Abstracts - Poster Sessions

Poster Session 1: Nitrogen and Environment

Effects of dairy farming intensification on environmental emissions. **J. Luo[1],** S.F. Ledgard[1], J.D. Finlayson[1], R.A. Carran[2], and M.E. Wedderburn[1]. [1]AgResearch Ruakura, Private Bag 3123, Hamilton, New Zealand, [2]AgResearch Grasslands, Private Bag 11008, Palmerston North, New Zealand

Abstract: Milk production on dairy farms in New Zealand has been steadily increasing since the 1970s. This has occurred through a number of factors including increased feed supply through greater use of nitrogen (N) fertiliser and increased use of supplementary forage feeds. Potentially, the integration of low-protein forage (e.g. maize), to reduce dietary-N concentration, or winter management practices (e.g. use of stand-off pads), to reduce excreta to soil, can mitigate environmental N emissions and increase efficiency. However, effects of these mitigation practices on resource use efficiency and environmental emissions, such as greenhouse gas emissions and N leaching, have not been tested. These effects are currently being investigated by AgResearch using simulation modelling. The model simulation using a life cycle assessment approach indicates that fertiliser N increases production and economic efficiency but decreases environmental efficiency through predicted increases in N leaching and greenhouse gas emissions. In contrast, using forage increases the use of land and production efficiency, with a decrease in N leaching and no increase in greenhouse gas emissions (per litre of milk). A comparison of an average New Zealand dairy farm and an example EU dairy farm is also presented.

Nitrogen retention in a red pine forest ecosystem in central Japan receiving high nitrogen deposition. **Wakamatsu, T**.[1], K. Sato[1], A. Takahashi[1], T. Kuboi[2], H. Shibata[2], and E. Konohira[3]. [1]Central Research Institute of Electric Power Industry, 2-11-1 Iwado-kita, Komae, Tokyo, 201-8511, Japan, [2]Hokkaido University, 250 Tokuda, Nayoro, 096-0071, Japan, [3]Nagoya University, Furo-cho, Chikusa-ku, Nagoya, 464-8601, Japan.

Abstract: The stable isotope ^{15}N ($^{15}NH_4Cl$) was applied to the forest floor and monitored for 1 yr in a 50-year-old Japanese red pine (*Pinus densiflora*) forest ecosystem in central Japan, where atmospheric inputs of nitrogen (50 kg N ha^{-1} yr^{-1}) have almost been equal to those in nitrogen-saturated Dutch forests. The gross rates of nitrogen mineralization, immobilization and nitrification in the soils were also measured using the ^{15}N dilution technique. After 1 yr, about 60% of the ^{15}N applied was retained in the organic (30%) and mineral (30%) soil horizons, and about 20% was assimilated by vegetation. $^{15}NO_3^-$ leached from the rooting zone accounted for only 8%. About 80～90% of the ^{15}N retained in the soils existed in the organic nitrogen pool. The ammonium production and immobilization rates (145 mg N kg^{-1} day^{-1}) in the organic soil were 7-fold higher than the gross nitrification rate (20 mg N kg^{-1} day^{-1}). The rates of nitrogen transformations observed in this study were approximately 10-fold higher than those in Dutch forests. It is concluded that the rapid nitrogen turnover in this site plays an important role in the retention of atmospheric nitrogen deposition.

Mapping of atmospheric deposition of nitrogen and sulphur in relation to critical loads of nitrogen and acidity in the Czech Republic. **Miloš Zapletal** and Petr Chroust. Centre for Environment and Land Assessment – Ekotoxa Opava, Horní nám. 2, 746 01 Opava, Czech Republic

Abstract: Estimates of dry and wet deposition of sulphur and nitrogen has been compared with critical loads of sulphur and nitrogen in the Czech Republic on 1 x 1 km grid. Deposition has been estimated from monitored and modelled concentrations in the atmosphere and in precipitation, where the most important acidifying compounds are sulphur dioxide, nitrogen oxides and ammonia, and their reaction products. Wet deposition was derived from concentration values for SO_4^{2-}, NO_3^- and NH_4^+ in precipitations and from precipitation amounts. Dry deposition was derived from concentrations of gaseous components and aerosol in the air, and from their deposition velocities. A multiple resistance model was used for calculation of SO_2, NO_x, NH_3 deposition velocities, deposition velocities of particles were parameterized. The simple mass balance model was used for calculating critical loads of suplhur and nitrogen. It was estimated that the annual average deposition of SO_x in the Czech Republic decreased from 2311 to 708 mol H^+ ha^{-1} a^{-1} between 1991 and 2000. The annual average NO_y deposition was estimated to be 945 and 649 mol H^+ ha^{-1} a^{-1} in 1991 and 2000 respectively. The annual average NH_x deposition was estimated to be 891 mol H^+ ha^{-1} a^{-1} and 828 mol H^+ ha^{-1} a^{-1} in 1991 and 2000 respectively. The annual average deposition of total (potential) acid decreased from 4147 to 2185 mol H^+ ha^{-1} a^{-1} between 1991 and 2000. The annual average exceedance of critical loads for nutrient nitrogen decreased from 1213 to 858 mol H^+ ha^{-1} a^{-1} and the annual average exceedance of critical loads for acidity decreased from 1731 to 733 mol H^+ ha^{-1} a^{-1} in the Czech Republic between 1994 and 2000.

The role of reactive nitrogen in the effect-oriented and monitoring activities under the convention on long-range transboundary air pollution. **Heinz-Detlef Gregor.** Federal Environmental Agency, Berlin, Germany, Chairman, Unece Working Group On Effects

Abstract: Since sulphur deposition has been drastically reduced on a European scale as a consequence of emission reduction plans based on the critical loads concept, the role of anthropogenic nitrogen compounds in large-scale acidification and eutrophication phenomena in Europe becomes more visible. Environmental effects include nutrient imbalances, forest damage, losses in biodiversity and other changes in structure and function of sensitive ecosystems.

Without a further reduction of the emission of nitrogen compounds the risk of environmental damage by acidification and eutrophication remains at an unacceptable level.

Six International Cooperative Programmes with National Focal Centres in 45 participating countries were installed under the Convention on Long-range Transboundary Air Pollution covering the region of the United Nations Economic Commission for Europe (UNECE) to study and monitor effects of air pollutants on a wide variety of receptors. Recently these Programmes have directed some of their efforts to the effects of nitrogen on sensitive elements of ecosystems and its movement in catchments and ecosystem compartments. An agreed methodology for effects-related work on forests, crops, semi-natural vegetation, aquatic systems and materials´ surfaces is applied for research on nitrogen oxides and ammonia from anthropogenic sources. A harmonized work plan based on scientific experimental work and field observations as well as on a comprehensive assessment of the scientific knowledge on processes and dynamics behind the behaviour of “reactive” nitrogen in the environment, provides the scope and time frame for a solid

effects-oriented approach in the planned review of the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone.

A possible difference in microbial process for nitrous oxide (N_2O) production among Japanese soils. Masahiro KOIDE and **Muneoki YOH.** Tokyo University of Agriculture and Technology, Tokyo 183-8509, Japan

Abstract: It is generally accepted that autotrophic nitrifiers are largely responsible for N_2O production in most soils. However, there are also some other processes that produce N_2O in soil (Bremner, 1997). We carried out laboratory experiments and measured the rate of CO_2, N_2O production, and CH_4 uptake in soils with and without N addition to evaluate the microbial process among soils. The results suggested that N_2O production via denitrification may occur in a certain soil even under aerobic condition. We collected 4 soils from 4 sites in Japan; two from forests (Forest1, Forest2) and two from upland fields (Upland1, Upland2). Forest1 is the highest in organic matter content (197.4 g C kg^{-1}) and the lowest in pH (H_2O) of 4.42. We incubated the soils with and without the addition of $(NH_4)_2SO_4$ at 60% WHC and 25℃. Forest1 soil, having a high organic matter content, indicated characteristic metabolisms of greenhouse gases (CO_2, N_2O, CH_4) as follows : (1) The production of CO_2 is the highest (22.6±3.9 CO_2-C μ g $kgdw^{-1}$ min^{-1}). Fertilizer addition had little effect on CO_2 production from soils, suggesting that CO_2 production didn't depend on inorganic nitrogen (NH_4^+). (2) The uptake of CH_4 was also the highest (49.1± 2.1 CH_4-C μ g $kgdw^{-1}$ day^{-1}). (3) The production of N_2O in Forest1 was also the highest (12.6± 8.0 N_2O-N μ g $kgdw^{-1}$ day^{-1}). In other soils (Forest2, Upland1 and Upland2), NO_3^- production of soil and N_2O production in soils increased with the amount of added NH_4^+. But in Forest1, added NH_4^+ didn't enhance NO_3^- and N_2O production. Conversely, the addition of high $NaNO_3$ resulted in the increase in N_2O production (about twice the soil without N addition). This fact suggested that N_2O may be produced via denitrification in Forest1 soil, where formed aggregate structure may create anaerobic spots. The results suggest that more N_2O production may occur via denitrification rather than nitrification in certain forest soils with such high organic matter content.

Effect of organic fertilizer application to Japanese Andisol on N_2O and NO emissions. **Hiroko Akiyama**, Haruo Tsuruta, and Kazuyuki Yagi. National Institute for Agro-Environmental Sciences (NIAES), University of Tokyo

Abstract: Both organic and chemical fertilizer applications to agricultural lands are considered as major sources of atmospheric N_2O and NO, while a relatively small number of paper assessed N_2O and NO emissions after organic fertilizer application compare to chemical fertilizer application. We investigated the effect of chemical and organic fertilizer application on N_2O and NO emissions and estimated the N_2O and NO emissions for Japanese Andisols. N_2O and NO fluxes were measured by using an automated monitoring system at NIAES, Tsukuba, Japan. Various kinds of organic fertilizer (oil cake, fish meal, poultry manure, swine manure, cattle manure, dried cattle excreta) and a chemical fertilizer, urea, were applied to an Andisol field, where Pac choi or Spinach was cultivated. Results showed that organic fertilizer applications were important sources of N_2O. N_2O and NO emissions were different among organic fertilizer treatments. Comparison of the NO-N/N_2O-N ratio suggested that nitrification was more dominant process in chemical fertilizer treatment and denitrification was more dominant in organic fertilizer treatment. N_2O and NO emission rates decreased with the C/N ratio of applied organic fertilizers

suggesting that C/N ratio of organic fertilizer could be used to estimate N_2O and NO emission rates. The N_2O emission factors in our fields with chemical fertilizer were similar to those of other Andisol fields in Tsukuba area, and were lower than the IPCC default value of 1.25 %. The estimate of N_2O emission from organic fertilizer application for Andisol fields in Japan was similar to that of chemical fertilizer application, while the estimate of NO emission from organic fertilizer for Andisol fields in Japan was lower than that of chemical fertilizer application.

Carbon storage in the desertified land: A case study from North China. **Qi Feng,** Wei Liu, Jianhua Shi, Yonghong Su, and Yanwu Zhang. Cold And Arid Regions Environmental And Engineering Research Institute, Chinese Academy Of Sciences, No. 260 West Donggang Road, Lanzhou, 730000 China

Abstract: Vegetation cover and climatic zones have been calculated for desertification-prone lands, covering a total of 334,000 km^2, mainly in northern China, using data from desertified soil, the organic and carbonate carbon in different soil orders. Regional accumulations were examined relative to precipitation, absolute height, and temperature. The largest accumulations of pedogenic carbonates were found in Calcic soil and warm, arid areas. Organic carbon accumulations predominated in soil under Betula platyphylla. Using the desertified lands of China as an example, the top 1.0-m soil layer in naturally desertified lands contain some 7841 Tg of organic carbon and 14907 Tg of carbonate carbon. It is hypothesized that total carbon stored as carbonate and as organic carbon will increase by a factor of 1.8 compared to the result based solely on organic carbon. Thus, the carbon released through land desertification in China may be an important factor affecting changes in concentrations of greenhouse gases world wide.

Dynamics of dissolved N_2O in underground water in upland field and estimation of indirect N_2O emission. **Nakajima Yasuhiro**[1], SAWAMOTO Takuji[2], FUJIWARA Hideshi[1], MATSUMORI Kenji[3], KANDA Kenichi[1], BANZAI Kenji[1], and TSURUTA Haruo[4]. [1]National Institute for Agro-Environmental Sciences, Japan, 3-1-3, Kannonndai, Tsukuba, Japan, [2]Rakuno Gakuen University, Japan, [3] National Institute for Rural Engineering, Japan, [4]Center for Climate System Research, The University of Tokyo, Japan

Abstract: N_2O is produced and degradated by nitrification and denitrification process not only at soil surface but also at subsoil and groundwater. Supersaturated N_2O flows downstream and is emitted after discharge to the ground surface water. In this study, dissolved N_2O and other nitrogen concentration in underground and spring water in a watershed were observed continuously, and indirect N_2O emission value was calculated. Furthermore, stable isotope ratio of N_2O-N and TN was measured. Water samples were collected every month from 15 wells and two springs in the watershed mainly utilized for upland fields in Ibaraki prefecture in Japan from June 2001 to June 2003. N_2O concentration in water sample was analyzed by gas chromatograph. NO_3^-, NO_2 and NH_4^+ concentration in water sample were analyzed by coloring method. Eh, pH, EC, TOC, TN, DN and water temperature were measured in same time. Concentration of dissolved N_2O in 15 wells and two springs in the watershed ranged 0.45 to 5630 μg-N L-1, which was super-saturated. N_2O and NO_2^- were correlated, indicating that N_2O was produced when nitrogen metabolism activity was high. Concentration of dissolved N_2O decreased from the middle of the watershed to the spring though concentration of NO_3^- did not change. D(d15N TN - d15N N_2O) was large in the middle of the watershed, while that was small in the lower stream. Those results indicate that N_2O

was degraded by denitrification in the latter. The emittted N2O-N/DN ratio was 0.000031. That was greatly lower than the IPCC default value of N_2O indirect emission (EF5-g:0.015).

Temporal and spatial variations of N_2O emission from Chinese cabbage field as affected by type of fertilizer and application. **Weiguo Cheng**[1], Shigeto Sudo[1], Haruo Tsuruta[2], and kazuyuki Yagi[1]. [1]Greenhouse gas emission team, NIAES, 3-1-3 Kannondai, Tsukuba, 305-8604, Japan, [2]CCSR, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8904, Japan

Abstract: An experiment was conducted in an Andosol field in Tsukuba, Japan to study the effect of type of nitrogen fertilizer on emission of nitrous oxide (N_2O), and also on nitrogen uptake of cabbage during a growing season. Four treatments were carried out, which were; no N fertilizer (CK); broadcast application of urea (BR-U); band application of urea (B-U); and band application of controlled release urea (B-CU). The rate of application was 250 kg N ha^{-1}, a conventional rate in the experiment region. N_2O flux measurements were carried out two or three times a week during 82 days growth period. The cumulative emission was divided to early (28d), middle (27d) and later (27d) 3 stages. There was different temporal variation of N_2O emission among 4 kinds of treatments. Broadcast application urea contributed 70% N_2O emission from early stage. N_2O emission increased with cabbage growth in no fertilizer treatment, indicated plant growth with root biomass increasing could stimulate N_2O emission from no fertilized soil. There were no difference in the patterns of temporal variation between two band applications for B-U and B-CU treatments, N_2O emissions from middle and later stages were 46% and 42%, respectively, for B-U, while were 41% and 40%, respectively, for B-CU. However, the N_2O emission was mitigated 40.5% in controlled-release urea treatment compared with band application of urea. The N_2O emissions from the soils within fertilizer bands and between fertilizer bands indicated there were extreme higher N_2O emissions from the soils within fertilizer bands than that of between fertilizer bands, and the trend was continued to harvest.

Environmental problems induced by tea cultivation and the control measure by using lime nitrogen fertilizer. Xiaoju Wang[1], **Tadashi Kato[2*]**, and Fayun Li[3]. [1]Center for Environmental Science in Saitama, Saitama 347-0115, Japan, [2]Society of Agrology and Sustainable Agriculture Movements, NPO, Shizuoka 421-0302, Japan, [3]Faculty of Environmental Sciences, Liaoning University, Shenyang110036, China

Abstract: Nitrogen (N) is the most limiting essential nutrient for growth and quality of tea (*Camellia sinensis L.*), and for this reason, tea fields usually receive much higher N rates than other crop fields. In Japan, N rates applied in tea cultivation have been over 800 kg ha^{-1} since 1980s, of which, however, about 200 kg ha^{-1} can be immobilized by tea plants. This paper, based on our field study, describes the environmental problems induced by over use N in tea cultivation in Japan, and discusses the effect of application of lime nitrogen (calcium-cyanamide) as a control measure.

Results showed that soil pH values in the 76 tea fields investigated ranged from 2.7 to 5.8, of which about sixty percent were below 3.5. This indicated that long-term tea growing had caused extremely strong soil acidification in Japan. Moreover, the excess N application caused a threat to plant growth and local water quality. A much higher annual N_2O emission rate (30-97 kg N ha^{-1}) in tea fields than that in other crop fields was also found. As to the result of the field experiment, compared with the conventionally high N application (1120kg/ha) without lime N, the low N

application (400kg/ha) with lime N increased soil pH and improved tea yield and quality. This indicated that application of lime N could be an effective measure against the environmental problems in tea cultivation.

Influence of nitrogen deposition on lithuanian forests: Ground vegetation changes in Scots pine stands. Remigijus OZOLINCIUS, Vidas STAKENAS, and **Kestutis Armolaitis.** Lithuanian Forest Research Institute, Liepu 1, 53101 Girionys, Kaunas reg., Lithuania

Abstract: Nitrogen is the limiting nutrient for plant growth in many forests ecosystems in Lithuania and the ground vegetation species are most adapted to nitrogen-poor conditions. The changes in the political and economic system, the implementation of the new advanced technologies in Lithuania as well as in the neighbouring countries have followed by the decrease of the environmental pollution. While during the two last decades total annual load of the sulphur was decreased by three times (from 24 kg ha^{-1} to about 8 kg ha^{-1}), nitrogen deposition has fallen down only by one-third (from 15 kg ha^{-1} to about 9-10 kg ha^{-1}). The effect of nitrogen deposition on ground vegetation in Scots pine stands was studied using the mean weighted nitrogen-demand values (*En*) of the Ellenberg's indicator scale. The significant increase of *En* value in the period from the 1972-1976 to 1994-1997 was detected only in the poor forest site (*Pinetum vacciniosum*) on sandy soils (Arenosols). The increase of this value in *Pinetum vaccinio-myrtillosum* forests on nitrogen-richer soils was not significant.

Evaluation of nitrogen losses from surface source based on a watershed investigation in typical Agro-eco-system in Southern China. **Jumei Li**[1], Dongchu Li[1], Minggang Xu[1], Daozhu Qin[1], Yasukazu Hosen[2], and Kazuyuki Yagi[3]. [1]Soil and Fertilizer Institute, Chinese Academy of Agricultural Sciences. Beijing, 100081, China, [2]Japan International Research Center for Agricultural Sciences, Tsukuba, Ibaraki 305-8686, Japan, [3]National Institute for Agro-Environmental Sciences, Tsukuba 305-8604, Japan

Abstract: The flux of irrigation and drainage from paddy field in a typical watershed in hilly red soils regions of southern China were monitored, nitrogen (NH_4-N, NO_3-N and total N) content in above water samples and rainfall were measured from 2000 to 2003. Types of land utilizations, agriculture status, human activity, N fertilizer application within the watershed were surveyed. Meanwhile, ammonia volatilization and nitrogen leaching from paddy field were determined. According those data, nitrogen balance in paddy field was calculated. The results showed that for paddy field, fertilization, irrigation and rainfall were the major N input items. Total N input paddy field was 466.7kg.hm^{-2} annually, and fertilization contributed to 444.6kg.hm^{-2}, which accounted for 95% of total N input, followed by rainfall (14.6 kg.hm^{-2} accounted for 3.1%) and irrigation (7.5kg.hm^{-2}accounted for 1.6%). Total N output from paddy field was 463.9kg/hm^{-2}, which were consisted by crop uptake (240.7kg.hm^{-2}), runoff (38.4kg.hm^{-2}) and leaching (7.0 kg.hm^{-2}), accounted for 51.6%, 8.3%, 1.5%, 38.3% of total N output, respectively. Ammonia volatilization was the greatest part of N losses, which became mainly pollution source to environment from paddy field, followed by runoff. Non-point source (NPS) pollution caused by nitrogen fertilization from agro-ecosystem was a serious threat to water environment. Reasonable fertilizer application and water management were the most important ways to reduce N losses from paddy field and improve agricultural environment.

Distribution of atmospheric N_2O concentration along tracks of XUELONG from the Arctic to the Antarctic. **Zhongyong Gao**[1], Suqing Xu[2], Liqi Chen[1,3], and Liyang Zhan[2]. [1]Key Laboratory of Global Change and Marine-Atmospheric Chemistry，SOA, Third Institute of Oceanography State Oceanic Administration, Xiamen 361005， China, [2]Department of Oceanography, Xiamen University, Xiamen, 361005, China, [3]Chinese Arctic and Antarctic Administration, Beijing 100860, China

Abstract: Concentrations of atmospheric nitrous oxide were measured during two almost continued voyages made by the ice-breaker XUELONG. One, termed as CHINARE-XVIII, lasted from November 2002 to April 2003 in the Antarctic and the other, CHINARE-2003, from July to September 2003 in the Arctic. The results showed that atmospheric N_2O concentration varied obviously between seasons. Atmospheric N_2O concentration was higher in September than in July and August in the northern hemisphere, and it was higher in February than in last December in the southern hemisphere. In the Prydz Bay, it was quite interesting to find an abrupt change between the inside and outside of the bay, with 65°Lat. S being its division. It was normal outside the bay, but increased dramatically with the latitude inside the bay. This was just opposite to the partial pressure of carbon dioxide (pCO_2) in the surface water layer. In short, the atmospheric N_2O concentration averaged 310.1ppvb from November to December when the ship sailed from Shanghai to the Great Wall Station in Antarctic, and increased to 319.1ppbv when it returned from the Zhongshan Station to Shanghai in February; The mean atmospheric N_2O concentration along the route around the Antarctic in the Southern Ocean was 314.1ppbv in January. Also it was only 308.1ppbv along the route from Shanghai to the Arctic (more than 80°N) from July to August, and increased sharply to 316.5ppbv when the ship returned in September. Generally speaking, it was 311.6ppbv in the North Hemisphere, and a little lower than 313.2ppbv in the South Hemisphere.

Study on nitrous oxide in the marine system. **Liyang Zhan** [1,2*], Liqi Chen [2]. [1]Department of Oceanography, Xiamen University, Xiamen 361005, [2]Key Lab of Global Change and Marine-Atmospheric Chemistry (GCMAC), Xiamen 361005

Abstract: The factors which influenced the distribution and strength of the sources of nitrous oxide were categorized according to the physical and biochemical processes through compiling Author's researches which are discussed as follows: (1) The nature of the ocean current and their mixing processes will determine saturation of dissolved nitrous oxide in the surface water. (2) Since the whole ocean acts as a net source for atmospheric N_2O， mechanism of the production of N_2O in the marine system should be an important factor that would influence the distribution and strength of the N_2O air-sea flux.

Though the mechanism of N_2O production in the marine system is still in argument, some other achievement about the relationships between N_2O and different factors such as dissolved oxygen, temperature, and nutrient and so on was made. Among all these factors, dissolved oxygen is the most important factor that will regulate the deep ocean profile of N_2O; thus, it can control the strength of .N_2O to some extent. There are still some other factors that will regulate or affect the distribution and strength of the N_2O production such as temperature, wind speed, salinity and so on was also investigated, with the result showing that some sea areas would become a temporal sink when the temperature dropped, while the high wind condition would enhance the air sea nitrous oxide flux. To sum up, great job has been done on the nitrous oxide in the marine system.

Yet, uncertainty of the flux and mechanism has not yet been solved, and further study is needed.

A laboratory study of CO_2 and N_2O emissions from soils amended with slurry from genetically modified pigs (Enviropigs^{TM}). **X.M. Yang[1],** C.F. Drury[1], T.Q. Zhang[1], A. Ajakaiye[2], C.W. Forsberg[3], M.Z. Fan[2], and J.P. Philip[3]. [1]Agriculture & Agri-Food Canada, Harrow, ON, Canada, [2]Department of Animal Science, University of Guelph, ON, Canada, [3]Department of Molecular and Cellular Biology, University of Guelph, ON, Canada

Abstract: Transgenic modified pigs (Enviropig^{TM}) that use efficiently phytate phosphorus (P) have been developed in Canada. However, there is no information available regarding the impacts of adding Enviropig^{TM} slurry to soils and the subsequently impact on greenhouse gas emissions. We evaluated short-term CO_2 (aerobic condition) and N_2O (anaerobic condition) emissions from soils amended with slurry from Enviropig^{TM} in comparison with that from conventional pigs (Yorkshire line), both fed with conventional and low-P diets. A Brookston clay loam and a Harrow sandy loam were used in this study (168-h incubation). Pig slurry was applied on an equivalent mass of total N, 115 mg N kg^{-1} soil. Slurry amendment increased CO_2 emissions in both types of soils. No differences were found between pig genotypes as to the effects of slurry amendment on productions of CO_2 and N_2O in the sandy loam soil. However, in the clay loam soil CO_2 emissions reduced by 17% with amendment of Enviropig^{TM} slurry than with conventional pig slurry, while N_2O emissions increased by 37% with amendment of Enviropig^{TM} slurry compared to the conventional pig slurry or control. There were no diet effects on either CO_2 or N_2O emissions. Overall, in comparison with slurry from conventional pigs, soil amendment of slurry from Enviropig^{TM} has nil difference or positive impacts on the environment in the aspect of CO_2 emission, with further evaluation necessary as to its N_2O production in the fine textured soils.

Effects of ventilation control on indoor air quality and NH_3 emission. **Angelika Haeussermann**, Eberhard Hartung, and Thomas Jungbluth . Hohenheim University, Institute of Agricultural Engineering, Germany

Abstract: Within the scope of this research project one question to answer is to what extent modern control devices and additional control variables can be used to influence NH_3 emission from pig houses. In this connection data were collected to estimate both the emission effect and the effect on the indoor quality of several innovative ventilation control strategies. In using high pressure water fogging combined with innovative ventilation control the indoor air quality in the pig facility was affected more adequate, regarding the indoor temperature, the humidity and the gas concentrations. The increase of the mean indoor temperature could be dampened significantly (maximum indoor temperatures could be lowered about 6 Kelvin). Due to the use of high pressure water fogging the ventilation rate was reduced in average about 25% using a temperature controlled ventilation strategy and about 34% when controlling the ventilation rate by the CO_2 indoor concentration. Lower ventilation rates did increase the CO_2 and NH_3 indoor concentration, but in general without exceeding the threshold of 3000 ppm CO_2, nor 20 ppm NH_3. The mean ammonia indoor concentration followed a diurnal course, nearly inversely proportional the ventilation rate. The potential of the ventilation strategies to influence the level of the NH_3 emission rate is determined by how far the release of NH_3 in the system can be influenced, i.e. due to a lowered indoor temperature or ventilation rate. Regarding mean daily outside temperatures

below 14°C, the daily emission rate on NH_3 for the temperature controlled reference strategy - without use of water fogging - averaged on 94 g d^{-1} LU^{-1} at night time (10 p.m. until 6 a.m.). A daily peak of the NH_3 emission that ranged in average of all the days up to 110 g d^{-1} LU^{-1} could be seen in the afternoon between noon and 5 p.m. For mean daily outside temperatures above 14°C the NH_3 emission rate for the reference strategy "R" averaged on 110 g d^{-1} LU^{-1} for night time. Two daily peaks of about 130 g d^{-1} LU^{-1} occurred at this outside temperature range, nearly parallel to animal activity peaks, i.e. one in the morning at about 9:30 a.m. and one in the evening between 7:30 p.m. and 9:30 p.m.. Although the indoor temperature as well as the ventilation rate could be lowered significantly due to the ventilation strategies using high pressure water fogging, no lowered NH_3 emission rate could be recorded for mean daily outside temperatures above 14°C. Especially during rather cold days with mean daily outside temperatures below 14°C, the daily course of the NH_3 emission rate for the three ventilation strategies with water fogging run partly parallel but on a significant higher level compared to the reference strategy. It seems that the increased indoor humidity combined with wet areas and floor surfaces caused an increase of NH_3 emissions.

Root exudation and microbial diversity in the rhizosphere of Bean *(Phaseolus vulgaris L.)* as affected by atmospheric CO_2 concentration and N-Nutritional status. **Susan Haase**[1], Günter Neumann[2], Angelika Kania[2], Annett Rothe[1], Volker Römheld[2], and Ellen Kandeler[1]. [1]Institute of Soil Science, University of Hohenheim, Stuttgart, Germany, [2]Institute of Plant Nutrition, University of Hohenheim, Stuttgart, Germany

Abstract: The aim of this study was to assess the effects of elevated CO_2 and N-nutritional status on the release of root exudates, with potential impact on N_2 fixing microorganisms (carboxylates, flavonoids) and on the rhizosphere microbial community, using bean as a model plant. Elevated CO_2 did not significantly affect biomass production (similar results reported by Salsman et al., 1999) but accelerated the development of N deficiency indicating a higher N use efficiency at elevated CO_2. Root exudation of carboxylates was increased by moderate N deficiency but decreased under more severe N deficiency. Both effects were particularly expressed under elevated CO2 concentrations and can be attributed to impaired photosynthesis (severe chlorosis) and reduced carbon supply to the roots when N deficiency proceeds. Increased shoot to root translocation of carbohydrates may explain higher root exudation under moderate N deficiency at elevated CO2 concentration. Higher root exudation of carboxylates as the preferential carbon source for N2 fixing microorganisms may thereby promote rhizobium symbiosis in apical root zones, with developing root hairs as infection sites. Accordingly, nodulation was most pronounced at elevated CO2 concentrations with moderate N deficiency. A potential impact on root exudation of signal flavonoids is currently under investigation. In contrast, under severe N deficiency, the limited carboxylate exudation particularly expressed at elevated CO2 was associated with reduced activities of marker enzymes of the N, P and C cycle in the rhizosphere, indicating declining soil microbial activity, probably induced by C limitation. The DGGE pattern also confirms changes in bacterial community structures. Biomass, root exudation and the structural and functional diversity of the rhizosphere microbial community were differentially affected by N supply, plant age and atmospheric CO_2 concentration.

Nitrous oxide emission from water-logged hillslope soils in the black forest (Germany): measurements and 2D modelling. **Marc Lamers**[1], Joachim Ingwersen[1], and Thilo Streck[1.1]
Institute of Soil Science and Land Evaluation (310), University of Hohenheim, D-70593 Stuttgart
Abstract: Besides water (H_2O), carbon dioxide (CO_2), and methane (CH_4), nitrous oxide (N_2O) contributes with about 5% to the enhanced greenhouse effect. Furthermore, it adds to the depletion of the stratospheric ozon layer. The contribution from the temperate forests to the global N_2O-budget is estimated to be 7% ($1{,}0 \cdot 10^9$ kg N a^{-1}). With the exception of Wetland-DNDC, the available N_2O-emission models for forest ecosystems have only be applied to terrestrial soils. Application to hydromorphic soils, which make up about 20% in the Black Forest Region, has only been limited. The longterm aim of this project is to test and to further develop existing models for simulation of N_2O-emissions from water-logged soils at the hillslope scale. As a first step, we applied the PnET-N-DNDC model to our data and observed satisfactory results for the non water-logged soils (Cambisols), whereas it was not possible to match simulations to data from temporarily water-logged soils (Humic Gleysol, Histic Gleysol, Fibric Gleysol) where the microbial processes are influenced by water table oscillations. In order to obtain data for calibrating and validating the models we have chosen a 80-year old spruce forest located in the southern part of the black forest region in Southwest Germany (Wildmooswald, St. Märgen). At this site we have carried out investigations on a hillslope of approx. 5 hectares. For one year we have measured N_2O emission once a week using the “closed chamber method”. To investigate soil water dynamics we installed a catena with 10 profiles in direct neighborhood to the gas chambers. At each profile we have measured matric potentials (Tensiometer) and the soil water contents (TDR) once per week since April 2003 in four different depths (10, 20, 40 and 60 cm). In our poster-presentation we will focus on first measurement and modelling results for 2003. We will point out the necessity to take the vertical and lateral flow components into account in simulations of N_2O emission from sloped soils.

Potentials to reduce methane emissions in sheep. **P. Leberl**, H. Steingaß, and W. Drochner.
Institute of Animal Nutrition, University of Hohenheim
Abstract: The aim of this study was to investigate two strategies names bypass and synchronism regarding their suitability to reduce CH_4 production in fattening sheep. Six groups each with six male merino lambs of an average live weight (LW) of 25kg were fed with a diet of 25% hay and 75% concentrate. In three diets the concentrate consisted mainly of corn as a carbohydrate source with low rate and extent of ruminal degradation (high bypass content) in contrast to the concentrate based on peas, modified starch and sugar, which are primarily degraded at a high rate and extent in the rumen. Furthermore the degradation rates of carbohydrates and nitrogen were varied forming synchronous, intermediate and asynchronous diets, respectively. Feeding level was approximately twice as maintenance energy requirements. After two weeks of diet adaption methane emissions were measured in a period of 2x 24 hours in an open circuit respiration chamber. For statistical analysis SAS for Windows was used in version 8.02 with the method LS-means and the test of Scheffé.

Generally, methane production was on a very low level in all six diets with only 2,53-4,37% of GE-intake. Pea based diets showed significantly higher values than corn based diets (P→C). Regardless of the carbohydrate source, CH_4 production was lowest in asynchronous diets (CA and PA) with 2,53 resp. 3,45% of GE or 3,29 resp. 4,38% of digestible energy intake (DE).

First it should be mentioned, that fattening lambs at the age of four months (this is normally one month before slaughtering) produce, related to GE- intake, not even the half of the percentage of CH_4 emission of an adult sheep per day. Therefore fattening lambs should be separately regarded from adult ewes, rams and wethers in future scenarios about CH_4 production. In this study diets with high bypass content have a high potential (up to 1,7 times less CH_4 than pea-based rations) to reduce CH_4 emissions in fattening lambs. In addition asynchronous diets add to lower methane emissions. The reason for this could be a lower intensity of ruminal fermentation.

Optimisation and evaluation of different sensitive spectroscopic measuring methods for greenhouse gases. **A. Link,** R. Sauter, and U. Haas. Institute of Physics and Meteorology, University of Hohenheim, Garbenstr. 30, D-70599 Stuttgart, Germany

Abstract: Methane and nitrous oxide belong besides water vapour and carbon dioxide to the most important green house gases. More than 30 % of the global methane emission and about 35 % of the global nitrous oxide emission originate from agricultural sources. The strength of this sources as well as of natural sinks are often spatial variable and hard to estimate. Therefore mobile, sensitive, accurate and inexpensive devices for field measurements of these gases in ambient conditions are necessary. Two measuring devices that meet these demands have been developed.
The first one is based on tunable diode laser resonant photoacoustic (TDL-PA) spectroscopy. The second one is based on tunable diode laser absorption spectroscopy (TDLAS) with a multi pass optic. Both devices use a laser diode, respectively, as light source for the selective detection of the trace gases in the near infrared. Multiple field measurements were performed, as for instance of methane concentrations in a hog house, as well as of methane fluxes from forest soils and Alpine soils using chamber methods. Very good correlations between TDL-PA, TDLAS, commercial NDIR and gas chromatographic measurements have been found, respectively.

Eye-safe lidar transmitter at 1.45 µm based on a cr^{4+}:yag laser. **Anna Petrova,** Gerd Wagner, and Volker Wulfmeyer. Institute of Physics and Meteorology, University of Hohenheim, D-70593 Stuttgart, Germany

Abstract: Even simple elastic backscatter lidars are very useful tools for investigating the structure of the cloud-free atmosphere. They can provide 2D to 3D data for investigating the spatial distribution and transport of both natural and anthropogenic aerosol particles.
More complex lidar systems that can measure, for example, the water vapour concentration (DIAL) or wind velocity (Doppler), have an even more direct impact because they provide measurements with fundamental units of mass, length and time. Regardless of whether simple or complex, the eye-safety of a lidar is perhaps the most important factor: a lidar that is not eye-safe will suffer from restrictions on its use.
Operation of lasers in the UV (below 400 nm) is outside the retinal hazard wavelength region, but UV aerosol backscatter systems suffer from strong molecular scattering and absorption from ozone. As an alternative to UV systems, generation of pulsed light at wavelength longer than 1.4 µm can be achieved in optical parametric oscillators [2], solid-state lasers such as Er:glass laser or using stimulated Raman scattering .
At the Institute of Physics and Meteorology (IPM) at Hohenheim University an eye-safe, scanning, mobile lidar system shall be developed which shall also have the flexibility of performing water vapor DIAL and coherent Doppler lidar measurements at 1.45 µm. We chose

building a solid-state laser based on Cr4+:YAG. This laser can directly be pumped with the fundamental of a diode laser pumped Nd:YAG laser. We decided to develop a laser, as its beam quality and divergence can be better controlled by a careful resonator design than using non-linear wavelength converters. This is particularly important, as efficient detectors in the eye-safe wavelength regions have diameters of the order of 200 µm. In the future, the wide tunability of Cr4+:YAG and laser frequency control using injection-seeding permits also the performance of water vapor DIAL and coherent Doppler lidar measurements. The all-solid state laser design ensures durability and long operational lifetimes which are required for permanent measurements.

The impact of elevated atmospheric co_2 on root exudation of signalling compounds in the clover-rhizobium symbiosis. **Stöber S.**[1], Sadowsky M.[2], Neumann G.[3], von Wirén N.[3]. [1]Institute of Crop Production and Grassland Research, University of Hohenheim, D-70593 Stuttgart, Germany, [2] Department of Soil, Water and Climate, University of Minnesota, St. Paul, MN 55108, USA, [3]Institute for Plant Nutrition, University of Hohenheim, D-70593 Stuttgart, Germany

Abstract: CO_2 is known to be one of the main greenhouse gases influencing climate and function in terrestrial ecosystems. Up to now, little is known about the impact of elevated atmospheric CO_2 on symbiotic interactions in the rhizosphere and particularly whether CO_2 influences root exudation of microbial signalling compounds.

This study addressed the question whether elevated CO_2 induces quantitative and qualitative changes in exudation of signalling compounds involved in the symbiosis of *Trifolium repens* with *Rhizobium leguminosarum* biovar. *trifolii*. Exudates of *T. repens* grown in axenic hydroponic culture under low (400 ppm) and high (800 ppm) CO_2 concentrations and different levels of N-supply were collected at three different plant ages and analysed by using HPLC. Under these conditions, 7',4-dihydroxyflavone (7´,4-DHF) and umbelliferone, as well as several yet unknown phenolic compounds, were identified in root exudates of *T. repens.* Nitrogen limitation stimulated root exudation of the nod gene inducer 7´,4-DHF and the antagonist umbelliferone. In addition, elevated CO_2 increased exudation of a yet unidentified compound (C), which is likely related to flavones as demonstrated by wavelength scans. This effect was detectable already after two days of N limitation (17 days after sowing). The stimulatory effect of elevated CO_2 concentrations on root exudation of flavonoids can be attributed partially to CO_2-induced higher root biomass production but also to increased exudation rates per unit root biomass, since CO_2 effects on root exudation were always higher than the CO_2-induced increase in root biomass, estimated at final harvest 19 days after sowing. There was a trend for a decline of root exudation with increasing age of the plants, which may be attributed to growth limitation in the sterile culture vessels. The data obtained suggest that elevated CO_2 may enhance nodulation in the Clover-Rhizobium symbiosis by inducing increased root exudation of signalling compounds and changes in the composition of exudates.

Nitrogen losses from intensive agiculture in the North China Plain. **Yuming Zhang**[A], Deli Chen[B], Robert E. White[B], Chunsheng Hu[A], and Robert Edis[B], [A]Institute of Shijiazhuang Agricultural Modernization, Chinese Academy of Sciences, Shijiazhuang 050021, China, [B] School of Resource Management, the University of Melbourne, Victoria 3010 Australia

Abstract: China is the largest consumer of N fertilizer in the world. Around 30% of this fertilizer is used in the North China Plain, which is one of the main areas for intensive food production in

China. The main cropping system in this area is maize-wheat rotation. The efficiencies of N fertilizer use, however, are very low, approximately 32%-35%. Nitrogen leaching, denitrification and NH_3 volatilisation are responsible for low efficiencies. The purpose of this study was to measure these pathways of N loss independently and simultaneously. Ammonia volatilisation was measured by the micrometeorological method, denitrification by the acetylene-intact soil core technique and nitrate leaching below the root zone (1.8m) by the soil water balance (SWB) with NO_3^--N concentrations using suction cup samplers. Ammonia volatilisation was the main pathway of fertilizer N loss. When urea was applied to maize (broadcast followed by irrigation) in July 1999, the NH_3 loss was 42 kg N ha^{-1}, accounting for 27% of applied N. Ammonia loss from the wheat field was much lower, <1% of applied N, when urea was ploughed in to 20 cm deep at the time sowing (October 1999). This lower loss was mainly attributed to the effective incorporation of fertilizer into soil. This contrasted to the loss of 16% of applied N for the top dressing when urea was applied by surface broadcast followed by irrigation in the following spring. Denitrification loss was 2.1~2.9 kg N ha^{-1} for the maize phase, accounting for 0.67~0.75% of the applied fertilizer N, which was slightly higher than that from the wheat phase (0.28~0.53%). The peaks of denitrification rate were observed 2~3 days after irrigation or rainfall following urea application. Nitrous oxide accounted for up to 70% of total denitrification losses. The results suggest that denitrification was not an important pathway in the fertilizer N economy, but may have significant environmental impacts because N_2O is a potent greenhouse gas. Cumulative leaching loss was 10~29 kg N ha^{-1}, accounting for 6~18% of applied N, which occurred mainly in the maize growing season (July and August 1999) after rainfall and irrigation events. The total N losses in the maize season were 53~73 kg N ha^{-1}, accounting for 34~47% of the applied N; while losses for the wheat season were 20~21 kg N ha^{-1}, accounting for 8~9 % of applied N. Substantial losses of N are not only financial losses for farmers but also serious environmental concerns. It is imperative to develop more effective agricultural management practices to minimise N loss, especially during the maize phase.

The short-term responses of soil available nitrogen of Dinghushan forests to simulated N deposition in subtropical China. **Fang Yun-Ting[1],** Mo Jiang-Ming[1*], Zhou Guo-Yi[1], Per Gundersen[2], Li De-Jun, Jiang Yuan-Qing. (1. Dinghushan Forest Ecosystem Research Station, South China Botanical Garden，the Chinese Academy of Science, Zhaoqing, Guangdong 526070, China; 2. Forest & Landscape Denmark, Hoersholm Kongevej 11, DK-2970)

Abstract: The short-term responses of soil available nitrogen of Dinghushan forests to simulated N deposition in subtropical China were studied in this paper. Three representative forests in Dinghushan Biosphere Reserve were chosen for our study: a pine (*Pinus massoniana*) forest, a pine and broadleaf mixed forest and a monsoon evergreen broadleaf forest. Nitrogen was sprayed monthly onto the forest floor of these three forests in Dinghushan in subtropical China. Four treated levels with three reduplicates were included within broadleaf stand: Control (0 g $N.m^{-2}.a^{-1}$), Low N (5 g $N.m^{-2}.a^{-1}$), Moderate N (10 g $N.m^{-2}.a^{-1}$) and High N (15 g $N.m^{-2}.a^{-1}$), but three treated plots within pine stand and mixed stand (C, Low N, and Moderate N). Every plot measures 20× 10 meters and is divided into eight 5×5m subplots. Fertilizer additions of NH4NO3 began in July 2003 as equal applications over the whole year. Fertilizer additions occurred at the beginning of every month, and soil sampling occurred at the end of every month.

Total average values of soil available nitrogen in two depths (0~10 cm and 10~20cm) of control plots were 6.24, 6.22 and 14.77 $mg.kg^{-1}$ for pine stand, mixed stand and broadleaf stand, respectively, with 45.3%, 48.7% and 14.5% as NH_4^+-N form. N addition increased the soil N availability for both soil depths in all stands, and soil N availability increased with N treatment

level. However, the magnitude of responses varied significantly depending on forest, soil depth and treatment time. The responses to N addition in broadleaf stand where N is abundant were not as strong as those in pine and mixed stand where N is short supply. The response of depth 0~10cm was lightly stronger than that of 10~20cm. In addition, the difference of soil available N between treatment plots and control plots became greater with experiment time. The soil pH values also varied significantly depending on forest and depth. Overall, soil pH values ranked as followed: pine > mixed > broadleaf (stand); and depth of 10~20cm (3.96~4.25) > depth of 0~10cm (3.81~4.08). No significant impact of N addition on soil pH in these three stands was observed after 5 months of N additions.

Nitrogen transformations in forest soils and their responses to atmospheric nitrogen deposition: a literature review. **Fang Yun-Ting[1],** Mo Jiang-Ming[1*], Per Gundersen[2], Zhou Guo-Yi[1]. (1. Dinghushan Forest Ecosystem Research Station, South China Institute of Botany，the Chinese Academy of Science, Zhaoqing, Guangdong 526070, China; 2. Danish Forest and Landscape Research Institute, Hoersholm Kongevej 11, Hoersholm 2970, Denmark)

Abstract: Atmospheric deposition of nitrogen - specifically oxides of nitrogen (nitrate and NOx) mainly from fossil fuel emissions and also ammonium from production and use of fertilizers remain elevated in industrial regions of the world and are accelerating in many developing regions. The emissions of nitrogenous compound from industry and agriculture is also suggested to been increasing rapidly in China recently. However, little information about the impacts of nitrogen deposition on forest ecosystems in China is available. Chronically elevated N inputs to forest from atmosphere can lead to changes in tree growth, mortality, and species composition, and to possible declines in soil fertility and drainage water quality. To identify the specific role of atmospheric N in changes observed in water quality and tree health, a group of experiments have been carried out in Europe and Northern America. In this paper, we introduced the biological processes and magnitudes of nitrogen transformations in forest soil and their roles in the ecosystem nitrogen cycling, firstly. Then, we discussed the effects of nitrogen deposition on nitrogen mineralization, nitrification, and denitrification of forest soil and their feed-back mechanisms. Nitrogen transformation in forest soil is a key component of ecosystem nitrogen cycling, and controlled by a number of variables. Elevated atmospheric nitrogen input, as a driving environmental factor, has changed the rate, direction and flux of nitrogen cycle of forest ecosystems, especially soil nitrogen transformations. Generally, chronic atmospheric nitrogen inputs would result in initial and often large increases in net N mineralization, but in a longer time responses in some of intensive study sites showed actual decreases in net N mineralization from early peak rates. Chronic atmospheric nitrogen addition would also simulate or increase the rates of nitrification and denitrification in forest soil. The magnitude of responses of nitrogen transformations to elevated atmospheric nitrogen deposition usually depends on the nitrogen status of ecosystem.

Hydrologic controls on denitrification in riparian ecosystems. Machefert[1] S.E and **Dise[1,2] N.B**. [1]Department of Earth Sciences, The Open University, Milton Keynes, MK7 6AA, UK, [2] Department of Biology, Villanova University, Villanova, PA 19085, USA

Abstract: Nitrous oxide fluxes and denitrification rates were measured *in situ* over a year at a riparian hillslope draining an agricultural field in the UK. Our study measured denitrification in an intact ecosystem in the field, rather than in cores in the field or the lab. An exponential relationship was found between denitrification rate and soil moisture, with a sharp increase in denitrification rate at a water-filled pore space of 60%. Very similar relationships were found in other studies compiled for comparison, although the amount of nitrogen released varied greatly. We conclude that the exponential relationship between denitrification rate and soil moisture, with a 'threshold' at 60-80% water-filled pore space, is comparable across a wide range of ecosystems, treatments and study conditions. Whereas moisture content determines the *potential* for denitrification, the *absolute* rate of denitrification is determined by available NO_3^-. These studies suggest the potential for estimating denitrification rates by using a single exponential relationship between relative denitrification rate and water-filled pore space multiplied by a constant

determined by the nitrogen status of the site.

Denitrification loss and N_2O emission from nitrogen fertilizer applied to a vegetable field. **Bing CAO [1,2],** Fa-Yun He [1], Xue-Xia JIN [1], Qiu-Ming Xu [2], Bin Yin[1], Gui-Xin CAI [1]. [1]State Key laboratory of Soil and Sustainable Agricultural (Institute of Soil Science, Chinese Academy of Sciences), Nanjing 210008; Graduate School of Chinese Academy of Sciences; [2]Institute of Plant Nutrition and Resources, Beijing Academy of Agricultural and Forestry Sciences, Beijing 100089. China

Abstract: A field experiment was conducted on Chinese cabbage in Nanjing suburb in 2003. It included 4 treatments with a randomized block design and 4 replicates: no chemical N fertilizer (CK); application of urea at a rate of 300 N kg/ha (U300) and 600 N kg/ha (U600), respectively; and application of polymer coated urea at a rate of 180 N kg/ha (PCU180). Pig manure at a rate of 30 ton per hectare, as well as P and K were applied as basal dressing to all the plots. For U300 and U600 2 treatments, urea was applied 3 times including basal application and twice topdressing, and for PCU180 treatment coated urea was applied by once as basal application. Denitrification (N_2 + N_2O) was measured by the acetylene inhibition-intact soil core technique, and N_2O emission was also measured in the absence of acetylene. Results showed that denitrification loss for CK, PCU180, U300 and U600 treatments were 19.8 kg N ha^{-1}, 35.2 kg N ha^{-1} (8.55% of applied N), 40.1 kg N ha^{-1} (6.76% of applied N) and 45.8 kg N ha^{-1} (4.33% of applied N), respectively; and the corresponding figures for N_2O emission were 1.77 kg N ha^{-1}, 4.71 kg N ha^{-1} (1.63% of applied N), 5.03 kg N ha^{-1} (1.09% of applied N) and 11.1 kg N ha^{-1} (1.55% of applied N), respectively. Total denitrification loss from chemical N fertilizer ranged from 4.33 to 8.55 % of applied N, and total N_2O emission from chemical N fertilizer was in the range of 1.09-1.63 % of applied N. Rate of denitrification and N_2O emission trended to decrease from transplanting to harvesting as temperature gradually decreased in the season. Peaks of denitrification and N_2O emission were observed after each N application in the treatments of U300 and U600. In the case of PCU180 treatment unexpected high release rate and shortened release period of polymer coated urea was shown due to high temperature and frequent rainfall in the first half stage of Chinese cabbage growth, which resulted in higher mineral nitrogen content in the soil and subsequently higher rates of denitrification loss and N_2O emission in the stage.

Poster Session 2: N and food production and soil N transformation

Nitrogen status of a saline sodic soil under cultivation of aromatic crops. **R.P. Singh,** R.K. Singh, and R.S. Singh. Department of Soil Science and Agricultural Chemistry, Udai Pratap Autonomous College, Varanasi -221 002 (U.P.), India

Abstract: Nitrogen deficiency is widespread in saline sodic soils of semi-arid and arid regions of India. Aromatic crops are reported to grow successfully in salt affected soils and their beneficial effect on physicochemical properties of soil. Therefore, a field experiment was conducted during the year 2000-2002 to find out the impact of three aromatic crops namely palmarosa (*Cymbopogon martinii*), lemon grass (*Cymbopogon flexuosus*) and citronella java (*Cymbopogon winterianus*) with and without amendments (sludge, hyacinth compost and pyrite) on the status and distribution of nitrogen in a saline sodic soil (pH 8.8, ECe 7.9 dSm^{-1} SAR 35, available N 225

kg ha^{-1}). Experiment was conducted in a randomized block design with four replications. The treatments were T_0 (control -no amendments), T_1 (Pyrite 60% gypsum requirements ha^{-1}),T_2 (sludge 10 t ha^{-1}), T_3 (hyacinth compost 10 t ha^{-1}), T_4 (hyacinth compost 3 t ha^{-1} + pyrite 40% GR ha^{-1}), T_5 (hyacinth compost 3 t ha^{-1} + sludge 5 t ha^{-1}) and T_6 (hyacinth compost 3 t ha^{-1} + sludge 2 t ha^{-1} + pyrite 40% GR ha^{-1}). Rooted slips of palmarosa, lemon grass and citronella java were transplanted with a spacing of 60 cm between rows and 45 cm between plants. Fertilizers were applied 120 kg N, 60 kg P_2O_5 and 60 Kg K_2O ha^{-1}. Organic and inorganic amendments were applied one month before transplanting of crops. Five harvests were taken. Soil samples were collected after each harvesting and analyzed by following standard procedures. Cultivation of aromatic crops alone and in combination with organic and inorganic amendments showed steady increase in available N status as compared to initial level. Maximum increase was recorded with T_6. Among the three crops lemon grass was found superior over palmarosa and citronella java in context of increasing the nitrogen status of soil. In case of lemon grass with T_6 available nitrogen eventually reached 335 kg ha^{-1} from 225 kg ha^{-1}. It was found that in general nitrate- nitrogen in soil at 0 to 15 cm was higher than 15 to 30 cm soil depth. Increased nitrogen status of soil was possible due to addition of organic matter by the residues of aromatic crops and through amendments.

Nitrogen fertilization improves quantity and quality of organic matter in a grassland soil.
S.S. Malhi[1], **Z.H. Wang**[2], C.M. Monreal[3], and J.T. Harapiak[4]. [1]Agriculture and Agri-Food Canada, Melfort, Saskatchewan S0E 1A0, [2]Northwestern Sci-Tec University of Agriculture and Forestry, Yangling, Shanxi 712100, China, [3]Agriculture and Agri-Food Canada, Ottawa, Ontario, [4]Western Co-operative Fertilizers Limited, Calgary, Alberta
Abstract: On cultivated lands, soil, crop and fertilizer management practices, which increase input of C to soil and/or prevent loss of C and N from soil, can build organic C and N in soil. A long-term field experiment on a thin Black Chernozem loam soil at Crossfield, Alberta, Canada was studied to determine the changes in quantity and quality of organic C and N in a grassland (smooth bromegrass - *Bromus inermis* Leyss.) soil receiving surface-broadcast ammonium nitrate at 0, 56, 112, 168, 224 and 336 kg N ha^{-1} in six replications. Data were collected on total organic C (TOC) and N (TN), light fraction organic C (LFOC) and N (LFN), and amino acids C (AAC) and N (AAN) in soil samples (0-5 cm - Layer 1, 5-10 cm - Layer 2 and 10-15 cm - Layer 3) collected in the autumn of 1994 after 27 annual applications, and on dry matter yield in every year. Dry matter yield of hay was increased substantially by application of N, and so did the amount of C removed in hay. Compared to the zero-N control, amount of C removed in hay was increased by 31.71 and 35.22 Mg C ha^{-1}, respectively, at 112 and 224 kg N ha^{-1}. However, mass of C removed for per unit of applied N was decreased from 14.9 to 8.28 kg C kg N^{-1} ha^{-1} yr^{-1} when N rate was increased from 112 to 224 kg N ha^{-1}. Concentration and mass of TOC, LFOC, TN, LFN, AAC and AAN increased with increasing N rate in all soil layers, but the increase due to N fertilization was much more in 0-5 cm layer than in the other soil layers. In 0-15 soil depth, mass of TOC was increased by 11.47 and 19.35 Mg C ha^{-1}, and that of LFOC was increased by 7.17 and 14.10 Mg C ha^{-1}, respectively, at 112 and 224 kg N ha^{-1} compared to the zero-N control. The corresponding increases were 0.95 and 1.92 Mg N ha^{-1} for TN, and 0.37 and 0.87 Mg N ha^{-1} for LFN. In the same order, mass of AAC was increased by 1.42 and 2.48 Mg C ha^{-1}, and that of AAN was increased by 0.44 and 0.76 Mg N ha^{-1}. In summary, the results suggest

that proper fertilizer management on grasslands can store more C and N in soil, while also improving the quality of soil organic matter (i.e., light fraction organic C and N, and amino acids C and N). The implication is that this may lessen the increase in atmospheric CO_2 concentration and release of N_2O from soil to the atmosphere, and at the same time improve nutrient release potential and tilth of soil. This would be beneficial to the environment.

Transport of nitrogen assimilate in xylem vessels of tea plants fed with NH_4^+-N and NO_3^--N.
Xiaoju Wang[1)*], Tadashi Kato[2)], and Fayun Li[3)]. [1)] Center for Environmental Science in Saitama, Saitama 347-0115, Japan, [2)]Society of Agrology and Sustainable Agriculture Movements, NPO, Shizuoka 421-0302, Japan, [3)]Faculty of Environmental Sciences, Liaoning University, Shenyang110036, China.
Abstract: An experiment was carried out to study the transport process of nitrogen assimilates from tea root by monitoring the dynamic composition of nitrogen compounds in xylem sap after ^{15}N-NO_3 and ^{15}N-NH_4 were fed to the root of tea plants (*Camellia sinensis* L.). Results showed that the main amino acids in the xylem sap were glutamine, theanine, arginine, asparic acid, and glutamic acid, which accounted for 49.3, 17.0, 7.8, 6.9, and 3.8%, respectively, of the total amino acids in the xylem sap. After the tea plants were fed with ^{15}N-NO_3 and ^{15}N-NH_4 for 48 hours, significant increase in the amount of total amino acids in xylem sap were found, and that fed with ^{15}N-NH_4 had higher increase values than that fed with ^{15}N-NO_3. After 2 hours of ^{15}N-NO_3 and ^{15}N-NH_4 feeding, ^{15}N abundance in glutamine, asparagine, glutamic acid, alanine, and arginine were detected, and it increased quickly with time going. This indicated that it took about two hours for nitrate and ammonium absorbed by tea roots to synthesize and transport the above amino acids to xylem sap. Rapid increase in ^{15}N abundance of nitrate in the xylem sap of tea plants fed with ^{15}N-NO_3 was found, which indicated that nitrate could be directly transport to the xylem sap. For xylem sap of tea plants fed with both ^{15}N-NO_3 and ^{15}N-NH_4, glutamine and theanine showed much higher ^{15}N abundance than other amino acids, which indicated that glutamine and theanine were the main amino acids transported in xylem sap.

Effects of fractions of lignite humic acid on the activity and stability of urease and seed germination.
Lianhua Dong, Jinshui Yang, **Hongli Yuan***, and Wenxin Chen. Key Laboratory of Agro-Microbial Resource and Application, Ministry of Agrio, College of Biological Science, China Agricultural University, Beijing, 100094, China
Abstract: Abstract: In this paper, we evaluate the effect of different humic acid (HA) fractions with high molecular weight (HMW>50KDa), middle molecular weight (MMW50-10KDa), and low molecular weight (LMW<1KDa), extracted from lignite with 0.1M NaOH on the activity and stability of Jack Bean urease, furthermore the bioactivity on seed germination of each humic acid fraction was also detected. HMW HA stabilised urease activity over a period of 12 days; MMW HA inhibited urease activity faintly at the beginning but lost the action quickly; LMW HA can only stabilise urease activity over a short period of about 4 days. After 12 days of incubation at 25 ℃, the residual urease activity for urease-HMW, ureas-MMW, urease-LMW and urease was 50%, 23%, 25%, and 24% of the initial activity at pH7.0 respectively. These results showed that the three HA fractions influenced both the activity and stability of the urease differently. Elemental analysis demonstrated the contents of C、H、O、N were also different. At the same time, tomato seeds were treated in Petri dishes with the three HA fractions. It showed that germination

parameters such as the number of total germinated seeds, the velocity of seed germination were related to the physicochemical properties of the HA fractions.

Nitrogen nutrition diagnostics for agricultural crops in Lithuania. Zigmas Vaisvila[1], **Jonas Arbacauskas[2]**. [1]Lithuanian University of Agriculture, [2]Lithuanian Institute of Agriculture

Abstract: Using field and laboratory tests under Lithuanian agroclimatic conditions, we have validated the significance of inorganic nitrogen present in the soil by diagnosing the need for the fertiliser for the nutrition of agricultural crops as well as its effects on the environment. The crop yield and the efficacy of nitrogen fertiliser in relation to soil ammonia and nitrate nitrogen content as well as their sum total (inorganic nitrogen) were identified. The parameters of this relationship were also calculated. An investigation was carried out with the aim to determine the need for extra crop fertilisation in relation to the contents of soil nitrogen compounds in the soil and nutrients in plants during the vegetative growth period and their interaction. The major methodological issues in the diagnostics of the nutrition of agricultural crops, namely the most suitable soil nitrogen form for diagnostics and soil sampling timing and depth, have been addressed. The relation between leaching of nitrogen compounds from the soil and the intensity of nitrogen, phosphorus and potassium fertilisation as well as soil mineral nitrogen content was ascertained. Our experimental evidence suggests that the most suitable soil nitrogen forms for diagnosing plant nitrogen nutrition are inorganic (NO_3+NH_4) and nitrate (NO_3) nitrogen. The optimal soil sampling depth for oilseed rape and flax is 0-40 cm, for cereals, potatoes and vegetables it is 0-60 cm, while for sugar beets it is 0-80 cm. According to the findings of the tests carried out in Lithuania, the contents of soil total inorganic and nitrate nitrogen in the same field differ in autumn and in spring. Since Lithuania is characterised by changeable and variable winters and different soil texture, plant nitrogen requirement can be more accurately diagnosed when total inorganic or nitrate nitrogen content is identified in the soil samples taken in spring. After summarising the findings of the tests conducted in Lithuania's agroclimatic conditions, scales for soil nitrogen richness assessment were worked out according to the contents of nitrogen compounds in the soil. Based on these scales, nitrogen fertiliser rates for various agricultural crops were adjusted. The obtained results contribute to a more economical use of fertilisers, production of good and high-quality yield and reduction of environmental pollution with nitrogen compounds.

S**tudies on nitrogen efficiency of common bean germplasm resources in low nitrogen level.** Zhiwei Qin, Tianzhu He, **Hongyu Liu,** and Xiuyan Zhou. Department of Horticulture, Northeast Agricultural University, Harbin China 150030

Abstract: In order to determine nitrogen efficiency of common bean under low nitrogen level, the experimental materials were planted in plastic pots. Through studying the differences of bean germplasm resources nitrogen efficiency, we tried to screen valuable bean germplasm resources of good botanical characters under low nitrogen level. Under low nitrogen level, the twenty-nine common beans were divided into four groups by six criterions, which were nitrogen accumulation, biology yield, pods yield, biology yield of one nitrogen unit, pods yield of one nitrogen unit, and average nitrogen accumulation per day. Under low nitrogen level, the multi-characters of four groups were best, better, good and ordinary, respectively. Some botanical characters on nitrogen efficiency were investigated at seedling stage, florescence, pod stage, and harvest stage. These botanical characters were root length, root volume, root dry weight, fresh and dry weight of root

nodule, dry weight of leaf, biology yield and pod yield. And then relationships of these botanical characters and nitrogen efficiency were analyzed, the results were as following. The significant positive correlations were found between root volume of florescence and nitrogen accumulation of pod stage, between root volume of pod stage and nitrogen accumulation harvest stage. The correlation index was positively significant between root dry weight and nitrogen accumulation at florescence. The dry weight and fresh weight of root nodule were correlated with average nitrogen accumulation per day and nitrogen accumulation of harvest stage. By integrated investigations and analysis four bean germplasm resources that had good botanical characters under low nitrogen level were selected.

Effects of long-term fertilization on dynamics and forms of Nitrogen in Heilu soil in loess plateau. Shuying Liu [2], **Ping Wang [1,2]**. [1]The Key Laboratory of Arid and Grassland Agroecology, Lanzhou University, Ministry of Education, Lanzhou, 730000, China, [2]College of Resource and Environment, Gansu Agricultural University, Lanzhou, 730070, China

Abstract: A long-term (24 years) field experiment was conducted to study the dynamics and forms of Nitrogen in Heilu soil in loess plateau. The results are as follows:(1) Different treatments have great effects on soil total N and the N dynamics. The soil total N with no fertilizer treatment largely decreased (It decreased by 0.17g/kg).When only N fertilizer was applied ,The soil total N slightly decreased, butcombined application of N fertilizer with P fertilizer increased slightly the soil total N (It increased by 0.06g/kg).when organic manure was applied for long time, it gave rise to the larger increase of soil total N ,especially the application of manure with inorganic chemical fertilizer .(the increase extent with manure,green manure mixed with NP, manure mixed with NP treatments respectively are 0.11g/kg,0.24g/kg,0.26g/kg).(2) The effects of the N profile distribution that long-term fertilization have were greatly different. There was little effect on dynamics of soil total N in the depths of 0-100cm profile with CK treatment.we also found there was larger effect on the dynamics of soil total N with N Treatment, but tiny effect in the depths of 20-100cm with N treatment. Furthermore, there was obvious effect on the soil total N with NP treatment. In addition, any application of organic manure increased soil total N in the depths of 0-100cm profile, especially in the depths of 0-40cm profile.(3) The results also showed ,long-term fertilization have different effects on the N forms.Any fertilization treatment could increase the proportion of soil organic N to soil total N ,and of all treatments ,N and NP treatments have little effects while combined manure and organic manure trearments with NP chemical fertilizer treatment have larger effects.

The research of the effects of long-term fertilization on the distribution characteristic of available N, P and K in the Calcic Kastanozems profile. **Ping Wang [1,2],** Fengmin Li[1], Shuying Liu[1] , and Shengmao Yang[1, 3], [1]The Key Laboratory of Arid and Grassland Agroecology, Lanzhou University, Ministry of Education, Lanzhou, 730000, China, [2]Institute of Resources and Environmental Sciences , Gansu Agricultural University Lanzhou, 730070 China, [3]Institute of Soil and fertilizer, Gansu Academy of Agricultural Sciences, Lanzhou 730070, China

Abstract: The profile distribution of available N, P, K and electric conductivity in the Calcic Kastanozems with a 25-year affected fertilization experiment were studied. The result showed that the affected depth of available N, K and electric conductivity was 60cm in all fertilization treatments . As for available P , the depth affected was only 40cm in all treatments except that

of Manure+N+P, which was 60cm.Comparing with CK available N increased in all treatments , with the highest increasing degree 73% in Manure+N+P treatment , and the least 20% in N treatment; except for N treatment , in which the content of available P increased significantly in all fertilization treatments from 0cm to 20cm, among them Manure+N+P had the highest increasing degree, with 13 times as that of CK; The content of available K increased in the treatments which the organic fertilizer was applied, of which Manure and Manure+N+P had the highest , with 1.2times as that of CK, and it is decreased 8% in N and NP treatments. The research also discover that the conductivity has positive liner correlation with available nutrients, which can be a comprehensive index to measure the fertility of the soil.

Nitrogen economy in rice through soil amendment with waste organic residues under irrigated and rainfed situations. **Pradeep K Sharma.** Chief Scientist (Water Management), Department of Soil Science, CSK Himachal Pradesh Agricultural University, Palampur – 176 062 (HP), India

Abstract: A field experiment was initiated in 1999 wet season (ws) in a silty clay soil (acid Alfisol) to investigate the effects of lantana (*Lantana* spp.) biomass on soil properties and productivity of rice-wheat cropping system. One of the objectives was to investigate N economy in rice under irrigated and rainfed situations. At the end of five annual additions of lantana (and five rice-wheat cropping cycles), soil organic carbon (OC) increased from 1.08 to 1.32 %, available N increased from about 314 to 360 kg ha^{-1}, Olsen's P increased from 28 to 35 kg ha^{-1} and exchangeable K increased from 121 to 160 kg ha^{-1}. Averaged over lantana and N treatments, irrigated rice yielded about 16 % higher than rainfed rice (2.98 Mg ha^{-1}). Apparent N use efficiency (NUE) was about 17 % higher under irrigated than under rainfed conditions. Water use efficiency (WUE) was higher under rainfed than irrigated conditions. Thus, soil incorporation of lantana improved soil nutrient status, rice yields, and N and water-use efficiencies under both rainfed and irrigated conditions. Hill and mountain ecosystems are endowed with several plant species that have few alternate uses as fodder and fuel, and can serve as potential organic sources for improving soil and crop productivity as well as check the pollution of natural resources like water.

Study of characteristics on nitrogen mineralization in organic matters. Chul-Hyun Yoo*, **Chang-Hyu Yang** and Jae-Duck Kim. Honam Agriculture Research Institute, NICS, Iksan, 570-080

Abstract: This study was carried out to measure the rate of N mineralization in silt loam, sandy loam and loam treated some organic matters such as CoMSC(Cow Manure Sawdust Compost), ChMSC(Chicken Manure Sawdust Compost), PMSC(Pig Manure Sawdust Compost), PMRHC(Pig Manure Rice Hulls Compost), PRHC(Popped Rice Hulls Compost) and RM(Rapeseed Meal) under flooded incubation by 20, 25, 30℃. The amount of total nitrogen on the applied organic matters was greater in order of CoMSC＞ChMSC＞PMSC＞PMRHC＞PRHC and C/N ratios of those was greater in order of RM＞PMRHC＞PRHC＞CoMSC＞PMSC＞ChMSC. NH_4-N release of applicated organic matters was varied according to soil texture and incubation temperature. In CoMSC was found, silt loam difference amount of NH_4 released, in sandy loam occurred mineralization and organic immobilization, and in loam occurred not much between various temperature. NH_4-N release increased dependent on soil texture in PMSC at the early stage of flooding incubation. It was the greatest in silt loam with ChMSC. Release of NH_4 in

PMRHC decreased because of increased mineralization and organic immobilization. In RM was this in silt loam increased to 70 days after flooding incubation and after that increased and at 30℃ increased mineralization and organic immobilization. In PMRHC was not release of NH_4 under the influence of soil texture. Nitrogen mineralization of applied organic matters varied according to from soil texture which was greater on silty loam in order of CoMSC＞PMRHC＞ChMSC＞PMSC＞PRHC＞RM and on sandy loam in order of CoMSC＞PMRHC＞PMSC＞ChMSC＞PRHC＞RM and on loam in order of PRHC＞CoMSC＞ChMSC＞PMSC＞RM.

Nitrogen dynamics and ^{15}N natural abundance study in alpine ecosystems of the Northern Caucasus. **M.I. Makarov**[1], T.I. Malysheva[1], B. Glaser[2], and W. Zech[2]. [1]Department of Soil Science, Moscow State University, 119992 Moscow, Russian Federation, [2]Institute of Soil Science and Soil Geography, University of Bayreuth, 95440 Bayreuth, Germany

Abstract: Alpine ecosystems are characterized by a stressful climate with low temperatures and a short vegetation season. These conditions restrict microbial activity leading to slow mineralization of organic compounds and, thus, to low nutrient availability. Nitrogen (N) availability is a major factor regulating primary plant production and composition of alpine plant communities. Therefore, knowledge of N transformation and plant N uptake in highly N limited and fragile mountain ecosystems is important because theirs stability and sustainability rely on N cycling to a considerable extent.

Alpine ecosystems are structurally and functionally diverse. Plant communities vary with differences in topography across landscapes. In conditions of N limitation, plant species of different communities and coexisting species within community may use different soil N sources for N supply. However, to interpret $\delta^{15}N$ results and to assess the contributions from different N sources to plant nutrition if based on $\delta^{15}N$ data alone is quite complex, because of the high complexity of the N cycle in ecosystems and the complex factors affecting the $^{15}N/^{14}N$ ratio in plants. Therefore, we obtained non-isotopic data of N transformation in natural and N applied alpine ecosystems of the northern Caucasus (e.g. net N mineralization, net nitrification, inorganic and organic N leaching, effect of separate plant species on soil NH_4^+ and NO_3^- concentrations) and compared these results with $\delta^{15}N$ of total soil N, dominant plant species N and small dynamic soil N pools (e.g. NH_4^+, NO_3^-, labile N_{org}).

Fractionation of N isotopes was pronounced in the alpine soils and plant species. $\delta^{15}N$ of the total soil N pool varied from 3.2 to 5.0 between communities, while foliar $\delta^{15}N$ of the dominant plant species varied widely within community (variations were from 1.7‰ to 4.5‰ within individual communities and up to 5.4‰ within all species studied). Higher foliar $\delta^{15}N$ was observed for species of plant communities with higher soil $\delta^{15}N$. A positive correlation was found between soil $\delta^{15}N$ and field-determined net N mineralization and nitrification as well as between soil $\delta^{15}N$ and potential N mineralization rates, while no correlation with potential nitrification was found.

Carbon - Nitrogen interactions in forest ecosystems: constraints on soil C-sequestration and N-retention. **Per GUNDERSEN**[1], Bjørn BERG BITÖK[2], William S. CURRIE[3], and B. DISE[4]. [1]Forest & Landscape Denmark, Hoersholm Kongevej 11, DK-2970 Hoersholm, Denmark, [2]Bayreuth University, D-95440 Bayreuth, Germany, [3]University ofMichigan, Ann Arbor, MI, USA), [4]Open University, Milton Keynes MK7 6AA, UK

Abstract: In terrestrial ecosystems the largest pools of carbon (C) and nitrogen (N) are bound in

soil organic matter. The fate of deposition N in forests is to large extent regulated by C availability in this soil pool. Then again C sequestration in plants and soil may be stimulated by N deposition. This interdependence of the C and N cycles is the basis for the project 'Carbon – Nitrogen inTERactions in forest ecosystems' (CNTER).

In CNTER we have use several relative simple methods to estimate the current *soil C-sequestration* in Europe. The estimates we calculate are maximum soil C sequestration estimates and the mean for Europe is c. 200 kg C/ha/yr. The spatial pattern over Europe show the highest values in Central Europe with a decline towards the north and the south. These maximum C sequestration estimates are much lower than some other estimates in the literature.

We have explored databases on N cycling in European forests for controlling factors for *soil N retention and N leaching*. The best predictor of N leaching is N deposition but also forest floor C/N ratio, temperature and other parameters are significantly influencing N leaching.

The fate of N deposition has been further studied in long-term nitrogen addition and labelling (^{15}N) experiments (European NITREX and similar experiments in N. America). We use the results from the distribution of the ^{15}N label in a model called TRACE to gain new insights in C and N interactions in forests. When this model is calibrated to a site, we can calculate the C sequestration associated with the accumulation of N input (per kg N/ha/yr). In the paper we compare these model calculation for specific site with the more simple C sequestration estimates, we discuss the different approaches to estimate soil C sequestration and how to assess the impact of N deposition on soil C sequestration.

Nitrogen retention and release in European forest ecosystems. **Nancy Dise[1]**, Caroline van der Salm, Ulrika Rosengren, Martin Forsius, Bridget Emmett, Janet Mol, Filip Moldan, Per Gundersen, and Albert Tietema. Department of Earth Science, The Open University, Milton Keynes, MK76AA, United Kingdom.

Abstract: This paper is a synthesis of research by the C-NTER consortium on controls on nitrogen retention and release from European forests. Three approaches are used: 1. correlative analysis of data from forested plots and catchments across Europe from two major databases (continent-scale spatial dynamics), 2. synthesis of 8 different long-term N-addition or N-removal experiments from forests across Europe (temporal dynamics), and 3. analysis of regional datasets from the Netherlands, Denmark, Sweden, and Wales (local dynamics). We describe how linking these approaches together gives better insights into the nature, timing, and rate of ecosystem change to N deposition than considering any one approach individually.

These different studies show that the nitrogen dynamics of forested ecosystems in Europe are broadly determined by (1) the rate of N input and (2) the nitrogen status of the site (as characterised by the forest floor C:N), and that these two factors are only partially related. Secondary, local controlling factors include stand age, annual temperature, soil pH, and proportion of NH_4^+ in deposition. Different ecosystem components respond to increased N deposition at different rates: needles/leaves react quickly and reversibly; runoff/seepage water reacts quickly but takes many years to reach an expected quasi-steady state; soil reacts slowly. These results suggest a general confirmation but modification of the Aber model of nitrogen saturation.

Comparison of soil residual nitrogen using the Canadian agricultural nitrogen budget model and the OECD-N model. **Jingyi Yang[1]**, Craig Drury[2], Ted Huffman[1] Reinder De Jong[1], Ying

Liu[1], and Fulin Chen[1]. [1]Eastern Cereal and Oilseed Research Center, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, ON Canada K1A 0C6, [2]Greenhouse & Processing Crops Research Centre, Agriculture and Agri-Food Canada, 2585 County Rd 20, Harrow ON N0R 1G0

Abstract: In 2001, a National Agri-Environmental Health Analysis and Reporting Program (NAHARP) was established within Agriculture and Agri-Food Canada to encompass three areas of work: i)development of national agri-environmental indicators, ii) integration of economic modelling with environmental forecasting and iii) economic valuation of farm management practices. Two N indicators: (i) Residual Soil Nitrogen (RSN) and (ii) Indicator of Risk of Water Contamination from Nitrogen (IROWCN) address nitrogen in the soil profile in excess of crop requirements and its linkage to climatic conditions, respectively. A Canadian Agricultural Nitrogen Budget (CANB) model is under development to calculate both RSN and IROWCN. The Organisation for Economic Co-operation and Development (OECD) has also developed Environmental Indicators for Agriculture, including RSN and NO_3-N loading to surface- and ground water. This paper compares the output from the CANB model with results from calculations based on the OECD N balance methodology. It was found that between 1985 and 1996 estimated RSN values using the OECD model were, on average, 5 kg N lower than those estimated by the CANB model, but this difference does not exist after the year 2000. Further analysis indicates that the difference can be attributed to: 1) the use of different databases, 2) the use of different nitrogen budgets (e.g. the OECD N balance includes atmospheric deposition of N, while the CANB model does not) and 3) the use of different N coefficients for N uptake by crops and N fertilizer application rates. This paper describes the current models and outlines future enhancements of the models to ensure that they share, as much as possible, the same database resources and nitrogen coefficients.

Study of characteristics on nitrogen mineralization in organic matters. **Chul-Hyun Yoo**, Chang-Hyu Yang, and Jae-Duck Kim. Honam Agriculture Research Institute, NICS, Iksan, 570-080

Abstract: This study was carried out to measure the rate of N mineralization in silt loam, sandy loam and loam treated some organic matters such as CoMSC(Cow Manure Sawdust Compost), ChMSC(Chicken Manure Sawdust Compost), PMSC(Pig Manure Sawdust Compost), PMRHC(Pig Manure Rice Hulls Compost), PRHC(Popped Rice Hulls Compost) and RM(Rapeseed Meal) under flooded incubation by 20, 25, 30℃. The amount of total nitrogen on the applied organic matters was greater in order of CoMSC＞ChMSC＞PMSC＞PMRHC＞PRHC and C/N ratios of those was greater in order of RM＞PMRHC＞PRHC＞CoMSC＞PMSC＞ChMSC. NH_4-N release of applicated organic matters was varied according to soil texture and incubation temperature. In CoMSC was found, silt loam difference amount of NH_4 released, in sandy loam occurred mineralization and organic immobilization, and in loam occurred not much between various temperature. NH_4-N release increased dependent on soil texture in PMSC at the early stage of flooding incubation. It was the greatest in silt loam with ChMSC. Release of NH_4 in PMRHC decreased because of increased mineralization and organic immobilization. In RM was this in silt loam increased to 70 days after flooding incubation and after that increased and at 30℃ increased mineralization and organic immobilization. In PMRHC was not release of NH_4 under the influence of soil texture. Nitrogen mineralization of applied organic matters varied according to from soil texture which was greater on silty loam in order of CoMSC＞PMRHC＞ChMSC＞

PMSC＞PRHC＞RM and on sandy loam in order of CoMSC＞PMRHC＞PMSC＞ChMSC＞PRHC＞RM and on loam in order of PRHC＞CoMSC＞ChMSC＞PMSC＞RM.

Can Nitrification be Inhibited/Regulated Biologically? New Approaches to Develop Germplasm to Minimize Nitrogen Losses in Crop-livestock Systems. **G.V. Subbarao[1*],** O. Ito[1], Huoyan Wang[1,2], K. Nakahara[1], T. Ishikawa[1], K. Suenaga[1], H. Samejima[1], Marco Rondon[3], I.M. Rao[3], and M. Ishitan[3]. [1]Japan International Research Center for Agricultural Sciences (JIRCAS), 1-1 Ohwashi 1-1, Tsukuba, Ibaraki 305-8686, Japan, [2]Institute of Soil Science, Nanjing, 210008, China, [3]Centro International de Agricultura Tropicale (CIAT), Cali, Colombia

Abstract: Nitrification by soil nitrifiers is a widespread phenomenon, where NH_4-N is converted into NO_3-N, results in substantial losses of applied N through NO_3^- leaching, and gaseous emissions (N_2O, NO and N_2). A major portion of the fertilizer-N (which is usually in NH_4^+ form) is rapidly converted into NO_3^- by two groups of soil bacteria, *Nitrosomonas* and *Nitrobacter*. Nitrification thus is the main cause of poor N recovery in most agricultural systems where 70% of the fertilizer-N is not utilized by the crops. The economic value of this wasted N fertilizer worldwide is estimated as US$16.4 billion annually from cereal production systems alone. Our research addresses nitrification inhibition (NI) in soil as an important biological mechanism/attribute to keep soil-N in NH_4^+ form. This unique phenomenon was discovered in a tropical pasture grass, *Brachiaria humidicola*. Inhibitory compound/s released from roots of *B. humidicola* suppressed the functioning of *Nitrosomonas*, thus inhibiting nitrification. A bioassay that uses a recombinant construct of *Nitrosomonas* to detect and quantify this inhibitory effect from root exudates (NI activity) is developed and calibrated. Substantial NI activity was detected in the root exudates of *B. humidicola*, but not with soybean where root exudates have stimulated nitrification. The inhibitory effect from *B. humidicola* root exudates on soil nitrification was more stable and effective than the most commonly used synthetic nitrification inhibitor, ©Nitrapyrin. Root exudates of this tropical grass specifically blocked the AMO (aminomonooxygenase) enzymatic pathway in *Nitrosomonas* bacteria, thus making the nitrifier dysfunctional. The bioassay that is developed to quantify the NI activity from roots can serve as a powerful tool in evaluating field crops and pastures for their ability to inhibit nitrification in soil From a genetic improvement perspective, this powerful bioassay can open the way for evaluation of germplasm for selecting high NI activity genetic stocks initially for *B.humidicola*, other tropical pastures, and subsequently in field crops. A research strategy is presented to exploit this biological trait/attribute genetically for the development of crops/pastures that can self-regulate nitrification process in soils, thus minimizing nitrification associated N losses from crop-livestock systems.

The Sino-German research training group “Sustainable Resource Use in North China”. **Diana Ebersberger[1]**, Reiner Doluschitz[1], Zhang Junling[2], and Zhang Fususo[2]. [1]University of Hohenheim (769), 70593 Stuttgart, Germany, [2]College of Agricultural Resources and Environmental Sciences, China Agricultural University, Beijing 100094, China

Abstract: The International Research Training Group “Modeling Material Flows and Production Systems for Sustainable Resource Use in Intensified Crop Production in the North China Plain” was established by the German Research Foundation (DFG) and the Chinese Ministry of

Education at University of Hohenheim (Stuttgart) and Chinese Agricultural University (Beijing) in June 2004. Agricultural food production in the North China Plain (high level production intensities, crop rotations and yields) raises - as in other intensive agricultural systems - serious environmental problems like water availability and pollution, air pollution, soil contamination and erosion. Sustainability, defined in the context of this project as production practises and systems which are environmentally sound and economically and socially viable, has been no important issue within agricultural development. Corresponding cropping systems and management practices would aim at high product quality standards and have an intergenerational time horizon.

At present, there is a significant research deficit in clearly identifying, measuring and modeling the related material flow effects. In addition, their interactions have to be explained by suitable integrated multi level modelling approaches. Strategies to reduce or avoid negative effects have to be developed, analyzed and assessed on field, farm and regional level in order to derive suitable agro-environmental policy measures.

The research program is focussed on these topics. The major hypothesis is that adjustments in cropping systems and management practices provide potential for sustainable resource protection on a high yield level. 11 subprojects with origins from different disciplines (soil sciences, plant nutrition, ecology, physics, crop production, plant breeding, agricultural economics, agricultural informatics and rural development policy) work jointly in the field. Material flow analyses and research on cropping systems will be carried out on a central experiment field. Results gained from plots will be regionalized to provide potential for aggregated assessment measures.

In all subprojects modeling approaches on different levels and scales are used which enable linkages between levels and projects. Modeling approaches are also the major topic in the accompanying study program for PhD students.

Nutrient release properties of controlled-release fertilizers and their contribution to soil nitrogen. **Xiaoli Wang** [1], Jianbin Zhou [1], Jinshui Wu [1,2], Xianfeng Zheng [1], and Shengxiu Li [1]. [1]Faculty of Resource and Environmental Sciences, Northwest Sci-Tech University of Agriculture and Forestry, Yangling Shaanxi, 712100; [2]Institute of Subtropical Agriculture, Chinese Academy Sciences, Changsha Hunan, 410125

Abstract: Seven-day dissolution method was used to evaluate the nutrient release properties of conventional urea and seven controlled release fertilizers, CRFs, and soil incubation experiment designed with the {3, 3} simplex centroid design method was adopted to evaluate the dynamic changes of nitrogen in soil in different combinations of urea and two kinds of polymer-coated ureas, D90 and D60. The initial solubility of seven CRFs was less than 12.0%, and differential solubility ranged from 0.26% to 2.49%. During the soil incubation, the NH_4^+-N in soils of all treatments decreased; while NO_3^--N and mineral N in these soils increased. The contents of NH_4^+-N, NO_3^--N and mineral N in soil were highest when only conventional urea were added, and lowest when only D90 and D60 or their combination were added; they were in the middle of the above two groups in treatments combined conventional urea with CRFs. The NH_4^+-N in soils derived from different sources during the incubation; in the early 20 days incubation the NH_4^+-N mainly came from the conventional urea; and during the 30 to 50 days incubation more portion of NO_3^--N from D60 fertilizer; and the conventional urea had more important effects on the NO_3^--N and mineral N in soil during the whole incubation. As the proportion of conventional urea in the combinations of different fertilizers was decreased, the contents of NH_4^+-N, NO_3^--N and mineral

N in soils also became lower. It is concluded that the mixture design is a useful method in developing the new kind of CRFs and for their rational application.

Potential impact of global warming on forage yield in South-Central Alberta. **S.S. Malhi[1],** J.T. Harapiak[2], N.A. Flore[2], and Z.H. Wang[1]**.** [1]Agriculture and Agri-Food Canada, Research Farm, P.O. Box 1240, Melfort, Saskatchewan S0E 1A0. [2]Western Co-operative Fertilizers Limited, P.O. Box 2500, Calgary, Alberta T2P 2N1

Abstract: The objective was to summarize information for a long-term bromegrass (*Bromus inermis* Leyss) experiment to determine the relationship of forage yield to precipitation and temperature during growing season. Total precipitation and mean maximum daily temperature for May, June and July fluctuated in the range of 142.2 mm and 3.4˚C from 1968 to 1990. The dry matter yields during this period ranged from 0.54 to 2.80 Mg ha^{-1} in the zero-N treatment, and from 2.93 to 10.06 Mg ha^{-1} with application of 112 kg N ha^{-1}. The regression analysis of data indicated that dry matter yield increased with increase in precipitation, and decreased with rise in temperature. Application of N intensified response of DMY to the changes in precipitation and temperature during the growing season. By implication, if temperatures were increased by only a few degrees, which may occur through global warming effect, without a corresponding increase in precipitation, there would be a marked reduction in forage production in south-central Alberta and similar areas elsewhere.

Influence of long-term application of N and S fertilizers (1980-2002) and liming in 1992 on dry matter yield of grass and soil properties in a dark gray Chernozem in North-Central Saskatchewan. **S. S. Malhi[1]**, M. Nyborg[2], E. Solberg[3], J. DeMulder[3], Z. Zhang[3], Z. H. Wang[1], and D. Leach[1]. [1]Agriculture and Agri-Food Canada, Research Farm, P.O. Box 1240, Melfort, Saskatchewan, Canada S0E 1A0 , [2]Department of Renewable Resources, University of Alberta, Edmonton, Alberta, Canada T6G 2E3, [3]Alberta Agriculture, food and Rural Development, Crop Diversification Centre North, R.R. 6, 17507 Fort Road, Edmonton, Alberta, Canada T5B 4K3

Abstract: The objective of this study was to determine the effects of long-term N, S and K fertilization (from 1980 to 2001) and liming in 1992 on forage dry matter yield (DMY) and soil properties in a Dark Gray Chernozem in north-central Saskatchewan. Long term experiments with N, S and lime application and forage removal (hay-off) and return (hay-on) showed that application of N or S alone had only a little effect on DMY, although the effect of S was slightly greater than N. But, application of N together with S substantially increased DMY. Decline of soil pH with annual applications of N and S fertilizers mainly happened in the 0-5 cm layer. In layers below 10 cm, soil pH tended to increase with N or NS fertilization, and this probably was due to downward movement of Ca or other bases. Surface application of granular lime increased soil pH mainly in the 0-5 cm layer, and maintained the high pH for at least 9 years. The TOC and TN in the 0-7.5 cm soil layer increased significantly with annual applications of N and S fertilizers, and the increase of was more with application of both N and S together compared to only N fertilizer. In the subsoil layers, the N alone treatment tended to decrease TOC and TN in the 7.5-30 cm layers, but the NS treatment increased TOC and TN in all layers of 15-37.5 cm soil depth. This suggests that application of N alone was not able to increase C and N sequestration in the soil profile as effectively as the application of N and S together. Annual applications of N and S fertilizers markedly increased LFC and LFN in the 0-7.5 cm soil layer, and the increase was

substantially more when N and S fertilizers were applied together than when only N fertilizer was applied. In the subsoil layers, the NS treatment increased LFC and LFN in all layers in 7.5-37.5 cm soil depth. The LFC in the total of the five layers from 0 to 37.5 cm depth indicated that application of N and S fertilizer increased light fraction of C and N sequestrated in soil, and the increase was more with application of N together with S than with N alone. Soil bulk density was substantially lowered (due to increase in organic C in soil) with annual applications of N and S fertilizers in the 0-7.5 cm soil layer. The decrease of soil bulk density was more when N and S fertilizer were applied together compared to N fertilizer alone. In the deeper subsoil layers, there was no effect of N fertilization on soil bulk density.

Traditional manuring techniques in Chinese agriculture and their value for soil fertility and the ecosystem. **Marco Roelcke[1*]**, Yongsong Zhang[2], and Shengxiu Li[3]. [1] Institute of Geoecology, Braunschweig Technical University, Langer Kamp 19c, 38106 Braunschweig, Germany, [2]College of Environmental and Resource Sciences, Zhejiang University, Hangzhou, China. [3]Faculty of Resources and Environmental Sciences, NW Science and Technology University of Agriculture and Forestry, Yangling, Shanxi, China.

Abstract: China has a several thousand-year-old tradition of utilizing organic manures in agriculture. Since the 1980s, however, there has been a steep decline in the recycling of crop residues, the growing of green manures, compost preparation, and complex rotation techniques. High and unbalanced amounts of mineral fertilizers (mainly N) are being applied, while straw is frequently burnt on the field. Two examples of traditional composts are presented.

"Waterlogged compost" (*ou fei, cao tang ni*) was the traditional manure in the Yangtze River area. 60% (fresh weight) canal and river sediments, 20-35% green matter (Chinese Milk Vetch, aquatic plants, grass), 0-15% pig manure, 2-4% straw were filled into a pit of approx. 3-4 m x 2-3.3 m size and 0.5-1 m depth. Total fresh matter (FM) weight was 3-18 t. The pit was covered with a layer of canal mud and water and the materials fermented anaerobically for 20-40 days. Waterlogged compost was used mainly as basal fertilizer for rice. Application rates were 25-60 t (FM) ha^{-1} per crop, about 50-120 t ha^{-1} yr^{-1}. Raw materials and different mature compost samples were analyzed for total and available macronutrients (N, P, K), organic matter and pH.

"Soil manure" (*tu fen*) is a traditional farmyard manure in N- and NW-China consisting of 80-90% soil used as bedding material and 10-20% animal excreta. The manure is stored for several months, during which a part of the organic N is mineralized to nitrate. Application rates are usually between 75 and 120 t (FM) ha^{-1} yr^{-1}, as basal manure to winter wheat. Soil manure samples were analyzed and long-term aerobic incubation experiments carried out with soil and increasing additions of soil manure, to estimate the contribution of organic nitrogen to the mineral N supply.

The multiple benefits of both composts for crop nutrition and soil fertility are highlighted. Drawbacks of traditional manuring techniques, new problems arising from the silting up of canals, and requirements under the present conditions are discussed.

Monsoon effects on the soil N dynamics of a subtropical rain forest ecosystem in Taiwan. **Chun-Chih Tsui** and Zueng-Sang Chen*. Department of Agricultural Chemistry, National Taiwan University, Taipei 10617, Taiwan, China

Abstract: The Nanjenshan Natural Reserve Region, which is located in the Kengting National Park in the south of Taiwan, is a typical subtropical to tropical rain forest ecosystem and the only natural lowland forest in Taiwan. There is strong northeastern monsoon from October to March in

this region. A monsoon effect hypothesis was proposed that it probably affects on the distribution of animal species, vegetation compositions and soil nutrient characteristics, but we still have no sufficient data to support it. The objectives of this study are to estimate the effects of northeastern monsoon on soil available N, net N mineralization rate, and microbial biomass C and N. We made a soil survey on 15×15cm quadrate sampled in 1×1m plots to evaluate the spatial variation of soil inorganic N in the experimental site. In October 2003, we selected three 2×2m plots at Nanjen Lake site kept off the northeastern monsoon with a PVC film, and other three 2×2m plots were selected as the control treatment which affected by monsoon. In each 2m×2m plot, ten PVC cylinder soil cores were installed into the soil to 20 cm depth as field-incubation cores, and two installed cores were removed from the site every one week for one month to calculate the net N mineralization rate and also to evaluate the effects of monsoon on the N dynamics. In-situ incubations of N mineralization are conducted and sampled in October and December in 2003, and February and April in 2004 during the monsoon season. Soil sample within each core was collected to calculate the available inorganic N, microbial biomass C and N, and total soil N. Litterfall in the neighborhood of our sampling plots were also collected for total C and N analysis. Laboratory incubations of N mineralization are also conducted in December, 2003, and February, 2004, to compare the results. The differences between final and initial levels of ammonium-N and nitrate-N were estimated as the net N mineralization rate and net nitrification rate. Data from different incubation months can be used to examine the influences of monsoon on soil N dynamics. Field experiments and laboratory analysis are still in processing, and we will have more data for discussions in the full paper.

Effects of long-Term fertilization on Nitrate-N accumulation and N balance in soil in Gansu Oasis of China. **Shengmao Yang**[1, 2], Fengmin Li[1], Ping Wang[1], Jianguo Wang[2], and Dongrang Suo[3]. [1]The Key Laboratory of Arid and Grassland Agroecology, Lanzhou University, Ministry of Education, Lanzhou, 730000, China, [2]Institute of Soil and fertilizer, Gansu Academy of Agricultural Sciences, Lanzhou 730070, China, [3]Institute of Agricultural Sciences of Zhangye Prefecture, Zhangye 734000, China.

Abstract: A long-term (1982 to 2002) field experiment was conducted at Zhangye, Gansu, China on a calcareous desert soil (sandy clay loam) under wheat (Triticum aestivum L.)-wheat (Triticum aestivum L.)-corn (Zea mays L.) rotation to determine the effects of long-term fertilizers and farmyard manure on grain yield, nitrate-N accumulation and distribution as well as nitrogen budget in the soil profile. Treatments consisted of a split-plot factorial that the main plots were with manure (M) and without manure, sub-plot treatments were CK N, NP, NPK, and re-subplot treatments were two levels of irrigation (R1 vs. R2). After crop harvested in 2002, each plot was soil sampled in 0.3 m increments to a depth of 2.1m for NO3-N determination. The results showed that N fertilizer alone led to NO3-N accumulation significantly（account for 3.9 % of total applied N） in soil with the lowest N apparent recovery（27 %） of all the treatments; Combined applications of N with P and/or K can reduce NO_3-N accumulation in soil profiles and make N apparent efficiency increase to 60-63%; the effect of NPK chemical fertilizers combined with organic manure reduced soil NO3-N accumulation prominently compared with chemical fertilizers alone. Whereas with manure, a rather high NO_3-N mass peak was found in the 1.2-1.5 m soil layer. Irrigation amount have no significantly effect on NO_3-N accumulation and NO_3-N movement under this condition. In conclusion, long-term fertilization can radically improved crop yields in this rotation system, but it is more important is to control chemical fertilizers rate as well as manure amount in order to protect soil and underground water from potential NO_3-N pollution.

Urea fertiliser linked with urease inhibitor a contribution to improve nitrogen use efficiency. **Carola Schuster**, Hans-Jürgen Michel, Hartmut Wozniak, and Hans-Joachim Niclas.

SKW Stickstoffwerke Piesteritz GmbH, Agricultural Application Research, Am Wieseneck 7, 04451 Cunnersdorf, Germany

Abstract: As ammonia is one of the most important gaseous nitrogen emissions from agricultural, reduction strategies had to be realised. Ammonia emissions result from the hydrolysis of urea. The use of urea fertiliser combined with an urease inhibitor to delay the hydrolysis of urea presents an opportunity to decrease ammonia losses associated with fertiliser application. A new candidate substance has been tested. Greenhouse pot trials have been carried out with oat and maize. Field trials with winter wheat and winter barley were located in several experimental stations differing in soil and weather conditions. The new urease inhibitor (UI 1) was evaluated in comparison to urea without inhibitor. The UI 1 was applied in different concentrations to fix up the appropriated inhibitor content. At harvesting the yield and the nitrogen content of grain and straw were quantified. Nitrogen uptake (NU) was calculated from yield of grain and straw and the corresponding nitrogen content. Nitrogen use efficiency (NUE) was calculated based on NU of the plants and the applied fertilizer nitrogen amount (NA) with: NUE = ($NU_{fertilized} - NU_{unfertilized}$) / NA * 100. The results present an indirect indication for reduced NH_3 losses. Only in some pot experiments there was a significant increase of yield where urease inhibitor was used. A significant enhancement in NU was determined in plants fertilized with urea containing urease inhibitor within pot experiments as well as field trials. The NUE was significantly improved by applying urea combined with urease inhibitors in all trials. The results indicate that the use of urea fertilizers containing urease inhibitors is an effective tool in reducing NH_3 emissions and improving NUE. Consequently, use of urea fertilizers may become more environmental friendly as well as more effective in promoting crop growth.

Effects of simulated nitrogen deposition on growth and photosynthesis of *Schima superba, Castanopsis chinensis* and *Cryptocarya concinna* seedlings. LI De-jun, MO Jiang-ming*, FANG Yun-ting，CAI Xi-an, Xue Jing-hua, Xu Guo-liang. (South China Institute of Botany, the Chinese Academy of Sciences, Dinghu, Zhaoqing, Guangdong 526070)

Abstract: To evaluate the responses of subtropical forest trees in China to elevated nitrogen (N) deposition, we sprayed dissolved NH_4NO_3 on seedlings of *Schima superba*, *Castanopsis chinensis* and *Cryptocarya concinna* twice every month. The simulated elevated N depositions were equivalent to 0 (A), 5 (B), 10 (C), 15 (D) and 30 (E) $gN.m^{-2}.a^{-1}$ and began in January, 2003. The results indicated that stem base diameter, height and branch number of seedlings for these three species increased significantly with N loads, whereas they decreased in the high N treatment (E). Medium N treatment enhanced growth significantly, e.g., stem base diameter, height and branch number of all species were highest in C treatment. High N load also had great impact on seedling mortality, e.g., the highest N treatment resulted in the highest mortality in all species. After treatment for 7 month, net photosynthetic rate (Pn) increased in treatments B and C, however decreased in D. Water use efficiency (WUE) of both *S. superba* and *C. chinensis*, and stomatal conductance of *C. chinensis* seedlings seemed to change with N treatment in the same way as Pn. However, the WUE and stomatal conductance of *C. concinna* and stomatal conductance of *S. superba* seedlings were not affected significantly. The chlorophyll and carotenoid content of *S. superba* and *C. concinna* increased with N load. For *C. chinensis* seedling, the content of Chl a and Chl (a+b) was highest in B treatment, and then seemed to decrease in the higher treatments, however, the content of carotenoid increased load up to the highest N load.

Effects of simulated nitrogen deposition on biomass production and its allocation of seedlings for *Schima superba* and *Cryptocarya concinna* in subtropical China. LI De-Jun, MO Jiang-Ming*, FANG Yun-Ting. (Dinghushan Forest Ecosystem Research Station, South China Botanical Garden, the Chinese Academy of Sciences, Dinghu, Zhaoqing, Guangdong 526070)

Abstract: To clarify the effects of elevated nitrogen deposition on subtropical tree seedlings, a

simulated study was carried out, in which we sprayed dissolved NH_4NO_3 to seedlings twice every month ever since January of 2003, equivalent to 0 (A), 5 (B), 10 (C), 15 (D) and 30 (E) $gN.m^{-2}.a^{-1}$. In this paper, we reported the responses of biomass production and its allocation of seedlings for *Schima superba* and *Cryptocarya concinna* to simulated nitrogen deposition during a period of eleven months. Results indicated that after eleven months of treatment, the stem base diameter, height, whole-plant biomass and relative growth rate of *C. concinna* seedlings grown on B, C and D plots were all higher than those on the A plots (control), however, the stem base diameter, height, whole-plant biomass and relative growth rate of treated *S. superba* seedlings were, except those on C plot, lower than those on the control plots. The leaf-weight ratio of seedlings of the two species on E plots was the lowest, implying the high N deposition was harmful to the foliage. The branch-and-stem weight ratio of seedlings of both species on E plots was the highest, indicating the biomass allocated to branches and stems was the highest under highest N deposition. The root-weight ratio and the root to shoot ratio of the control plot were highest, indicating nitrogen deposition decreased the ratio of biomass allocated to roots. In a whole, except the highest N treatment, nitrogen load still enhanced the growth of *C. concinna*, but not that of *S. superba*, which tended to be negatively affected by nitrogen load after such a long period, indicating that the *C. concinna* seedlings were more resistant to high nitrogen load.

Nutritional responses of *Schima superba* and *Cryptocarya concinna* seedlings to simulated nitrogen deposition in subtropical China. LI De-Jun, MO Jiang-Ming*, Peng Shao-Lin, FANG Yun-Ting. (Dinghushan Forest Ecosystem Research Station, South China Botanical Garden, the Chinese Academy of Sciences, Dinghu, Zhaoqing, Guangdong 526070)

Abstract: Effects of nitrogen deposition on forest ecosystems and plants are increasingly concerned worldwide, as nitrogen deposition has become an important aspect of global changes. To clarify the effects of elevated nitrogen deposition on subtropical tree seedlings, a simulated study was carried out, in which we sprayed dissolved NH_4NO_3 to seedlings twice every month began in January of 2003, equivalent to 0 (CK-control), 5 (T_5), 10 (T_{10}), 15 (T_{15}) and 30 (T_{30}) $gN.m^{-2}.a^{-1}$. In this paper, we report the nutritional responses of seedlings of *Schima superba* and *Cryptocarya concinna*, which are all predominant in subtropical forests in South China, to simulated nitrogen deposition during a period of eleven months. Soil nitrogen availability increased greatly with increasing nitrogen addition levels. Soil pH values, however, decreased with increasing nitrogen addition levels. Nitrogen addition significantly increased the nitrogen contents in leaves, shoots (including branches and stems) and roots, but decreased the contents of P, K, Ca and Mg in leaves, shoots and roots. Nitrogen storage per seedling of *Schima superba* in all plots except for T_5 plots was higher than that in CK plots, with the highest in T_{10} plots. Nitrogen storage per seedling of *Cryptocarya concinna* increased with increasing nitrogen addition levels from CK to T_{15}, followed by a decline in the rest treated level. Nitrogen treatment also caused decreases of N / other elements ratios for seedlings.

Impact of Nitrogen Deposition on Forest Plants. LI De-jun, MO Jiang-ming*, FANG Yun-ting, PENG Shao-lin, Per Gundersen[2]. (1 South China Institute of Botany, Chinese Academy of Sciences, Dinghu,Zhaoqing, Guangdong 526070; 2 Danish Forest and Landscape Research Institute, Hoersholm Kongevej 11, DK-2970 Hoersholm, Denmark)

Abstract: Human activities such as combustion of fossil fuels, intensive agriculture and stockbreeding, have significantly altered the global nitrogen cycle in the last several decades, increasing the concentrations of nitrogenous compounds in the atmosphere and rising the consequent N deposition to the global surface by several folds.

As N is usually a limiting nutrient in most terrestrial ecosystems, additional N inputs to forest ecosystems may influence the growth, functioning and dynamics of those receiving forests. Based on available scientific evidence, we reviewed the impacts of N deposition on forest plants. The potential impacts were related to the following six aspects:

1) N deposition to some degree promotes photosynthetic rate, which is significantly correlated with leaf N concentration, as N deposition increases the leaf N concentration. However, when N deposition exceeds the nutritional demands of plants, it would reduce net photosynthesis by decreasing the concentrations of chlorophyll and Rubisco and activity of Rubisco in the leaves.
2) As N deposition increases the availability of N in soils, it would increase the productivity of

plants at least in the short term. However, excess N inputs would lead to a reduction of productivity of plants.

3) Excess N deposition lead to an increasing leaching loss of cations as counterbalancing ions of leached nitrate, resulting in reduced amounts of exchangeable cations in forest soil. . Moreover, soil acidification promoted by N deposition increases the mobilization of toxic Al^{3+}. These combined with disproportionately high N concentration in soil lead to nutritional imbalance in plants.
4) N deposition is likely to cause a morphological change of plants, especially on the shoot/root ratios, because N deposition tends to promote growth of aboveground plants and inhibit root growth.
5) The susceptibility of plants to secondary stress factors such as frost, drought and fungal pathogens or insect pests, is increased by high N loading.
6) N deposition changes species composition and decrease plant diversity in forest ecosystems.

Ecophysiological Responses of Woody Plants to Elevated Nitrogen Deposition. LI De-jun, MO Jiang-ming*, FANG Yun-ting, Jiang Yuan-qing. (South China Institute of Botany, the Chinese Academy of Sciences, Dinghu,Zhaoqing, Guangdong 526070).

Abstract: During the past several decades, nitrogen deposition has brought series of environmental and ecological problems and is arising globally. In this paper, we reviewed the ecophysiological responses of woody plants to elevated nitrogen deposition in the following four aspects: 1) elevated nitrogen deposition altered nitrogen metabolism of plant by increasing tissue nitrogen concentration; 2) nitrogen deposition influenced photosynthesis and associated nitrogen-comprised constituents, and increased photosynthetic rate, photosynthetic pigments and Rubisco concentrations in some degree; 3) elevated nitrogen deposition increased plant respiration; 4) elevated nitrogen deposition increased the susceptibility to hardiness such as cold, insects and pathogens.

Effects of Nitrogen Deposition on Ectomycorrhizal fungi. XUE Jing-hua, MO Jiang-ming*, LI Jiong, FANG Yun-ting, LI De-jun. (South China Institute of Botany, Chinese Academy of Sciences, Dinghu, Zhaoqing, Guangdong 526070).

Abstract: As a result of increasing anthropogenic nitrogen deposition, N availability in many forest ecosystems, which are normally N-limited, has been enhanced. Increased N availability may impact the Ectomycorrhizal fungi (EMF) that are generally regarded as an adaptation to nutrient limited conditions. Based on available scientific knowledge the effects of nitrogen deposition on ectomycorrhizal fungi, including the formation of EMF, the change of extraradical mycelium and mycorrhizal, the productivity of the fruiting bodies and EMF structure are reviewed in this paper. It is recovered that increasing nitrogen deposition (1) affects the nutrient allocation and cycle between EMF and autoecious trees; (2) would lead to a reduction of the productivity of fruit body, the production of the extraradical mycelium in soil, the ectomycorrhizal fungal sporocarp abundance, and the numbers and the productivity of mycorrhizal; (3) would change structure and the function of the ectomycorrhizal fungal community. The future research on the effects of N deposition on ectomycorrhizal fungi are also discussed in this paper.

N emission and N_2-fixation activity under chitin microbial transformation in chestnut and sodic soils of Kazakhstan. Manucharova N.A., Belova E.V, Sazonov S.N., and Stepanov A.L. Moscow State University, Dep.of Soil Sciences, Moscow 119992

Abstract: The purpose of our work was studying nitrous oxide emission and nitrogen fixation activity under chitin application in chestnut and sodic soils of Kazakhstan. The results of our work shown stimulation of nitrogen fixation activity and N-emission in soils enriched by chitin. The

maximal nitrous oxide emission and nitrogen fixation were observed in all soils studied at 7-th day incubation. Nitrogen fixation activity reached to 1,5 ± 0,2 ng N g^{-1} h^{-1} for sodic and chestnut soils and nitrous oxide emission was equal 1.45 – 3,34 μg N-N_2O $g^{-1}d^{-1}$, correspondingly. We can conclude that N cycle in studied soils may be imbalanced by chitin transformation.

The importance of biological nitrogen fixation in arid sand dunes (Negev desert). Maik Veste[1], **Rolf Russow[2],** and Thomas Littmann[3]. [1]University of Hamburg, Biocentre Klein Flottbek, Ohnhorststrasse 18, D-22609 Hamburg, Germany, [2]UFZ Centre for Environmental Research Leipzig-Halle, Department of Soil Sciences, Theodor-Lieser-Strasse 4, D-06120 Halle, Germany, [3]Martin-Luther-Universität Halle Institute of Geography, Halle Germany

Abstract: For the evaluation of the origin of nitrogen or the paths of N input into a ecosystem the variation of the natural ^{15}N abundance is often used. We have applied this approach to assess the major input paths of nitrogen into the sand dune area of the north-western Negev Desert (Israel). Overall input rates of nitrogen by bulk deposition are fairly low with 2 – 4 kg ha^{-1} y^{-1} and decreased from north to south. The biological N fixation by the legume-*Rhizobium* symbioses of the shrub *Retama raetam* could be a further main N input path. From this investigation we can conclude that cyanobacteria within the biological crusts and *Retama raetam* fix atmospheric nitrogen. The bulk deposition is very low, therefore biological nitrogen fixation, especially by the cyanobacteria containing crusts are the major pathways of N input in this sandy desert.

Impact on the fates of fertilizer Nitrogen of Different soil managements on black soil farmland. Han Xiaozeng[1] Song Chunyu[1] Wang Shouyu[1] Qiao yunfa[1] Song Chun[1] Zhao Liyuan[2]. [1]northeast Institute Of Geography And Agricultural Ecology, Chinese Academy Of Sciences, China; [2]Northeast Agricultural University, China

Abstract: The use efficiency of fertilizer N was decreased gradually during the grain production in black soil region in northeast China. Through a ten-year long experiment, the evaluation on soil capacity of keeping and supplying N under three different soil management patterns using ^{15}N have been conducted. The crops adapted were wheat, corn and soybean. The results showed that: there were no significant difference between the three management patterns in wheat removal of soil N, while the removal of chemical fertilizer differed significantly; the residual rate of fertilizer was 12.84% in pattern , while 2.44 and 4.67 percentage higher in pattern and pattern than in pattern respectively on wheat. the loss rates of fertilizer in the three patterns were 57.93%, 49.49% and 42.07% respectively on wheat. Under the pattern management, soil N removal by corn was less. There were no significant difference on the soil N removal between pattern and pattern , that probably because of the equal effect of high level chemical fertilizer plus organic fertilizer in pattern and low level of chemical fertilizer plus sweet clover in pattern . The loss ratios were 54.19%, 46.61% and 39.94% in pattern , and respectively. Soybean as one crop that can fertilizing the soil have the effect of symbiotic fixation, need relatively less chemical fertilizer N. however the use efficiency of chemical N were different among the different management patterns. The highest is 39.55% in pattern ; the lowest is 26.85% in pattern , pattern , 31.25%. The order of N use efficiency of soybean was pattern >pattern >pattern . Under the farmer's farming, fertilization and rotation conditions (pattern Ⅰ), the use efficiency of chemical fertilizer N of wheat, corn and soybean were 29.93%, 32.01and 26.85% respectively with the order of corn>wheat>soybean. Under the management of chemical fertilizer plus organic

manure (Pattern Ⅱ), the use efficiency of chemical fertilizer N of wheat, corn and soybean were 35.23%, 37.22% and 31.25% respectively with the same order as in pattern Ⅰ. Under the management of intercrop of corn and sweet clover in which the sweet clover were returned to the field (Pattern Ⅲ), the use efficiency of chemical fertilizer N of wheat, corn and soybean were 40.42%, 41.98% and 39.55% respectively.