
focus on **NRM** research

# Nitrogen losses & indirect nitrous oxide emissions

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**What are you researching?**
Application of nitrogen (N) fertiliser in irrigated cotton is necessary to maintain the quality and quantity of yield. Excess N may remain stored in the soil, or may be lost. Losses of N can occur as gaseous emissions of $N_2$ and $N_2O$ from the soil surface or via tail water run-off and deep drainage. Subsequent transformations of N in run-off water or deep drainage may result in indirect $N_2O$ emissions.

We are interested in N losses from irrigated cotton, with a particular focus on nitrous oxide emissions. Using 15-N labelled urea, we quantified the movement of fertiliser N to different pools (plant, soil, atmospheric losses, run-off and deep-drainage) over the 2014-15 cotton season. We also measured indirect nitrous oxide ($N_2O$) emissions from farm irrigation systems over three cotton seasons and are beginning to develop a better understanding of the magnitude of and potential controls on indirect $N_2O$ emissions.

**Why is it important?**
Nitrogen losses should be concerning for a number of reasons. Excessive N losses may affect environmental systems (eg. eutrophication and biodiversity losses), contribute to changing climatic conditions and present potential risks to human health (eg. elevated concentrations of nitrate in drinking water). $N_2O$ emissions are of particular interest because of its role as a greenhouse gas (100 year global warming potential 298 times that of carbon dioxide) and as a key causal agent in the depletion of stratospheric ozone. Agricultural $N_2O$ emissions resulting from fertiliser or manure use represent 56-70 percent of total global $N_2O$ sources. Much of the work on $N_2O$ emissions from irrigated cotton has focused on direct emissions from the soil surface, however the magnitude of and controls on indirect emissions resulting from N leaching and runoff remain uncertain.

**What have you found?**

*Nitrogen losses:* Under a rate of 220N, 25.5 percent of the N fertiliser applied was taken up by the plant, 27 percent remained in the soil, 9.5 percent was lost via run-off and deep drainage, and 38 percent was lost to the atmosphere. Under these conditions, nitrogen concentrations in tail water run-off ranged between 0 - 346 $mgL^{-1}$, with most of the N lost early in the season with irrigations following fertiliser application.

Greater concentrations of N were found in water sampled from skip vs irrigation furrows, suggesting that N is leached from the beds as water moves through the beds from irrigated to skip furrows. Within the storages, concentrations of nitrate did not change significantly during the 10 days following the first irrigation, where movement of irrigation water in or out of the storages had paused.

*Indirect Emissions:* Our estimates of $N_2O$ flux, using chambers and dissolved $N_2O$ concentrations, ranged between 0 to 0.28 $ugm^{-2}min^{-1}$ (in storages), and -0.3 to 2 $ugm^{-2}min^{-1}$ (in tail water). Cumulative emissions from irrigation tail drains were approximately 2.4-4 percent the magnitude of direct land emissions.

**How can I apply the research/what should I do about it?**

Increasing both nitrogen and water use efficiency will help minimise N losses via runoff. Reductions in N run off may also be achieved through altering the timing and placement of N (e.g. using split applications, changing the placement of N in hills relative to water furrows). Re- use of N rich tail water may also provide an opportunity for N lost in run-off to be returned to the system. The use of nitrate test strips also provides an inexpensive method for growers to better monitor run-off losses.

**Where do I go for more information?**

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