Nitrogen Oxides

Title	Effects of Nitrogen Dioxide on Biochemical Responses in 41 Garden Plants
Author Name	Qianqian Sheng and Zunling Zhu
Journal Name	Plants (Basel)
Year	2019
Volume and Issue	8, 45
Pages	---
Abstracts	Nitrogen dioxide (NO_2) at a high concentration is among the most common and harmful air pollutants. The present study aimed to explore the physiological responses of plants exposed to NO_2. A total of 41 plants were classified into 13 functional groups according to the Angiosperm Phylogeny Group classification system. The plants were exposed to 6 µL/L NO_2 in an open-top glass chamber. The physiological parameters (chlorophyll (Chl) content, peroxidase (POD) activity, and soluble protein and malondialdehyde (MDA) concentrations) and leaf mineral ion contents (nitrogen (N+), phosphorus (P+), potassium (K+), calcium (Ca2+), magnesium (Mg2+), manganese (Mn2+), and zinc (Zn2+)) of 41 garden plants were measured. After NO2 exposure, the plants were subsequently transferred to a natural environment for a 30-d recovery to determine whether they could recover naturally and resume normal growth. The results showed that NO_2 polluted the plants and that NO_2 exposure affected leaf Chl contents in most functional groups. Increases in both POD activity and soluble protein and MDA concentrations as well as changes in mineral ion concentrations could act as signals for inducing defense responses. Furthermore, antioxidant status played an important role in plant protection against NO_2-induced oxidative damage. NO_2 poses a pollution risk to plant systems, and antioxidant status plays an important role in plant protection against NO_2-induced oxidative damage. In conditions of strong air pollution, more evergreen plants may be considered in landscape design, particularly in seasonal regions. The results of this study may provide useful data for the selection of landscaping plants in NO_2 polluted areas.
Keywords	garden plants; chlorophyll; POD; soluble protein; MDA; mineral ions

Title	**Research progress on the effects of atmospheric nitrogen dioxide on plant growth and metabolism**
Author Name	Wang Y , Teng ZY, Zhang XL, Che YH & Sun GY
Journal Name	The Journal of Applied Ecology
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Pages	316-324
Abstracts	Nitrogen dioxide (NO_2) is one type of the atmospheric nitrogen oxides, which is the main component of atmospheric aerosol particles. Reducing the concentration of atmospheric NO_2 can decrease the haze in the air. Atmospheric NO_2 deposits on plant leaves by both dry and wet deposition. After leaf absorption, atmospheric NO_2 was reduced by two metabolism ways: one was the nitrogen metabolism by reductase mainly in cytoplasm and chloroplast, and the other was the pathway of NO_2 decomposition reaction in the apoplast and cytoplasm. Plant absorption of NO_2 disturbs plant normal growth and physiological metabolism, including vegetative growth and reproductive growth, nitrate reductase (NaR) activity, nitrite reductase (NiR) activity, nitrogen uptake, photosynthetic and other physiological metabolic processes. Here, we reviewed the research progress on the effects of atmospheric NO_2 on plant growth and metabolism, and proposed the future research direction of physiological and molecular mechanism of atmospheric NO_2 absorption by plants.
Keywords	aerosol particles; leaf absorption; apoplast; nitrate reductase (NaR); nitrite reductase (NiR)

Title	**Nitrogen Management Affects Nitrous Oxide Emissions under Varying Cotton Irrigation Systems in the Desert Southwest, USA**
Author Name	Kevin F. Bronson, Doug J. Hunsaker, Clinton F. Williams, Kelly R. Thorp, Sharette M. Rockholt, Stephen J. Del Grosso, Rodney T. Venterea & Edward M. Barnes
Journal Name	Journal of Environmental Quality
Year	2018
Volume and Issue	47
Pages	70-78
Abstracts	Irrigation of food and fiber crops worldwide continues to increase. Nitrogen (N) from fertilizers is a major source of the potent greenhouse gas nitrous oxide (N_2O) in irrigated cropping systems. Nitrous oxide emissions data are scarce for crops in the arid western United States. The objective of these studies was to assess the effect of N fertilizer management on N_2O emissions from furrow-irrigated, overhead sprinkler-irrigated, and subsurface drip-irrigated cotton (Gossypium hirsutum L.) in Maricopa, AZ, on Trix and Casa Grande sandy clay loam soils. Soil test- and canopyreflectance-based N fertilizer management were compared. In the furrow- and overhead sprinkler-irrigated fields, we also tested the enhanced efficiency N fertilizer additive Agrotain Plus as a N_2O mitigation tool. Nitrogen fertilizer rates as liquid urea ammonium nitrate ranged from 0 to 233 kg N ha-1. Two applications of N fertilizer were made with furrow irrigation, three applications under overhead sprinkler irrigation, and 24 fertigations with subsurface drip irrigation. Emissions were measured weekly from May through August with 1-L vented chambers. N_2O emissions were not agronomically significant, but increased as much as 16-fold following N fertilizer addition compared to zero-N controls. Emission factors ranged from 0.10 to 0.54% of added N fertilizer emitted as N_2O-N with furrow irrigation, 0.15 to 1.1% with overhead sprinkler irrigation, and <0.1% with subsurface drip irrigation. The reduction of N2O emissions due to addition of Agrotain Plus to urea ammonium nitrate was inconsistent. This study provides unique data on N_2O emissions in arid-land irrigated cotton and illustrates the advantage of subsurface drip irrigation as a low N_2O source system.
Keywords	Fertilizer; emissions; irrigation; nitrogen; ammonium; nitrate; oxide; urea; drip

Title	Nitrous Oxide Emissions from Turfgrass Receiving Different Irrigation Amounts and Nitrogen Fertilizer Forms
Author Name	Ross C. Braun & Dale J. Bremer
Journal Name	Crop Science
Year	2018
Volume and Issue	58, 4
Abstracts	Nitrous oxide is an important greenhouse gas associated with global climate change. Turfgrasses emit N_2O when fertilized with N and irrigated. The development of management practices such as use of controlled-release N fertilizers and/or deficit irrigation may reduce N_2O emissions in turf soils. The objectives of this study were (i) to quantify the magnitude and patterns of N_2O emissions in turfgrass, and (ii) to determine how irrigation and N fertilization may be managed to reduce N_2O fluxes. Nitrous oxide emissions were measured for 2 yr in 'Meyer' zoysiagrass (Zoysia japonica Steud.) under an automated rainout shelter in Manhattan, KS, using static chambers. Two irrigation levels (66 [medium] and 33% [low] reference evapotranspiration replacement), and three N fertilization treatments (urea and polymer-coated urea [PCU], both applied at a rate of 98 kg N ha^{-1} yr^{-1}, and an unfertilized plot) were included. During two summers, N_2O emissions were reduced by 6% with low (2.71 kg ha^{-1}) vs. medium irrigation (2.88 kg ha^{-1}) ($P \leq 0.001$). Over the 2 yr, cumulative N2O emissions averaged 4.06 kg ha^{-1} in unfertilized turf and 4.5 kg ha^{-1} in PCU-treated turf, which represent reductions of 28 and 20%, respectively, from urea-treated turf (5.62 kg ha^{-1}) ($P \leq 0.01$). Results from this study indicate that the use of a controlled-release fertilizer, such as PCU, and/or lower irrigation reduces N_2O emissions in turfgrass.
Keywords	Emissions; irrigation; fertilization; oxide

Title	**A three-year experiment of annual methane and nitrous oxide emissions from the subtropical permanently flooded rice paddy fields of China: Emission factor, temperature sensitivity and fertilizer nitrogen effect**
Author Name	Minghua Zhou, Xiaoguo Wang, Yanqiang Wang & Bo Zhu
Journal Name	Agricultural and Forest Meteorology
Volume and Issue	250–251
Year	2018
Pages	299-307
Abstracts	Annual CH_4 and N_2O emissions from these rice production systems that accounts for over 10% of national rice cultivation of China are rarely reported. To improve understanding of greenhouse gas emissions from croplands in China, we measured methane (CH_4) and nitrous oxide (N_2O) emissions from the subtropical permanently flooded rice paddy fields through a 3-year field experiment that utilized three nitrogen fertilizer application rates (0 [N0], 150 [N150] and 250 [$N_2$50] kg N ha^{-1}) in southwestern China. Results showed that seasonal patterns of CH_4 and N_2O emissions were consistent with temporal weather patterns. The average annual cumulative CH_4 fluxes were in the range of 794 to 883 kg CH_4-C ha^{-1} yr^{-1} and N_2O fluxes ranged from 1.61 to 3.10 kg N_2O-N ha^{-1} yr^{-1} across the experimental treatments. The Q10 values (soil temperature sensitivity coefficient) of CH_4 and N_2O emissions were 2.72–3.67 and 3.32–6.05, respectively, for the three treatments. Inconsistent with our hypothesis, the nitrogen fertilizer application did not increase seasonal and annual N_2O emissions over three years, compared to the control. Thus, the annual direct N_2O emission factors (EFd) averaged 0.07%, which was substantially lower than the IPCC default value of 0.30% for rice paddy fields. Nitrogen fertilizer application significantly decreased the mean seasonal global warming potential (GWP) and yield-scaled GWP for the rice season, whereas this was not true on an annual basis if fallow season was also considered. Since CH_4 emission was the major contributor to total GWP, it is necessary to propose mitigation options, which could include draining the floodwater layer and introducing upland crops during the fallow season. However, it will be challenging to reduce N_2O emissions and retain soil organic carbon if the floodwater layer is drained and upland crops are introduced during the fallow season.
Keywords	Nitrous oxide; Methane; Temperature sensitivity; Emission factor; permanently flooded rice

Title	**Management of pig manure to mitigate NO and yield-scaled N_2O emissions in an irrigated Mediterranean crop**
Author Name	Guillermo Guardia, Max T. Cangani, Alberto Sanz-Cobena, J. Lucas Junior & Antonio Vallejo
Journal Name	Agriculture, Ecosystems & Environment
Year	2017
Volume and Issue	238
Pages	55-56
Abstracts	Substitution of conventional mineral fertilizers with organic sources can avoid the environmental problems associated with high concentrations of intensive livestock production in some Mediterranean areas. Some management practices, such as the use of nitrification inhibitors or more efficient irrigation techniques (e.g., drip irrigation), have been suggested as effective alternatives to mitigate nitrous oxide (N_2O) and nitric oxide (NO) emissions released from soils amended with synthetic and organic fertilizers. In this experiment, we aimed to assess the effect of different organic amendments derived from pig manure (control without N fertilization (C); liquid fraction of pig slurry (LFPS); pig urine with the nitrification inhibitor 3,4 dimethylpyrazolephosphate (DMPP) (LFPSI); compost from the solid phase of pig slurry (COM)) compared to urea (U) and two different irrigation systems (the widespread sprinkler and alternative drip irrigation systems) on greenhouse gas (N_2O, methane, CH_4, and carbon dioxide, CO_2) and NO emissions in a maize (Zea mays L.) crop. The effect of these treatments on crop yields and yield-scaled N_2O emissions were also evaluated. The use of DMPP with LFPS was an effective practice to reduce N_2O and NO losses (40 and 32% mitigation, respectively, compared to LFPS alone), and was also associated with the highest rates of CH_4 oxidation. Drip irrigation significantly reduced the global warming potential (in spite of a lower CH_4 sink) but increased the NO losses by 58%, as opposed to sprinkler irrigation. The higher biomass production and similar grain yields observed with drip irrigation resulted in lower yield-scaled N_2O emissions in this treatment than in sprinkler irrigation. The use of organic fertilizers penalized grain yields compared to U (16–33%), although the differences were not significant in the case of LFPSI. Consequently, LFPSI in drip irrigation was (together with U applied by drip-*fertigation*) the treatment that led to the lowest yield-scaled N_2O emissions. The use of organic N sources in irrigated maize is an environmentally advisable strategy in Mediterranean cropping systems, but an optimum balance between N oxides and greenhouse gas losses, N efficiency and crop yields requires the use of nitrification inhibitors (e.g., DMPP) with liquid organic sources.
Keywords	Irrigation system; Compost; Nitrification inhibitor; Pig slurry; GHG emissions

Title	**Dynamic responses of nitrous oxide emission and nitrogen use efficiency to nitrogen and biochar amendment in an intensified vegetable field in southeastern China**
Author Name	Bo Li Zhichao Bi & Zhengqin Xiong
Journal Name	Global Change Biology Bioenergy
Year	2016
Volume and Issue	9
Pages	400–413
Abstracts	Intensive vegetable production exhibits contrasting characteristics of high nitrous oxide (N_2O) emissions and low nitrogen use efficiency (NUE). In an effort to mitigate N_2O emissions and improve NUE, a field experiment with nine consecutive vegetable crops was designed to study the combined effects of nitrogen (N) and biochar amendment and their interaction on soil properties, N_2O emission and NUE in an intensified vegetable field in southeastern China. We found that N application significantly increased N_2O emissions, N_2O–N emission factors and yield-scaled N_2O emissions by 51–159%, 9–125% and 14–131%, respectively. Moreover, high N input significantly decreased N partial factor productivity (PFPN) and even yield during the seventh to ninth vegetable crops along with obvious soil degradation and mineral N accumulation. To the contrary, biochar amendment resulted in significant decreases in cumulative N_2O emissions, N_2O–N emission factor and yield-scaled N_2O emissions by 5–39%, 16–67% and 14–53%, respectively. In addition, biochar significantly increased yield, PFPN and apparent recovery of N (ARN). Although without obvious influence during the first to fourth vegetable crops, biochar amendment mitigated N_2O emissions during the fifth to ninth vegetable crops. The relative effects of biochar amendments were reduced with increasing N application rate. Hence, while high N input produced adverse consequences such as mineral N accumulation and soil degradation in the vegetable field, biochar amendment can be a beneficial agricultural strategy to mitigate N_2O emissions and improve NUE and soil quality in vegetable field.
Keywords	biochar; intensified vegetable field; N_2O emissions; nitrogen use efficiency; soil quality