Manures/Fertilizers

NPARR, 8(1), 2017-97 Recovering soil health of eroded lands through fertilizers and crop rotation

Soil health is important for the sustainable development of terrestrial ecosystem. The soil health and fertility of eroded lands can be restored and improved through integration of farm yard manure (FYM) with mineral fertilizers as well as incorporating legumes in the cropping system. This study was undertaken to assess the effects of integrated use of fertilizers and inclusion of a legume in crop rotation on soil microbial attributes on eroded land within a three years long field experiments at three locations in north western Pakistan. Three locations were Thana, Kabal and Matta; two croppings were wheat-mungbean and wheat-maize; and three fertilizer treatments were farmer’s practice (N at 60 and P$_2$O$_5$ at 45 kg ha$^{-1}$), recommended mineral fertilizers (N at 120, P$_2$O$_5$ at 90, K$_2$O at 60 and Zn at 5 kg ha$^{-1}$), and recommended mineral fertilizers + FYM (N at 120, P$_2$O$_5$ at 90, K$_2$O at 60, Zn at 5 kg ha$^{-1}$ + 20 t FYM ha$^{-1}$). Soil microbiological properties were measured after 5 cycles of cropping (3 winter and 2 summer) in 2013. The effect of fertilizer treatments on soil microbiological properties was significant at all the three sites, while the effect of cropping system was variable. The interactive effects were also variable. Soil receiving organic fertilizer (FYM) along with mineral NPK showed over 120% improvement in microbial biomass C and over 50% improvement in N fertility of eroded lands. Similarly, inclusion of legume in crop rotation improved soil microbial biomass C and N fertility by 31%. Regression analysis revealed that soil microbiological properties were determining factor for increased yield of wheat crop. Thus integration of FYM with mineral fertilizers and incorporation of a legume in crop rotation helps improve soil health and N fertility of eroded lands[Shah, Z., Ali, S., Shah, T. and Amanullah*. (Department of Agronomy, University of Agriculture, Peshawar, Pakistan), Soil and Environment, 2016, 35(2), 194-206].


The long-term crop residue retention coupled with external nutrient inputs are crucial for maintaining soil phosphorus (P) and soil organic carbon (SOC) in Vertisols of Central India. A study was conducted to evaluate the long-term effect of three wheat residue management practices (residue burning, incorporation, and surface retention) in combination with three supplementary nutrient inputs (SNI) [control, fertilizer, and farmyard manure (FYM)] on stratification of P and SOC in the soybean–wheat system in Vertisol. The wheat residue either incorporated or retained on the soil surface increased the availability of P and SOC content as compared to the common practices of residue burning. Residue retention or incorporation increased stratification of P and soil organic carbon over the residue burning. Irrespective of the nutrient treatments, greater stratification ratio of SOC and P were registered under wheat residue incorporation or retention compared to residue burning. It is evident from the study that wheat residue incorporation or retention plus addition of FYM could be an effective strategy for increasing the soil fertility in a soybean–wheat system of Vertisols of Central India [Kushwah, S.S., Reddy, D.D., Somasundaram, J.*, Srivastava,S. and Khamparia, R.S. (Division of Soil Physics, ICAR-Indian Institute of Soil Science, Nabibagh, Bhopal, Madhya Pradesh, India), Communications in Soil Science and Plant Analysis, 2016, 47(21), 2387-2395].

NPARR, 8(1), 2017-99 Relay intercropping and mineral fertilizer effects on biomass production, maize productivity and weed
dynamics in contrasting soils under conservation agriculture

Cash-constrained farmers who cannot afford herbicides and mineral fertilizers may incorporate green manure cover crops (GMCCs) as relay crops to aid in management of weeds and nitrogen in maize systems under conservation agriculture in cases where rotations are a challenge. An experiment was conducted at two sites with contrasting soil types, University of Zimbabwe farm (clay) and Domboshawa Training Centre (sandy) to investigate the effects of maize/velvet bean intercropping at 8 weeks after planting maize (WAPM), applying different fertilizer rates and exploring their interactive effects on weed composition, maize productivity and biomass production [total maize non-cob biomass (stover) plus GMCC biomass]. The performance of the system depended largely on the amount of rainfall received within and across the seasons, sites and their interaction; also on the amount of fertilizer applied. Generally, biomass yields attained by velvet bean [Mucuna pruriens L. (DC.)] were lower than reported previously. Maize grain yield and weed diversity were higher in treatments with higher fertilizer rates, reaching up to 5.1 t/ha and 1.39, respectively. Generally, the highest weed diversity and highest maize grain yield values were observed in maize/velvet bean combinations and higher fertilizer rates (i.e. 0.27 and 4.8 t/ha, respectively) in the sandy soil. Higher fertilizer rates resulted in greater maize stover yield and this contributed greatly to the biomass productivity of the system in the sandy soil in the 2012/13 season, while the high biomass productivity observed in velvet bean in the clay site in the final season contributed significantly to productivity. Maize productivity was not affected by velvet bean introduced at 8 WAPM in any of the seasons. The present study showed that relay cropping velvet bean as late as 8 WAPM and onwards has potential to increase biomass production without compromising maize yields. However, planting it as late as 8 WAPM results in reduced productivity due to reduced moisture availability [Mhlanga, B.*, Cheesman, S., Maasdorp, B., Mupangwa, W. and Thierfelder, C. (Department of Crop Science, Faculty of Agriculture, University of Zimbabwe, P. O. Box MP 167, Mount Pleasant, Harare, Zimbabwe), Journal of Agricultural Science, 2016, 1-12].

NPARR, 8(1), 2017-100 Horticultural crop yields and nitrogen uptake response to green manure, farmyard manure compost and organic commercial fertilizer

A 3-year field organic crop rotation was set up in a sandy loam soil with a cover crop of rye and vetch over the autumn/winter for green manure followed by potato and lettuce (1st year), Swiss chard and turnip (2nd year) and Portuguese cabbage and carrot (3rd year). A randomized block design was arranged with green manure (GM), GM with 20 and 40 t ha$^{-1}$ of farmyard compost manure (C20 and C40) and GM with 1 and 2 t ha$^{-1}$ of commercial organic fertilizer (CF1 and CF2) to access nitrogen uptake and crop yield. Lettuce, turnip and carrot yields were significantly increased, by 90, 115 and 56%, respectively, for C40 compared with CF2, probably because of the rapid nitrogen mineralization of the commercial fertilizer during the previous crop, decreasing nitrogen availability for the 2nd crop of the season. There were no significant differences in potato yield between C40, CF1 and CF2, whereas Swiss chard yield increased for CF2 compared with C40, probably because of the long growth period of potato associated with the increased nitrogen availability from compost application. Portuguese cabbage yield, unlike Swiss chard, did not increase for CF2 compared with C20 and C40, even with the same short growth period, probably because of the effect of continuous compost and green manure application that increased nitrogen availability in the medium/long term. The application of 40 t ha$^{-1}$ farmyard manure compost and rye with vetch as green manure has the potential to enhance crop yields during the

NPARR. 8(1), 2017-101 Long-term application of compost versus other organic fertilizers: Effects on phosphorus leaching

Many agricultural soils in north-west Europe contain an amount of phosphorus that not only exceeds the crop's needs, but is also an important source of diffusive P losses to the environment. The restriction of P fertilization also implies a restricted application of organic fertilizers and soil improvers as sources of carbon. Our objective was to compare organic fertilizers in their ability to increase the soil organic carbon level, and their influence on P leaching. Three long-term field trials were conducted where fertilization with compost, farmyard manure, digestates, cattle slurry and mineral fertilizers was compared, to determine soil P availability, soil organic carbon level and the soil P content. Soil samples of the tillage layer (0-30 cm) were used in a leaching experiment in controlled unsaturated conditions. This experiment revealed differences in susceptibility to P leaching between the fertilizer types. We observed that compost based on green waste materials is a better option than cattle farmyard manure to increase the soil organic carbon level, without further increasing P losses in soils with highly elevated P levels. Although farmyard manure has a potential to increase the soil organic carbon level comparable to that of compost, the use of farmyard manure stimulates increased soil P availability and P leaching. The solid fraction of mechanically separated digestate also stimulated increases in soil P availability and P leaching. Stopping P fertilization had an immediate decreasing effect on soil P availability. However, continued zero P fertilization over 4 years did not further decrease soil P availability [Vanden Nest, T*., Vandecasteele, B., Ruysschaert, G., Cougnon, M., Baken, S., Smolders, E., Houot, S., Reheul, D. and Merckx, R. (Institute for Agricultural and Fisheries Research (ILVO), Plant Sciences Unit, Crop Husbandry and Environment, Burg. Van Gansberghelaan 109, Merelbeke, Belgium), Acta Horticulturae, 2016, 1146, 213-220].

NPARR, 8(1), 2017-102 Effect of charcoal-blended compost on plant growth of Brassica rapa var. peruviridis for reduction of nitrogen fertilizer use

Agricultural use of biochar has recently been paid attention as an alternative strategy for mitigating greenhouse gas emissions and as a useful tool for enhancing soil fertility. Our study focused on the effects of compost with biochar on plant growth and soil properties to address whether poultry manure compost with or without biochar (PM, PM+B) as an additional component of compost is an alternative for the replacement of chemical nitrogen fertilizer. A treatment with a sole chemical fertilizer was set up as a control in a plant growth experiment using komatsuna (Brassica rapa var. peruviridis). Based on calculation of the same nitrogen content as the control (0% organic fertilizer), four different doses (12.5, 25, 50, and 100%) of compost with and without biochar (PM, PM+B) were tested for the replacement of a chemical N fertilizer (urea). After the experiment, morphological measurements, nutrient content in the leaf, and soil physico-chemical properties were analyzed. Root fresh weight and root activity in the treatment with PM+B (25 and 50%) was much higher than in the control (100% chemical N fertilizer), although no differences were observed in shoot weight or plant height. Vitamin C content in the leaf was higher after the application of PM and PM+B than in the control. Concerning soil characteristics, the combination between chemical fertilizer and PM+B (25 and 50%) increased both total and water-soluble carbon content. Synergic effect of chemical and organic fertilizer application gave favorable
results in providing equilibrate nutrient components in a leafy vegetable and mitigated the environmental risk in soil Matsumoto, K.*, Sato, S., Sudo, H., Fujita, T., Sánchez-Monedero, M.A. and Jindo, K. (Faculty of Agriculture and Life-Sciences, Hirosaki University, Japan), Acta Horticulturae, 2016, 1146, 257-262].

**NPARR, 8(1), 2017-103** Date palm wastes co-composted product: an efficient substrate for tomato (*Solanum lycopersicum* L.) seedling production

Purpose: The present study aimed to investigate the feasibility of using co composted date palm waste fibers as a growth medium for tomato (*Solanum lycopersicum* L.) plants production under greenhouse. Methods: Date palm waste fibers were co-composted with goat manure, and the resulting compost was characterized and evaluated for its effects on the tomato plants growth under greenhouse conditions. The tested substrates included a control composed of 100% soil, soil mixed with the produced compost or goat manure, experimented at two concentrations of 20 and 30% (v:v). For these substrates, small pieces of crushed palm waste fibers were added at a rate of 5% to test their efficiency as a biological structuring agent. Results: The results revealed that the compost displayed high levels of nutrients (N, P, K), a relatively low C/N ratio of 17, and a fertilizing value similar to that of goat manure, exhibiting its stability and lack of phytotoxic effect. Greenhouse experiment showed that co-composting of date palm waste fibers and goat manure induced positive effects on soil quality by increasing its organic matter content. The addition of crushed palm waste fibers increased seed germination percent for both manure and compost. Conclusions: Date palm waste composting constitutes the suitable substrate for tomato seed germination, aerial growth and root development. Consequently, the date palm waste fibers co composting could offer a viable, ecological and sustainable alternative to conventional fertilizers [Abid, W.*, Magdich, S., Mahmoud, I.B., Medhioub, K. and Ammar, E. (Research Unit “Costal and Urban Environments”, National Engineering School of Sfax, B.P. 1173 - 3038, Sfax, Tunisia), Waste and Biomass Valorization, 2016, 1-11].

**NPARR, 8(1), 2017-104** Reducing antibiotic resistance genes, integrons, and pathogens in dairy manure by continuous thermophilic composting

This study explored the effects of composting using three temperature regimes, namely, insufficient thermophilic composting (ITC), normal thermophilic composting (NTC), and continuous thermophilic composting (CTC), on antibiotic resistance genes (ARGs), integrons, and human pathogenic bacteria (HPB), as well as the mechanisms involved. The NTC and CTC treatments led to greater decreases in 5/10 ARGs and two integrons than ITC, and the abundances of ARGs (tetC, tetG, and tetQ) and int1 only declined in the NTC and CTC treatments. The abundances of HPB decreased by 82.8%, 76.9%, and 96.9% under ITC, NTC, CTC, respectively. Redundancy analysis showed that both bacterial succession and horizontal gene transfer play important roles in the variation of ARGs, and the changes in different ARGs were due to diverse mechanisms. CTC performed significantly better at reducing ARGs, integrons, and HPB, thus it may be used to manage the public health risks of ARGs in animal manure [Qian, X., Sun, W., Gu, J.*, Wang, X.J., Zhang, Y.J., Duan, M.L., Li, H.C. and Zhang, R.R.(College of Natural Resources and Environment, Northwest A&F University, Yangling, Shaanxi, China), Bioresource Technology, 2016, 220, 425-432].

**NPARR, 8(1), 2017-105** The influence of flue gas desulphurization gypsum additive on characteristics and evolution of humic substance during co-composting of dairy manure and sugarcane pressmud

For the purpose of evaluating the effect of flue gas desulphurization gypsum (FGDG)
additive on characteristics and evolution of humic substance (HS) during composting, HS from composts with FGDG (CPG) and without FGDG (CP) were extracted and assessed with respect to their particle size, elemental analysis, FTIR and UV–vis spectroscopy, and the molecular composition of HS was characterized via pyrolysis-GC/MS as well. The particle size of HS ranged between 300 and 600 nm, representing a bimodal distribution. As composting proceeded, the C/H of HS increased, and C/N decreased. The FTIR and UV–vis spectroscopy indicated that the aromatization of HS was promoted over the composting process. Adding FGDG increased the unsaturated degree and aromatization of HS. Pyrolysis-GC/MS showed the level of alkane decreased, and the level of benzene and nitrogen compounds increased upon the addition of FGDG. The nitrogen compounds of HS in CPG was significantly higher than that in CP [Guo, X., Huang, J., Lu, Y., Shan, G. and Li, Q*. (School of Chemistry and Chemical Engineering, Guangxi University, Nanning, China), Bioresource Technology, 2016, 219, 169-174].

NPARR, 8(1), 2017-106 Agronomic values of anaerobically digested cattle manure and the separated solids for barley forage production

As biogas production expands, digestates from that industry are increasingly available as potential nutrient sources for crop production, but their agronomic value is poorly understood. Thus, a 5-yr field experiment was conducted to determine the agronomic values of anaerobically digested solid beef cattle feedlot manure (ADM) and the separated solids (SS) from ADM under a semiarid reduced-tillage dryland barley (Hordeum vulgare L.) forage cropping system. Three organic amendments, ADM, SS, and undigested solid beef cattle feedlot manure (CM), were applied annually at 200 or 400 kg total N ha⁻¹ for 4 yr, while the residual effect was examined in the fifth year. The higher N and P availability in ADM translated into greater barley forage yields, total N uptake, and apparent N recovery (ANR) from ADM-amended soil than SS- and CM-amended soils, while there were no significant differences between soils receiving SS or CM. The ANR was 22% for ADM but only 12% for CM and 9% for SS. In contrast, P uptake, the fraction of amendment-derived P uptake, and apparent P recovery were similar among all amendments. Similar yields, ANR, post-harvest soil NH₄, NO₃, and Olsen-P concentrations between SS- and CM-amended soils suggest that they have a comparable agronomic value. Less residual Olsen-P in soil receiving ADM than SS or CM suggests that ADM is a lower risk for P accumulation when applied at N-based rates. We recommend that current agronomic values for cattle feedlot manure could be applied to SS but not ADM [Hao, X*., Thomas, B.W., Nelson, V. and Li, X. (Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, 5403-1st Avenue South, Lethbridge, AB, Canada), Soil Science Society of America Journal, 2016, 80(6), 1572-1584].

NPARR, 8(1), 2017-107 Influence of organic fertilizers, mineral fertilizers and carbolime on root yield, sugar content and polarized sugar yield of sugar beet

A field polyfactor experiment with sugar beet investigated the influence of variety and different fertilizing on root yield, sugar content and polarized sugar yield. The experiment was carried out in years 2012, 2013 and 2014 at EXBA SPU in Nitra-Dolná Malanta. In the experiment two sugar beet varieties (Predator and Expert) and three variants of fertilizing were monitored: MH-application of cattle manure in dose 50 t ha⁻¹ (autumn) + mineral fertilizers (300 kg ha⁻¹ DASA 26/13); SK-application of carbolime in dose 10 t ha⁻¹ (autumn) + mineral fertilizers (300 kg ha⁻¹ DASA 26/13); PH-application of mineral fertilizers only (300 kg ha⁻¹ DASA 26/13). Among the investigated varieties in the given soil-climatic conditions, the Predator variety achieved better parameters of root yield
and polarized sugar yield. The Expert variety had better results in sugar content. All the differences in the investigated parameters were statistically significant. The influence of fertilizing variants on root yield and polarized sugar yield was statistically significant. Fertilizing variant did not statistically influence sugar content. The variant with cattle manure had highest statistically significant root yield and polarized sugar yield. We also found significantly higher root yield and polarized sugar yield in the variant with carbolime application compared to the variant that used only mineral fertilizers [Pačúta, V.*, Krebs, M., Ondrišík, P., Buday, M. and Rašovský, M. (Slovenská pol'nohospodárska univerzita v Nitre, Slovakia), *Listy Cukrovarnicke a Reparske*, 2016, 132(11), 340-343].

**NPARR**, 8(1), 2017-108 **Impacts of fertilization practices on pH and the pH buffering capacity of calcareous soil**

Modern intensive agricultural practices, particularly the use of nitrogen fertilizers, have accelerated soil acidification on a global scale. The soil pH buffering capacity (pHBC) is often used to quantify the soil acidification rate. Calcareous soils have relatively higher pH and pHBC, reflecting the presence of carbonate minerals; however, the impact of long-term fertilization treatment on pH and pHBC is poorly understood for calcareous soils. Here, calcareous soil samples (0–20 cm) were collected from fields receiving six different fertilization treatments for 22 years: control (CK, unfertilized but planted); nitrogen (N); nitrogen and phosphorus (NP); nitrogen, phosphorus and potassium (NPK); combined manure and NPK (NPKM); and combined corn-stover and NPK (NPKS). Both pH and pHBC significantly decreased for all treatments relative to CK. NPKS treatment had the lowest soil pH. Compared with CK, the soil pHBC decreased 5.7 to 17.3% under different treatments. The calcium carbonate (CaCO$_3$) content was significantly reduced by fertilization treatments, with a maximum decrease under the NPKS treatment. Structural equation model (SEM) analysis revealed that calcium carbonate and soil organic matter (SOM) made important contributions to effective cation exchangeable capacity (ECEC). Soil pHBC was directly controlled by ECEC, while CaCO$_3$ and SOM indirectly contributed to the pHBC through ECEC. These results indicated that NPKS treatment induces more severe soil acidification, reflecting the higher H$^+$ input and lower pHBC under this treatment [Zhang, Y., Zhang, S., Wang, R., Cai, J., Zhang, Y., Li, H., Huang, S. and Jiang, Y*. (Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang, China), *Soil Science and Plant Nutrition*, 2016, 62(5-6), 432-439].

**NPARR**, 8(1), 2017-109 **Effect of three types of organic fertilizers on the heavy metals transfer factor and maize biomass**

Organic matter plays an important role in the soil fertility as well as physical and biological properties of soil. However, these organic fertilizers sometimes contain heavy metals which are very harmful to human health. So, the aim of this study was to investigate the effect of three types of organic fertilizers on the heavy metals transfer factor (TF) and maize biomass. For this purpose, pot experiment in a completely randomized factorial design was used with three replications and three types of soil as well as three types of organic fertilizers such as municipal solid waste compost, poultry manure and cow manure have been used at 5 levels in Hamedan province, Iran. Heavy metals TF, biomass and amount of heavy metals in maize root were measured. In this research, sandy loam has received all three types of fertilizer while only compost was added to the clay and loam soil. Results demonstrated that TF value for Pb was higher than one in all three soil textures indicating the high concentration of Pb in the maize shoots. The TF value of Zn was increased from 0.33 to 0.66 mg/kg by enhancing the
amount of municipal solid waste compost. The TF of Pb in the shoots showed greater value in the municipal solid waste compost with amount of 1.35 mg/kg compared to the poultry manure and cow manure with amount of 0.33 and 0.94 mg/kg, respectively and 120 Ton/ha compost treatment accounted for the highest value of TF for Pb. Furthermore, the maximum biomass of maize was related to the sandy loam with amount of 120 Ton/ha compost. In conclusion, the application of organic fertilizers not only is useful for the maize but also contributes to increase in the biomass of this plant [Yari, M.*, Rahimi, G., Ebrahim, E., Sadeghi, S., Fallah, M. and Ghesmatpoor, E. (Faculty of Agriculture, Department of Soil Science, Bu Ali Sina University, Hamadan, Iran), Waste and Biomass Valorization, 2016, 1-11].

**NPARR, 8(1), 2017-110 Effects of combined application of manure and inorganic fertilizer on N$_2$O emissions and sources in vegetable soils**

The soils are dominating source of nitrous oxide (N$_2$O), a greenhouse gas that contributes to stratospheric ozone destruction. In China, vegetable soils are amended with the highest level of N fertilizers among agricultural soils, causing large N$_2$O flux. Bacterial nitrification and denitrification are thought to be the primary process for N$_2$O emission from soil. Recently, it has been suggested that the intramolecular distribution of $^{15}$N between central ($\alpha$) and terminal ($\beta$) position in the linear N$_2$O molecule ($^{15}N^{14}NO$, known as site preference or SP), can indicate which processes contribute to N$_2$O fluxes. The goal of this test was to confirm N$_2$O isotopomer signature stability effects on source partitioning of N$_2$O and the contribution of microbial process to N$_2$O production and consumption. Here, a microcosm experiment was performed to partition N$_2$O production pathways and its change pattern emitted from vegetable soils amended with different manure, inorganic fertilizers and their combinations by using abundant isotope technique, which mainly focused on SP. The experiments set up five different manure and inorganic fertilizers treatments: 100%M (manure fertilizers), 100%U (inorganic fertilizers), 80%M+20%U, 50%M+50%U, CK (no fertilizers). $N_2O$ concentration, $^{15}N^{14}NO$ and $^{15}N_{bulk}$ were measured by an element analyzer isotope ratio mass spectrometer and a trace gas analysis system. SP was calculated by N$_2$O isotope characteristic value, giving the contribution to denitrification and nitrification. The results showed that inorganic fertilizer drove significantly higher N$_2$O emissions than that of manure fertilizer. The higher quantity of inorganic fertilizer was used, the more N$_2$O was released. The cumulative emissions of N$_2$O from manure fertilizer treatment were 6.63 folds higher than that of inorganic fertilizer. The values of SP increased first and then decreased gradually with time, suggesting that production processes of N$_2$O were associated with different microbial pathways. Denitrification was the dominant microbial process within seven days after fertilization in each fertilizer combination, the highest proportion reached 78.89%, SP value of 6.97% and then nitrification became the main pathway with the highest proportion of 76.48%, SP value of 25.24%. Denitrification was likely to occur when applying inorganic fertilizer, the average proportion reached 52.98%, SP value of 15.52% and the application of manure fertilizer enhanced the nitrification process with the average proportion of 71.35% and SP value of 23.55%. Considering both values of N$_2$O emissions and SP, it was suggested that manure fertilizer had a positive effect on reducing N$_2$O emissions in Drab Fluvo-aquic soil of Beijing. Of course, denitrification is most important source of N$_2$O production. The results provide scientific basis for the rational fertilization in vegetable production. At the same time, we need to make further work to explore and characterize isotopic signature of N$_2$O to find out microbial identification of N$_2$O [Lin, W.*, Zhang, W., Li, Y., Xu, C., Li, Q. and Zheng, Q. (Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Ministry of Agriculture of the People's
The recycling of agricultural organic wastes not only can mitigate its pollution to the environment, provide nutrients for farmland, but also increase soil carbon storage and reduce greenhouse gas (GHG) emissions, which play an important role to climate change. Five kinds of agricultural organic wastes were selected to the wheat-maize rotation system, including crop residue, biogas residue, mushroom residue, wine residue and pig manure, with chemical fertilizer as control. Based on the field trials, the effects of soil carbon storage, soil GHG emissions and net greenhouse gas emissions (NGHGE) were measured. The results from 2013-2015 showed that: 1) Compared with chemical fertilizer control, returning organic materials improved the ability of soil carbon sequestration by 63.52% of 0-20 cm soil during 2013-2015 years of observation, crop residue, biogas residue, mushroom residue, wine residue and pig manure increased by 33.13%, 86.34%, 75.97%, 52.66% and 69.48% in 2013-2015, respectively. Except the treatment of mushroom residue returning, organic material outside the croplands were more conducive to the increasing of soil carbon storage than crop residue. 2) Except crop residues returning, organic materials returning increased soil GHG emissions, soil GWP of crop residues were the lowest one, which was significantly lower than wine residue and pig manure (p<0.05), compared with biogas residue, mushroom residue, wine residue and pig manure, crop residue reduced emissions by 30.23%, 27.84%, 62.10% and 52.55%, respectively. 3) The values of NGHGE of each treatment were positive, which means all of the treatments were GHG emission sources. Compared with inorganic fertilizer control, except the treatment of mushroom residue returning, other organic amendments reduced GHG emissions and increased soil carbon pools of the system (p<0.05), crop residues, biogas residues, wine residues and pig manures decreased NGHGE by 52.78%, 56.30%, 54.19% and 90.35%, respectively. Organic materials from outside had a better NGHGE than crop residues. In conclusion, recycling organic wastes is beneficial to the soil carbon storage, although increasing soil GHG emissions; it ultimately presents an enhancement of NGHGE, which reduced total GHG emissions of the whole system. Returning organic amendments such as crop residues, biogas residues, wine residues and pig manures far beyond the croplands had better effects of mitigating GHGs than crop residues.

NPARR, 8(1), 2017-112 The effect of green manure and organic amendments on potato yield, nitrogen uptake and soil mineral nitrogen

Fertility management is challenging for organic crops with intensive nutrient demands such as potatoes (Solanum tuberosum L.). Four crop sequences varying in pre-potato green manures as main plots and four fertility treatments applied in the potato phase only [control, inorganic fertilizer (FERT), municipal solid food waste compost (MSW) and paper mill biosolid compost (PMB)] as subplots were compared in five-year organic potato rotations in Eastern Canada. Potato yields did not differ significantly between crop rotations; however, soil amendments had significant impacts on potato yields. Averaged across years, total tuber yields were in the order; FERT (34.2 Mg ha$^{-1}$) > MSW (29.6 Mg ha$^{-1}$) > control.
Total potato N uptake (TNU) levels were 89, 115, 107 and 147 kg N ha$^{-1}$, respectively, for control, MSW, PMB and FERT, and were greater when potato followed red clover (119–124 kg N ha$^{-1}$) compared with oat/pea/vetch mixture (107–108 kg N ha$^{-1}$). Plant N use efficiency (NUE) was 299, 263, 263 and 235, respectively, for control, MSW, PMB and FERT. Pre-plant soil mineral N (SMN) ranged between 39 and 112 kg N ha$^{-1}$ among different crop rotations. During the tuber initiation stage, SMN ranged between 40 and 66 kg N ha$^{-1}$ while during tuber bulking it ranged between 10 and 14 kg N ha$^{-1}$ among different crop rotations and soil amendments. Post-harvest SMN ranged between 8 and 30 kg N ha$^{-1}$ for all rotations and amendment treatments. High temperature and oxygen concentration decreased the emission of CH$_4$ with a significantly negative correlation (r=-0.470; r=-0.494). Gas emissions can be controlled through adjusting the levels of composting oxygen concentration and temperature. Multi-parameters characterization and correlation analyses can provide theoretical and methodological basis for process optimization of chicken manure and digestion co-composting. However, characterization and the coordination mechanism should be explored in depth on fermentation performance and gas emissions combining with comprehensive multi-indexes during and digestion co-composting in future studies.

A laboratory scale experiment of chicken manure digestion co-composting was carried out using a reactor system with oxygen monitoring and feedback control. The physiochemical indexes, including temperature, oxygen concentration, volatile solid content (VS), moisture, C/N, pH value, EC, cellulose, hemicellulose, lignin, biological index, and main gas emissions (CH$_4$, NH$_3$ and N$_2$O) were monitored and analyzed, respectively. Physical, chemical and biological indicators presented a good dynamic corresponding relationship, and the degradation of cellulose materials mainly appeared at the middle and later periods of aerobic co-composting. Temperature and oxygen concentration had an effect on gas emissions: high temperature promoted the emissions of NH$_3$ and N$_2$O with a significantly positive correlation (r=0.378; r=0.695), high temperature and oxygen concentration decreased the emission of CH$_4$ with a significantly negative correlation (r=-0.470; r=-0.494). Gas emissions can be controlled through adjusting the levels of composting oxygen concentration and temperature. Multi-parameters characterization and correlation analyses can provide theoretical and methodological basis for process optimization of chicken manure and digestion co-composting. However, characterization and the coordination mechanism should be explored in depth on fermentation performance and gas emissions combining with comprehensive multi-indexes during and digestion co-composting in future studies.
content of all five fractions increased, the H/C ratio decreased, but the humification degree increased; The result from $^1$H-NMR analysis showed that the HIM had low alkyl chain, short branched chain, high branches and carbohydrate structure, which was opposed to the HON fraction. The composition of AIM was similar to that of humic acids, while the HOB was rich in nitrogen-containing compounds. The result from the FTIR analysis showed that the HOA and HOB fractions were rich in abundant carboxyl, ester group and hydroxyl functional group. Besides the above functional groups, the AIM and HIM were rich in benzene groups. The HON fraction was rich in aliphatic functional group except for the abovementioned functional groups. The aliphatic functional group was degraded and the benzene functional group after composting [Li, D*, He, X.S., Xi, B.D., Gao, R.T., Zhang, H., Huang, C.H. and Dang, Q.-L. (State Key Laboratory of Environmental Criteria and Risk Assessment, Chinese Research Academy of Environmental Sciences, Beijing, China), Huanjing Kexue/Environmental Science, 2016, 37(9), 3660-3669].

NPARR, 8(1), 2017-115 Molecular and morphological structure of poultry manure derived organo-mineral fertilizers (OMFs)

In this work, we determined the molecular and morphological structures of complex granulated organic and organo-mineral fertilizers (OGFs and OMFs) obtained from poultry manure and mineral additives, such as diammonium phosphate (DAP) and potassium chloride (KCl). XRD data indicated complex compositions of the mineral additives DAP and KCl, while OGF and OMF exhibited amorphous backgrounds with small peaks due to the common Earth crust minerals (Si, Mg, Zn, Ca). Addition of DAP generated several new chemical compounds, while KCl did not react. Thermogravimetric analysis indirectly showed mineral-mineral interactions at high temperatures, as can be inferred from their 478 °C peak shift. Spatially resolved SEM-EDS analysis showed a particularly interesting colocalization of potassium, sulfur, and phosphorus within the OMF, suggesting a reactive salt interaction between DAP and minerals inherently present in OGF. FTIR analysis, on the other hand, did not show significant involvement of organic moieties with the interactions of mineral additives, suggesting organic compounds act mostly as inert support for DAP and KCl. Collectively, these data suggest a complex nature of the OGF and OMF at the molecular and crystalline levels, which improves our understanding of these complex systems with direct relevance to sustainable nutrient management [Mazeika, R., Dambrauskas, T., Baltakys, K., Mikolajunas, M., Staugaitis, G., Virzonis, D. and Baltrusaitis, J*. (Department of Chemical and Biomolecular Engineering, Lehigh University, B336 Iacocca Hall, 111 Research Drive, Bethlehem, PA, United States), ACS Sustainable Chemistry and Engineering, 2016, 4(9), 4788-4796].

NPARR, 8(1), 2017-116 Long-term effects of organic manure and manufactured fertilizer additions on soil quality and sustainable productivity of finger millet under a finger millet–groundnut cropping system in southern India

In a 20-yr-old long-term experiment, the impact of continuous application of organic manures and inorganic fertilizers on soil quality and the sustainability of finger millet production was conducted on two cropping systems: finger millet and finger millet–groundnut on an Alfisol of semi-arid southern India. The study was conducted from 1992 to 2011 at the All India Coordinated Research Project for Dryland Agriculture, UAS, Bangalore, using a randomized block design. The treatments comprised of T$_1$: control [no fertilizer and no farmyard manure (FYM) applied], T$_2$: FYM 10 t/ha, T$_3$: FYM 10 t/ha + 50% of recommended NPK (50:50:25 kg/ha), T$_4$: FYM 10 t/ha + 100%
of recommended NPK and T1: 100% recommended NPK. Comparison of long-term yield data between treatments was used to calculate a 'sustainability yield index' (SYI), which was greatest for T1 (FYM 10 t/ha + 100% of recommended NPK), in both rotational (0.68) and monocropping (0.63) situations. Soil quality indices were determined using principal component analysis linear scoring functions. The key indicators which contributed to the soil quality index (SQI) under rotation were organic C; potentially available N; extractable P, K and S; exchangeable Ca and Mg; dehydrogenase activity and microbial biomass C and N. The largest SQI (7.29) was observed in T4 (FYM 10 t/ha + 100% NPK), and the smallest (3.70) SQI was for the control. Application of 10 t/ha FYM together with NPK (50:50:25 kg/ha) sustained a mean yield of 3884 kg/ha [Sathish, A.*, Ramachandrappa, B.K., Shankar, M.A., Srikanth Babu, P.N., Srinivasarao, C.H. and Sharma, K.L. (All India Co-ordinated Research Project for Dryland Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India), Soil Use and Management, 2016, 32(3), 311-321].

NPARR, 8(1), 2017-117 Establishing a method to evaluate the maturity of liquid fertilizer by liquid fertilizer germination index (LFGI)

With the ongoing growth of liquid manure production, it was necessary to build a proper certification system to check the fertilizer and pollutant qualities of manure fertilizer. The certification criteria of fertilizer and pollutant properties have been developed, but no certification method has been developed for testing the maturity of liquid manure fertilizer until now. Meanwhile, the germination index is a well-known parameter when measuring the maturity of fertilizer. Several methods are advised for measuring the germination of compost-based fertilizer. Until now, there was no specific method for certifying or performing a germination index test for liquid fertilizers. In this study, the ordinary germination index (GI) or Solid fertilizer germination Index (SFGI) is performed for 23 solid-composted fertilizers to evaluate the method's applicability when the average SFGI count is 137. However, when this method is applied to 26 liquid anaerobic manures, the average SFGI count was 22, with germination only happening for eight samples. When the LFGI method was applied for the same samples, the average LFGI count was 30 with 10 germinated samples. LFGI was applied to 66 liquid aerobic manure fertilizers that had mechanical maturity tests and were classified as 22 matured, 25 semi-matured, and 19 immature samples. The average LFGI results were 90 for matured samples, 25 for semi-matured, and 5 for immature. This study focused on finding a proper and acceptable germination index testing method to examine the maturity of liquid manure fertilizer [Halder, J.N., Kim, S.R., Rang, T.W., Yabe, M., Lee. and M.-G*. (Laboratory of Environmental Economics, Division of Agricultural and Resource Economics, Department of Agricultural and Resource Economics, Faculty of Agriculture, Kyushu University, Fukuoka, Japan), Journal of the Faculty of Agriculture, Kyushu University, 2016, 61(2), 417-426].

NPARR, 8(1), 2017-118 Bio- organic fertilizer production using saffron petal wastes by vermicomposting method

Sanitary disposal of agricultural wastes is considered among the major problems in waste management. The bioorganic fertilizer production using vermicomposting method with usability in agriculture is one of the proper management practices for such wastes. This study was conducted to evaluate the capability of producing fertilizer using saffron petal wastes by vermicomposting method. First, certain proportions of cow manure and agricultural waste obtained from saffron petals wastes were produced in five different ratios, and then resulting fertilizer was tested in pilot conditions.
In all steps, pH, total organic carbon and Kjeldahl nitrogen were measured and recorded using the standard method, in addition to temperature and moisture control of the masses to achieve the appropriate time and fertilizer products. The results showed that the most appropriate biological fertilizer was produced in sustainable conditions, including 65% to 75% moisture, temperature of about 24 °C in treatment of 46% saffron petal wastes mixed with cow manure. Saffron petal wastes has suitable ability of conversion to bio-organic fertilizer using vermicomposting method [Biglari, H., Saeidi, M*., Rahdar, S., Narooie, M.R., Sohrabi, Y., Alipour, V., Khaksefidi, R., Zarei, A. and Ahamadabadi, M.(Development & Health Promotion Research Center, Gonabad University of Medical Sciences, Gonabad, Iran), International Journal of Pharmacy and Technology, 2016,8(3), 17988-17995].