H.

*Bioscience Journal* 23(3): 17-31. (2007); ISSN: 1516-3725.

*Notes:* Original title: Potencial de uso de agregados siderurgicos e outras fontes de silicio em quatro materiais de solo fase cerrado.

*Descriptors:* application rates/ calcium carbonate/ Entisols/ grasslands/ nonclay minerals/ Oxisols/ savannas/ silicates/ silicon/ silicon fertilizers/ slags/ wollastonite

*Abstract:* To supply the demand for silicates fertilizers, there is need to investigate and to identify the potential sources of silicon (Si) available. This study evaluated materials (fertilizers/slags) with high concentration in Si, through chemical methods of soil incubation, to predict its agronomic efficiency and reatividade in the soil. Incubation studies (with and without balance with CaCO<sub>3</sub> and MgCO<sub>3</sub>) were carried out for 90 days, using 4 soil materials under savanna vegetation (Rhodorthox, Gibbsiorthox, Ferrorthox and Quartzipsamment soil) with 12 materials (wollastonite, blast furnace I and II, steel slag of LD I, II, III and IV, slag of P, steel slag of AOD, electric furnace steel slag, stainless steel slag and silicate clay) and a control. Wollastonite was used with doses of 125, 250 and 500 kg/ha and the other materials in the dose of 125 kg/ha. The Si levels in acetic acid were larger than the extracted with water, overestimating the content of Si in the sources when the calcium and magnesium carbonate was used. The metallurgical aggregate originated of blast furnace, which possesses larger Si levels, are more soluble in acetic acid and less soluble in water compared with the other slags. The electric furnace steel slag presented the level of Si extracted in water, wherein it was more soluble, showing high use potential for agriculture, although studies are necessary with plants.

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**817. Problems and prospects of efficient use of fertilisers in acid soils of India.**

Panda, N.

*Fertiliser News* 43(5): 39-50. (1998)

*NAL Call #:* 57.8 F4123; ISSN: 0015-0266

*Descriptors:* acid soils/ agroforestry/ amendments/ basic slag/ capacity/ cultivation/ fertilizers/ industrial wastes/ lime/ phosphorus/ rock phosphate/ sludges/ soil/ soil management/ use efficiency/ wastes/ agriforestry/ agro forestry/ phosphate rock

*Abstract:* Acid soils in India are base unsaturated, infertile, low water retentive, nutritionally imbalanced and problematic from the management standpoint. Amelioration of acid soils with commercial lime is cost-prohibitive, and industrial wastes such as basic slag, blast furnace slag, lime sludge from paper mills, cement kiln wastes etc. have potentiality. Indigenous rock phosphate like Mussoorie and Udaipur and imported rock phosphate like North Carolina and Gafsa could also be used. Cultivation of acid-soil-tolerant crop species and varieties are sustainable though not commercially viable. Agro-horticultural and agroforestry systems with proven technology should be encouraged. Integrated nutrient management is highly desirable with chemical fertiliser as a major component. Since fertilizer

use efficiency in acid soils is low, soil-test-based fertilizer recommendations aiming at balanced fertilisation is remunerative.

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**818. Reclamation of a Badarkhali hot spot of acid sulfate soil in relation to rice production by basic slag and aggregate size treatments under modified plain ridge ditch techniques.**

Khan, Md. H. R.; Kabir, S. M.; Bhuiyan, Md. M. A.; Blume, H.-P.; Oki, Y.; and Adachi, T.

*Soil Science and Plant Nutrition* 54(4): 574-586. (2008)

*NAL Call #:* 56.8 SO38; ISSN: 00380768 [SSPNA].

*Notes:* doi: 10.1111/j.1747-0765.2008.00263.x.

*Descriptors:* acid sulfate soil/ aggregate size/ basic slag/ growth performance/ reclamation

*Abstract:* A field experiment was conducted for the reclamation of a Badarkhali hot spot of acid sulfate soil manipulated by flash leaching followed by basic slag (BS) at 10 t ha<sup>-1</sup> (BS<sub>10</sub>) and 20 t ha<sup>-1</sup> (BS<sub>20</sub>) and aggregate sizes (A) of soil less than 20 mm (A<sub>20</sub>) and less than 30 mm (A<sub>30</sub>) treatments under two different techniques (Tech 1: pyrite layer at top, jarosite layer at middle and topsoil at the bottom of the ridge; Tech 2: topsoil at top, pyrite layer at middle and jarosite layer at the bottom of the ridge). Responses to two cultivars of rice (Pizam [local cultivar] and BR 14 [high yielding cultivar]) with the treatments were evaluated. The initial soil had a very low pH(H<sub>2</sub>O) 4.0 and a high electrical conductivity (EC) of 1.4 m S<sup>-1</sup>, and the pyrite content was 68 g kg<sup>-1</sup>. The exchangeable Mg content of the soil was approximately twice that of Ca and the Al content was at a highly toxic level. The average soil data of all the treatments, except for the control plots (where no amendment was applied), after harvesting of rice increased by 1.1 units for soil pH and 17-524% for the contents of N, P, Ca and Mg, while the concentrations of Fe, Al, Na, Cl- and SO<sub>4</sub><sup>2-</sup> decreased by 30-94% compared with the initial soil. The maximum growth and yield of rice grains (4.4 t ha<sup>-1</sup>) were obtained by the Pizam compared with the BR 14 (4.0 t ha<sup>-1</sup>) in the A<sub>20</sub>BS<sub>20</sub> treatment in the ridges of Tech 2. The lowest grain yields of 0.02 (BR 14) and 0.07 t ha<sup>-1</sup> (Pizam) were recorded for the control plots. The other treatments also resulted in significantly (P < or equal to 0.05) improved performance on rice production. The highest N, P, K, Ca and Mg contents in the shoots of BR 14 and Pizam rice were obtained under the A<sub>20</sub>BS<sub>20</sub> treatment followed by the A<sub>20</sub>BS<sub>10</sub> > or equal to A<sub>30</sub>BS<sub>20</sub> treatments. Application of A<sub>20</sub>BS<sub>20</sub> under Tech 2 is the most appropriate reclamation option and the local Pizam is the most suitable rice for this soil. © 2008 Japanese Society of Soil Science and Plant Nutrition.

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**819. The reduction of phosphorus effluence from greenhouse canal soil using amendments in Korea.**

Yun, S. W.; Baek, S. H.; Park, J. C.; and Yu, C.

In: 2007 Asabe Annual International Meeting, Technical Papers.; Vol. 3.

Minneapolis, MN; 2007.

*Notes:* Conference code: 70499. Sponsors: American Society of Agricultural and Biological Engineers, ASABE.

*Descriptors:* greenhouse sector/ industrial by-products/ phosphorus/ runoff reduction/ agricultural runoff / catchments/ cultivation/ eutrophication/ greenhouses/ pH effects/ soils/ greenhouse sectors/ incubation/ rotating cultivation systems/ runoff reduction/ phosphorus

*Abstract:* Phosphorus(P) export from agricultural catchments can accelerate freshwater eutrophication. For most soils around canals of greenhouse sector in Korea, it has been well known that soil P exceeded the appropriate P level because of the continuous rotating cultivation system and the excessive fertilizing. Therefore the excessive P was concentrated in soils around canals and the effluence of P from these soils during the irrigation or flooding season has become a major cause of the pollution of reservoirs or rivers in Korea. In this presentation, the alternative method was investigated in order to reduce the P effluence, especially water extractable soil P (WEP), from these P-rich canal soils to freshwater system. In the tests, a typical soil at excessive soil P level were incubated for 56 weeks after the treatment with the types of 4 application rates (3%, 6%, 9%, 12%) of various industrial by-products such as blast furnace slag (BFS), steel refining slag (SRS), fly ash (FA), bottom ash (BA) and oyster shell (OS) meal. The efficiency of WEP reduction of samples which were treated with industrial by-products as potential PSSAs in the 3-12% application rates and in 56 days incubation period was appeared in the order of OS > FA > SRS > BFS > BA. But all samples were shown the efficiencies that were higher than about 70% during 21 days incubation and higher than about 80% during 56 days incubation. As a result of statistical analysis, among the various relationships, between WEP content and pH and then between WEP content and total P content were shown the most highest significant level when we referred to the result of Student's t-test. Also WEP contents between 21 day and 56 day were not different significantly for all PSSAs and these results suggest that sorption reactions induced by PSSAs are rapid and remain stable over time. On the other hand, pH value of all samples was in the range of 7.35-8.03 at 56 day. It is also suggesting that solubility of soil P which was treated with PSSAs will be low and sustainable for a long period because pH level had sustained in the range above 7.0 for 56-days. Therefore industrial by-product as potential PSSAs can be considered in selecting a material as a possible. These results were considered appropriate in the view of the management of canals around greenhouse site according to the regulation in Korea. Especially, the effect of oyster-shell and bottom-ash were remarkable.  
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**820. Remediation of arsenic-contaminated soils by iron oxide application, evaluated in terms of plant productivity, arsenic and phytotoxic metal uptake.**

Hartley, W. and Lepp, N. W.

*Science of the Total Environment* 390(1): 35-44. (2007)

*NAL Call #:* RA565.S365; ISSN: 0048-9697

*Descriptors:* arsenic/ bioavailability/ biomass/ coal/ fly ash/ goethite/ growth/ heavy metals/ iron/ iron oxides/ lime/ phytotoxicity/ polluted soils/ soil amendments/ soil pollution/ soil types/ spinach/ sulfates/ tomatoes/ uptake/ limonite/ remediation/ sulphates

*Abstract:* Four iron-bearing additives, selected for known or potential ability to adsorb anions, were evaluated for their effectiveness in attenuation of arsenic (As) in three soils with different sources of contamination (canal dredgings,

coal fly ash deposits, and low-level alkali waste).

Amendments used were lime, goethite (alpha-FeOOH) (crystallised iron oxide) and three iron-bearing additives, iron grit and iron (II) and (III) sulphates plus lime, which result in 'de novo' iron oxide formation in soils. Each was applied to the test soils at a rate of 1% w/w. A series of plant growth trials were conducted on the equilibrated, amended soils using spinach (*Spinacia oleracea*) and tomato (*Lycopersicon esculentum*) as test crops. These were grown in the contaminated soils for a period of three months in controlled glasshouse conditions. Evaluation of the potential of the amendments as immobilising agents was determined by plant growth (biomass) and elemental accumulation in plant tissues, indicating the bioavailability of As and other heavy metals following amendment. Goethite produced the most promising results in terms of reduction of plant shoot As content. It was concluded that, whilst Fe-oxides may be used as effective in situ amendments to attenuate As in soils by reducing its bioavailability, their effects on plant growth require careful consideration. In addition, soil-plant transfer of As was not completely halted by any amendment. Reproduced with permission from the CAB Abstracts database.

**821. Remediation of copper-contaminated topsoils from a wood treatment facility using in situ stabilisation.**

Bes, C. and Mench, M.

*Environmental Pollution* 156(3): 1128-1138. (Dec. 2008)

*NAL Call #:* QH545.A1E52; ISSN: 1873-6424

*Descriptors:* adsorption/ carbon/ copper: analysis/ environmental remediation: methods/ fabaceae: chemistry: growth & development/ France/ humic substances/ industrial waste/ iron/ phosphates/ plant shoots: chemistry: growth & development/ sewage/ soil: analysis/ soil pollutants: analysis/ wood

*Abstract:* Five organic matters, three phosphate compounds, zerovalent iron grit (ZVIG, 2% by soil weight), two alkaline compounds, and two commercial formulations were incorporated, singly and some combined with ZVIG, into a highly Cu-contaminated topsoil (Soil P7, 2600 mg Cu kg(-1)) from a wood treatment facility. Formulations and two composts were also singly incorporated into a slightly Cu-contaminated topsoil (Soil P10, 118 mg Cu kg(-1)) from the facility surrounding. This aimed to reduce the labile pool of Cu and its accumulation in beans cultivated on potted soils in a climatic chamber. Lowest Cu concentration in soil solution occurred in P7 soils amended with activated carbon (5%) and ZVIG, singly and combined. Basic slag (3.9%) and compost of sewage sludge (5%) combined with ZVIG promoted shoot production and limited foliar Cu accumulation. For amended P10 soils, no changes occurred in soil solution and foliar Cu concentrations, but one compost increased shoot production.

This citation is from PubMed.

**822. The Rengen Grassland Experiment: Soil contamination by trace elements after 65 years of Ca, N, P and K fertiliser application.**

Hejzman, M.; Szaková, J.; Schellberg, J.; Šrek, P.; and Tlustoš, P.

*Nutrient Cycling in Agroecosystems* 83(1): 39-50. (2009)

*NAL Call #:* S631.F422; ISSN: 13851314 [FRESO].

*Notes:* doi: 10.1007/s10705-008-9197-8.

*Descriptors:* arsenic/ basic slag/ chromium/ heavy metals/ long-term fertilisation/ mobility and accumulation/ risk elements/ bioavailability/ element mobility/ experimental study/ fertilizer application/ grassland/ heavy metal/ slag/ soil pollution/ soil profile/ trace element/ Central Europe/ Eifel/ Eurasia/ Europe/ Germany/ Rhenish Schiefergebirge/ Rhineland Palatinate

*Abstract:* The Rengen Grassland Experiment (RGE) was established in the Eifel Mts. (Germany) on a low productive Nardetum in 1941. Since then, the following fertiliser treatments have been applied along with a two cut system: unfertilised control, Ca, CaN, CaNP, CaNP-KCl and CaNP-K<sub>2</sub>SO<sub>4</sub> with basic slag (syn. Thomas phosphate) as the only P fertiliser. The effect of long-term fertilisation on plant-available (extracted with 0.01 mol l<sup>-1</sup> CaCl<sub>2</sub>), easily-mobilisable (extracted with 0.05 mol l<sup>-1</sup> EDTA), potentially-mobilisable (extracted with 2 mol l<sup>-1</sup> HNO<sub>3</sub>) and total concentrations of trace elements (As, Cd, Cr, Cu, Fe, Mn, Ni, Pb and Zn) in the top 0-10 and 10-20 cm of soil were investigated in 2006. According to redundancy analysis (RDA), the effect of treatment on the concentrations of risk elements was significant and explained 82.3 and 90.6% of the variability in the data in the 0-10 and 10-20 cm soil layers, respectively. Basic slag supplied the soil with considerable amounts of As, Cr, Cu, Fe, Mn and Zn. Following 65 years of fertiliser application the concentrations of risk elements in the soil profile had increased substantially, especially with basic slag. However, threshold limits for total trace element concentration in soil permitted by Czech national legislation were exceeded only in the case of As. The increase in plant-available As concentrations was most critical as it increased the potential uptake of As by plants in plots fertilised with P. Although P treatments received more than 300 g of Cr ha<sup>-1</sup> annually, no effect on plant-available Cr soil content was detected. This contrasted with the accumulation of total Cr in the 0-10 and 10-20 cm soil layers. Furthermore, plant availability of Cd, Fe, Mn and Zn was affected by soil pH and generally decreased with the application of quick lime. Plant availability of these elements was not correlated with amounts supplied by fertilisers. © 2008 Springer Science+Business Media B.V. © 2009 Elsevier B.V. All rights reserved.

#### 823. Residual effect of calcium silicate slag as soil acidity corrective in sugar cane ratoon.

Prado, R. M.; Fernandes, F. M.; and Natale, W.  
*Revista Brasileira de Ciencia do Solo* 27(2): 287-296. (2003)

*NAL Call #:* S590 .R44; ISSN: 0100-0683.

*Notes:* Original title: Efeito residual da escoria de siderurgia como corretivo de acidez do solo na soqueira de cana de acucar.

*Descriptors:* application rates/ base saturation/ calcium silicate/ crop yield/ limestone/ liming/ liming materials/ ratooning/ residual effects/ slags/ soil acidity/ soil pH/ sugarcane

*Abstract:* Calcium silicate slag, as a soil acidity corrective material with long-lasting residual effects, can benefit long-cycle cultures like sugarcane, thus minimizing production drops during the productive cycle. This study, conducted in Brazil, evaluated different base saturation levels, comparing calcitic limestone to basic slag as a soil corrective agent, in relation to alterations of some chemical soil properties, as well as to the response of sugarcane ratoon. Sugarcane of

the SP 80-1842 type, during the third and fourth cut in the agricultural years 2000/01 and 2001/02, was used for the experiment. The treatments, arranged in randomized blocks with four replications, consisted in the application of two corrective agents (calcitic limestone and basic slag) evaluated by the base saturation method, with four correction levels (V %): control (without correction), correction for V % to 50; 75; and 100, applied at planting. After 48 months, both calcitic limestone and basic slag had generated a beneficial residual effect in the correction of soil acidity and the increase of base saturation. The highest limestone rate caused a restrictive effect on the sprouts, the number of industrially usable culms and on the sugarcane yield, while under the use of basic slag, this fact was not observed. The application of basic slag and limestone in pre-planting caused a positive residual effect on the yield of sugarcane ratoon.

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#### 824. Response of guava plants to basic slag application as corrective of soil acidity.

Prado, R. de M.; Correa, M. C. de M.; Cintra, A. C. O.; and Natale, W.

*Revista Brasileira de Fruticultura* 25(1): 160-163. (2003)  
*NAL Call #:* SB354 .R48; ISSN: 0100-2945.

*Notes:* Original title: Resposta de mudas de goiabeira a aplicacao de escoria de siderurgia como corretivo de acidez do solo.

*Descriptors:* calcium/ fertilizers/ guavas/ magnesium/ plant nutrition/ slags

*Abstract:* Basic slag was evaluated for plant nutrition and production of guava plants in pots in Sao Paulo, Brazil. Basic slag was incubated in soil for 90 days before planting. Application of basic slag positively affected values of pH, sum of bases and base saturation and concentrations of calcium, magnesium, phosphorus, and aluminium in soil. Height, number of leaves and foliar area of plants significantly increased with slag application. Concentration of calcium, magnesium and phosphorus in aerial parts and roots also increased. It is concluded that basic slag is suitable for production of young guava plants for correction of acidity and a source of nutrients.

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#### 825. Response of sugarcane to application of iron and steel slag as a corrective for acidity in soil .

Prado, R. M. and Fernandes, F. M.  
*Revista Brasileira de Ciencia do Solo* 25(1): 199-207. (2001)

*NAL Call #:* S590 .R44; ISSN: 0100-0683.

*Notes:* Original title: Resposta da cana de acucar a aplicacao de escoria de siderurgia como corretivo de acidez do solo.

*Descriptors:* application to land/ base saturation/ calcium/ growth/ limestone/ liming/ magnesium/ plantations/ productivity/ responses/ slags/ soil / soil acidity/ soil chemical properties/ stems/ sugarcane/ chemical properties of soil/ land application

*Abstract:* High acidity predominates in southeastern and midwestern Brazilian soils, where the largest area of sugarcane plantations is concentrated. Large amounts of slag, a steel industry residue containing nutrients such as calcium and magnesium and acting as acidity corrective

agents, are also present in the region. This study aimed to evaluate different base saturation levels using slag as a soil corrective agent. This material was compared to calcitic limestone to analyse acidity neutralization and certain chemical soil properties, as well as sugarcane response during the first two cuts. Thus, an experiment was carried out using sugarcane variety SP 80-1842 during 1998-99 and 1999-2000. The treatments were arranged in a randomized block design, with four replications, consisting of two sources of corrective agents-calcitic limestone and slag - and four correction levels, estimated by the base saturation method (V%): control without correction and V% correction of 50, 75 and 100. It was concluded that the limestone and slag application had a similar effect on the correction of the soil acidity as well as on the increase of calcium and magnesium concentrations of the soil and base saturation. Limestone and slag applications had a quadratic and linear effect, respectively, on culm production and number of millable stalks.

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**826. Results of three long term P-field experiments in Austria: 1st report: Effects of different types and quantities of P-fertiliser on yields and pcal/dl contents in soils.**

Spiegel, H.; Lindenthal, T.; Mazorek, M.; Ploner, A.; Freyer, B.; and Köchl, A.

*Bodenkultur* 52(1): 3-17. (2001); ISSN: 00065471 [BODEA].

*Notes:* Original Title: Ergebnisse von drei 40 jährigen P-dauerversuchen in österreich: 1. Mitteilung: Auswirkungen ausgewählter P-düngerformen Und mengen auf den ertrag und die pcal/dl gehalte im boden. Language of Original Document: German.

*Descriptors:* cereals/ long-term field experiment/ P-fertiliser/ root crops/ soil-P

*Abstract:* The effects of different types (superphosphate, basic slag and rockphosphate) and quantities (0, 44 and 175 kg P ha<sup>-1</sup> a<sup>-1</sup>) of P-fertiliser application on crop yields and PCAL/DL-contents in soils were evaluated in three long-term field experiments lasting 40 years. After 20 to 40 years of application of 44 kg P ha<sup>-1</sup> a<sup>-1</sup> as superphosphate and basic slag crop yields increased in comparison to zero P-fertilisation. These differences are statistically significant (Tukey test) for spring barley (at three sites), sugar beet and potato (at one site each). The omission of P-fertiliser during the whole 40 year period caused great economic losses in these root crops in a conventional cultivation regime. No statistically significant yield decreases were observed when discontinuing P-fertilisation after 20 years of application compared to continuous fertilisation. After 20 years of application of 44 kg P ha<sup>-1</sup> a<sup>-1</sup> the soil PCAL/DL-contents were at a medium stage (less at one site with heavily textured soil) and decreased only slowly in 20 years of zero application. In the case of zero fertilisation during 40 years the soil PCAL/DL-Contents remained at almost the same level. The correlations between spring barley, winter wheat and sugar beet yields and PCAL/DL-contents in soils are significant and highly significant, the coefficients of determination show that other factors are also important for crop yields.

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**827. Results of three long-term P-field experiments in Austria: 2nd report: Effects of different types and quantities of P-fertiliser on P-uptake and P-balances.**

Lindenthal, Th.; Spiegel, H.; Mazorek, M.; Heß, J.; Freyer, B.; and Köchl, A.

*Bodenkultur* 54(1): 11-21. (2003); ISSN: 00065471 [BODEA].

*Notes:* Original title: Ergebnisse von drei 40jährigen P-dauerversuchen in Österreich: 2. Mitteilung: Auswirkungen unterschiedlicher P-düngerformen und mengen auf den P-entzug und die P-bilanzen. Language of Original Document: German.

*Descriptors:* crops/ long-term field experiment/ P-balances/ P-fertiliser/ P-uptake

*Abstract:* The effects of different types (super-phosphate, basic slag and rock-phosphate) and quantities (0, 44 and 175 kg P ha<sup>-1</sup>a<sup>-1</sup>) of P-fertiliser application on P-uptake by crops and P-balances were evaluated in three long-term field experiments lasting 40 years. The omission of P-fertiliser during the whole 40-year-period resulted in P-uptakes of 649-694 kg P ha<sup>-1</sup> and considerable negative balances. The fertilisation of 44 kg P ha<sup>-1</sup>a<sup>-1</sup> as basic slag and super-phosphate showed higher P-uptake than zero P-fertilisation in 40 years, these differences were statistically significant at all three experimental sites for the last 20 years. When discontinuing P-fertilisation after 20 years of application the annual P-uptakes by crops remained at a high level and differed in the majority of cases not significantly compared to continuous fertilisation. But an annual fertilisation of 44 kg P ha<sup>-1</sup>a<sup>-1</sup> had already caused an accumulation of 371-562 kg P ha<sup>-1</sup> in the soil during the first 20 years. After 40 years a balanced P supply in which crop P uptake nearly equalled the P fertiliser rate was assessed at the variants where the fertilisation of 44 kg P ha<sup>-1</sup>a<sup>-1</sup> as basic slag and super-phosphate was terminated after 20 years. The different P-fertilisation during 20-40 years affected the P-uptake more strongly than the yields at all three sites. In the majority of cases also the correlations between PCAL/DL-contents in soils and P-uptake were closer compared to the crop yields.

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**828. Silicate compost used as resistance inductor against the leafminer on chrysanthemum.**

Polanczyk, R. A.; Pratisoli, D.; Paye, H. de S. ; Pereira, V. A.; Barros, F. L. S.; Oliveira, R G. S.; Passos, R. R.; and Martins Filho, S.

*Horticultura Brasileira* 26(2): 240-243. (2008)

*NAL Call #:* SB320.43 .B7H67; ISSN: 0102-0536.

*Notes:* Original title: Inducao de resistencia a mosca minadora em crisantemo usando composto silicatado.

*Descriptors:* composts / cultivars/ induced resistance/ insect control/ insect pests/ metallurgy/ pest control/ pest resistance/ plant pests/ silicates/ slags/ varietal resistance/ cultivated varieties/ *Dendranthema morifolium*

*Abstract:* The silicate compost (basic slag from metallurgy) was evaluated as a resistance inducer against leafminer (*Liriomyza* spp.) on 2 chrysanthemum (*Dendranthema grandiflorum* [*Chrysanthemum morifolium*]) cultivars (Puritan and Yellow Diamond) in a greenhouse in Espirito Santo, Brazil. Five doses of basic slag were used, i.e. 0.00, 1.40, 2.80, 4.20 and 5.60 g/pot. Evaluations were performed weekly, for 9 weeks, observing the presence of

leafminer and the number of mines in each leaf. The basic slag from metallurgy showed potential against the leafminer. The 2 cultivars also showed differences in susceptibility to the leafminer attack. Reproduced with permission from the CAB Abstracts database.

#### 829. Silicon sources for rice crop.

Pereira, H. S.; Korndorfer, G. H.; Vidal, A. de A.; and Camargo, M. S. de  
*Scientia Agricola* 61(5): 522-528. (2004); ISSN: 0103-9016

*Descriptors:* chemical composition/ crop yield/ grain/ nutrient content/ nutrient uptake/ plant composition/ rice/ silicon/ silicon fertilizers/ slags/ soil chemical properties/ wollastonite/ chemical constituents of plants/ chemical properties of soil/ paddy

*Abstract:* The effect of Si sources on the agronomic efficiency and economic viability in rice crops was investigated in the greenhouse. The treatments (applied at 125 kg Si/ha) comprised: control; wollastonite; blast furnace slag 1, AF1; blast furnace slag 2, AF2; LD furnace steel slag 1, LD1; LD furnace steel slag 2, LD2; LD furnace steel slag 3, LD3; LD furnace steel slag 4, LD4; phosphorus soluble slag; stainless steel slag; electric furnace steel slag; AOD furnace steel slag; silicate clay; Schist; and Schist ash. Dry matter yield, in the aboveground parts, grain yield, and soil and plant part Si contents were evaluated 150 days after sowing. Wollastonite was also applied at 350, 375 and 500 kg Si/ha to obtain the Si absorption curves.

Wollastonite showed a linear effect in yield, increasing Si content in the soil and plants with increasing application rates. The highest Si uptake was obtained with phosphate slag, followed by wollastonite and electric furnace slag. The highest grain Si accumulation was obtained with stainless steel, while the lowest was obtained with silicate clay.

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#### 830. Soil chemical attributes, root growth and rice yield according to slag application.

Carvalho Pupatto, J. G.; Bull, L. T.; and Crusciol, C. A. C.  
*Pesquisa Agropecuaria Brasileira* 39(12): 1213-1218. (2004)

NAL Call #: S15 .P452; ISSN: 0100-204X.

*Notes:* Original title: Atributos quimicos do solo, crescimento radicular e produtividade do arroz de acordo com a aplicacao de escorias.

*Descriptors:* chemical composition/ crop yield/ dry matter/ rice/ roots/ shoots/ silicon/ slags/ soil acidity / soil chemical properties/ sprinkler irrigation/ chemical properties of soil/ paddy/ spray irrigation

*Abstract:* A study was conducted to evaluate the effect of metallurgy slag on soil chemical properties and grain yield of upland rice under sprinkler irrigation. Treatments include two scums: blast furnace (196g/kg of Si) and steel slag (56 g/kg of Si), and a control without application. The scums can be used to correct soil acidity and silicon source.

Alterations on the soil chemical properties were related to the chemical composition of the scums. Treatment with blast furnace slag produced maximum root growth in depth and better distribution in the profile, which resulted to higher shoot dry matter and grain yield.

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#### 831. Some possibilities for sustainable organic production from clover rich pastures in the hills and uplands.

Anderson, G. D.

In: Organic farming: Science and practice for profitable livestock and cropping. Newport, Shropshire, UK.; pp. 96-100; 2004.

*Notes:* Proceedings of the BGS/AAB/COR Conference.

*Descriptors:* dry matter accumulation/ grass sward/ moorlands/ nitrogen fertilizers/ organic farming/ pastures/ reviews/ rock phosphate/ slags/ sustainability/ triple superphosphate/ Britain/ eco agriculture/ ecological agriculture/ grazing lands/ moorland/ moors/ organic culture/ phosphate rock/ United Kingdom

*Abstract:* The paper reviews results of experiments in the 1970s in which white clover was oversown at 4 kg/ha on to moorland swards in Yorkshire, without cultivation or herbicide. Within 3-4 years, mean yields of *Molinia* and *Nardus* swards almost doubled, to 4 t DM/ha/annum, and on Calluna heath increased five-fold to 1.45 t/ha, associated with 51% and 35% clover cover, respectively. This was achieved by one application of 12 t lime/ha with 90 kg P<sub>2</sub>O<sub>5</sub>/ha as triple superphosphate or basic slag, but after 4 years rock phosphate was catching these up. N fertilizer reduced clover, while clover without N in *Molinia* and *Nardus* swards gave DM yield increases exceeding 1.5 t/ha/annum. These findings were subsequently put into practice on a Scottish farm where application of 7.5 t/ha magnesium lime, followed after grazing by 2.5 kg/ha each of clover, timothy and ryegrass with 90 kg P<sub>2</sub>O<sub>5</sub>/ha, enabled doubling of the livestock on *Molinia* and *Nardus* swards within 4 years. A further 6.0-7.5 t lime/ha increased clover spread and sward palatability. In rejuvenated in-bye and hill swards, S184 clover has persisted for over 20 years. Reproduced with permission from the CAB Abstracts database.

#### 832. Steel industry furnace residue as a source of micronutrients and contaminants to maize plants.

Aguar Accioly, A. M. de; Furtini Neto, A. E.; Muniz, J. A.; Faquin, V.; and Aquino Guedes, G. A. de  
*Pesquisa Agropecuaria Brasileira* 35(7): 1483-1491. (2000)  
NAL Call #: S15 .P452 ; ISSN: 0100-204X.

*Notes:* Original title: Po de forno eletrico de siderurgia como fonte de micronutrientes e de contaminantes para plantas de milho.

*Descriptors:* acidity/ application rates/ biomass/ biomass production/ cadmium/ Cambisols/ contaminants/ contamination/ dry matter/ iron/ lead/ liming/ maize/ plant composition/ shoots/ slags/ soil acidity / soil pollution/ trace elements/ treatment/ zinc/ chemical constituents of plants/ corn/ microelements

*Abstract:* Steel making residue (slag) was tested as a source of micronutrients and contaminants to maize under greenhouse conditions in Minas Gerais, Brazil. Soil material of an Inceptisol (Alic Cambisol) was used as substrate, which received 0, 2 and 4 ton ha<sup>-1</sup> of liming material and the following treatments: blank, micronutrient as p.a. reagent, and 250, 500, and 1000 kg slag ha<sup>-1</sup>. Liming dose was the main factor accounting for the differences in dry matter production. The residue increased biomass production in relation to check, but results from p.a. reagents were lower; there were no significant differences due to doses of this product. The residue supplied mainly

Zn and Fe to maize. The solubility of this byproduct increased with the soil acidity. Cadmium and Pb were detected in the shoot dry mass of maize. The potential risk of soil and food contamination must be taken into account when using the slag as a source of micronutrients. Reproduced with permission from the CAB Abstracts database.

**833. Steel industry slags compared with calcium carbonate in neutralizing acid mine soil.**

Munn, David A.

*Ohio Journal of Science* 105(4): 79-87. (2005); ISSN: 0030-0950

*Descriptors:* steel/ slags/ calcium carbonate/ acid mine soil/ liming

*Abstract:* Ohio has substantial lands impacted by surface mining for coal and an active steel industry. Steel industry slags have been used as liming compounds for agriculture and acid mine soil reclamation. This 3-year study evaluates slags from Ohio steel mills in greenhouse trials where these materials are compared to reagent grade CaCO<sub>3</sub> in their ability to improve plant growth on acid mine soil. The objectives of this study were to evaluate the effectiveness of these materials at two rates of application in raising acid mine sod pH and to address concerns about metals in such slags. Three slags and reagent grade CaCO<sub>3</sub> were applied at rates equivalent to 12.5 and 25 g CaCO<sub>3</sub> kg<sup>-1</sup> soil on acid mine soil (pH = 3.5). Five consecutive crops of oats (*Avena sativa* L.), wheat (*Triticum aestivum* L.), corn (*Zea mays* L.), wheat and soybean (*Glycine max* (L.) Merr.) were grown and harvested at the seedling stage. The slags and CaCO<sub>3</sub> increased yields ( $P < 0.01$  level) compared to unlimed control pots. Soil and plant Ca were increased and plant Al and Mn decreased by application of all four materials. The slags increased soil and plant Mg. Particle size of the slags was somewhat coarse which decreased their effectiveness, but overall these slags proved to be satisfactory liming materials. The fineness efficiency developed for carbonate forms of time may not adequately characterize slag effectiveness. Micronutrient metals including iron were not found to be in excess in plant tissue treated with slags despite the steel slags' high Fe content.  
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**834. Steel slag as an iron fertilizer for corn growth and soil improvement in a pot experiment.**

Wang Xian and Cai QingSheng

*Pedosphere* 16(4): 519-524. (2006)

NAL Call #: S590 .P43 ; ISSN: 1002-0160

*Descriptors:* application rates/ biomass production/ calcareous soils/ crop yield/ dry matter accumulation / growth/ industrial wastes/ iron/ iron fertilizers/ maize/ nutrient uptake/ pot experimentation/ slags/ soil types/ waste utilization/ corn

*Abstract:* The feasibility of steel slag used as an iron fertilizer was studied in a pot experiment with maize. Slag alone or acidified slag was added to two Fe-deficient calcareous soils at different rates. Results showed that moderate rates (10 and 20 g kg<sup>-1</sup>) of slag or acidified slag substantially increased maize dry matter yield and Fe uptake. Application of steel slag increased the residual concentration of ammonium bicarbonate-diethylenetriamine pentaacetic acid (AB-DTPA) extractable Fe in the soils. The increase of extractable Fe was usually proportional to the application rate, and enhanced by the acidification of slag.

Steel slag appeared to be a promising and inexpensive source of Fe to alleviate crop Fe chlorosis in Fe-deficient calcareous soils.

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**835. Suppression of methane emission from paddy soil by application of iron materials.**

Furukawa, Y; Tsuji, T; and Inubushi, K

*Japanese Journal of Soil Science and Plant Nutrition* 72(2): 257-264. (2001); ISSN: 0029-0610

*Descriptors:* basic slag/ emission/ iron/ methane/ paddy soils/ rice/ slags/ soil amendments/ soil types/ suppression/ fluxes/ paddy

*Abstract:* A study was conducted to investigate the suppression of methane emission from paddy soil by application of iron materials such as revolving furnace slag (RFS), an industrial by-product, and spent disposable portable body warmer (PBW). Rates of RFS added to the pots planted with rice were 0 (control), 10, 20, 40, and 100 tonnes ha<sup>-1</sup>, and PBW at 10 tonnes ha<sup>-1</sup> only. Results showed that pots which received RFS exhibited lower Eh values compared with the control plot, although the RFS was applied to keep soil oxidative in the early period of cultivation. A significant decrease in Eh under a high rate of RFS application may be due to high pH of the RFS (pH (H<sub>2</sub>O)=12.2). On the other hand, methane flux was suppressed under a high rate of RFS application, during the early period of cultivation. However, this flux trend was reversed during the mid-growing period. This may be due to disturbances in the soil environment caused by dissolving element from RFS. Total methane flux during the cultivation period was significantly decreased, approximately 10%, when 10-40 and 10 tonnes ha<sup>-1</sup> of RFS and PBW, respectively, were applied. Methanogenic activity did not change significantly when 0-40 tonnes ha<sup>-1</sup> of RFS were applied, while that of RFS pots at 100 tonnes ha<sup>-1</sup> and of PBW pots with 10 tonnes ha<sup>-1</sup> were decreased. Methane oxidizing activity was increased, maximum of 15%, when 10-40 tonnes ha<sup>-1</sup> of RFS were applied, while that of RFS pots at 100 tonnes ha<sup>-1</sup> and of PBW pots at 10 tonnes ha<sup>-1</sup> were decreased. The decrease in total methane flux may be attributed to enhanced methane oxidizing activity rather than inhibition of methanogenic activity. The grain yield was significantly increased, approximately 30%, when 40 or 100 tonnes ha<sup>-1</sup> of RFS was applied. It was also partly due to the dissolving inorganic substances from RFS. From this study, it is clear that the use of RFS and PBW in paddy field are desirable because they increase grain yield and decrease methane emission.

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**836. Time-dependent phosphorus extractability from soils treated with different fertilizer phosphorus sources.**

Indiati, R. and Neri, U.

*Communications in Soil Science and Plant Analysis* 35(11-12): 1741-1755. (2004)

NAL Call #: S590.C63; ISSN: 0010-3624

*Descriptors:* Time-dependence/ phosphorus extractability/ treated soils/ fertilizer/ phosphorus sources/ basic slag

*Abstract:* Effect of application of different fertilizer phosphorus (P) sources (diammonium phosphate-DAP, single super phosphate-SSP, phosphate rock-PR, partially

acidulated phosphate rock-PAPR, basic slag phosphate-BSP, and humo phosphate-HP), and time (up to three years of soil-fertilizer P equilibration) on soil extractable P was studied on two representative Italian soils, principally differing in pH values and the capacity to retain P. Phosphorus extractability was measured by seven chemical and two nonconventional soil P test methods based on the use of anion exchange resin membranes and iron oxide coated paper strips. The increases in the amount of extracted P following soil P fertilization were practically in the same order for both Ravenna and Paliano soils: DAP > SSP > HP > BSP > PAPR > PR; that order reflecting the corresponding scale of P water solubility. More P tended, however, to be dissolved from PR treatment in more acidic soil. On an average, the effectiveness of the different soil P test procedures in extracting P from two soils was in the order: Egner-P > Bray2-P > Olsen-P > Mehlich3-P > resin-P > iron oxide-strip-P > Bray1-P > water-P > CaCl<sub>2</sub>-P. The Egner soil P test method appeared to overestimate P bioavailability of all P treatments in the calcareous soil, while both the Egner and Bray2 soil tests overestimated the amount of extractable P of the PR treatment in the other soil. Data of P extracted by the Olsen and Mehlich3 procedures resulted the most closely correlated with the corresponding data obtained with the nonconventional soil P test procedures, currently considered with potential for use in widely ranging soils fertilized with water soluble as well as water insoluble P fertilizers. This citation is from AGRICOLA.

### 837. Why phosphorus is important.

*Monographic Series NSW Agriculture 10/92 : 3 pp. (2002)*

*Descriptors:* animal manures/ diammonium phosphate/ double superphosphate/ growth/ monoammonium phosphate / nutrient uptake/ phosphorus/ phosphorus fertilizers/ plant nutrition/ rock phosphate/ slags/ superphosphate/ ammonium dihydrogen phosphate/ phosphate fertilizers/ phosphate rock

*Abstract:* This paper discusses the importance of phosphorus in plant growth and nutrition. Phosphorus fertilizers are available in several forms based on rock phosphate, including superphosphate, double superphosphate, monoammonium phosphate and diammonium phosphate. Manure and steel slag are also used as a source of phosphorus. Some possible reasons why plants seem to get little benefit from phosphorus are discussed, as well as the methods on how to improve phosphorus uptake by plants.

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