FARMING PRACTICE
COVER AND CATCH CROPS

IMPACT: CROP YIELD

Reference 39

Quemada, M.; Baranski, M.; Nobel-de Lange, M. N. J.; Vallejo, A.; Cooper, J. M. 2013 Meta-analysis of strategies to control nitrate leaching in irrigated agricultural systems and their effects on crop yield AGRICULTURE ECOSYSTEMS & ENVIRONMENT 10.1016/j.agee.2013.04.018

Background and objective

Nitrate leaching (NL) is an important N loss process in irrigated agriculture that imposes a cost on the farmer and the environment. The main objective was the identification of those strategies that have proven effective at reducing NL losses and quantification of the scale of reduction in N losses that can be achieved by the various strategies. In addition, the following questions concerning the fate of N in irrigated systems were addressed: (i) do deficit irrigation or scheduling reduce NL with respect to adjusting water application to crop requirements? (ii) at which level of N application does the relationship between yield and NL become most favorable? and (iii) how does including a cover crop, either a grass or a legume, during winter affect NL relative to the conventional winter fallow?

Search strategy and selection criteria

A survey of peer-reviewed published literature was conducted to identify articles that reported nitrate leaching (NL) in irrigated agricultural systems using the ISI-Web of Science and CAB Abstracts (Ovid) from 1910 to 2012. The following search terms and their variations were used: irrigation, nitrogen, nitrate leaching, leachates, losses (from soil), percolation, eutrophication, nonpoint source or diffuse water pollution. This provided 234 articles published from 1963 to 2012 in scientific journals from the Journal Citation Report. More relevant papers were found by searching through the reference lists of papers already selected for the MA. (i) study of nitrate leaching (NL) in an irrigated agricultural cropping system; (ii) study for at least one growing season; (iii) conducted under field conditions; (iv) NL was measured in terms of mass of N lost (i.e. NO_3-N concentration and the volume of water leached were both considered). Studies that determined the risk of NL through soil or soil solution NO_3-N concentrations, were not considered as these might give a skewed view of NL. Even if the study relied on computer modeling to simulate components of the water balance or solute transport, the studies were selected if data collected under field conditions were the major component of the results. A further selection was conducted by critical examination of these papers for inclusion and exclusion from the data-set, following quality criteria that ensure statistical power avoiding unconscious bias (Hedges et al., 1999). These criteria were that: (i) the experimental design had to be sufficiently detailed to determine all critical aspects of the treatments, plot size and recent history, irrigation systems and fertilizer management; (ii) studies reflected typical regional practice; and (iii) in most cases included treatment replicates. In some cases exceptions were made to this final criterion.

Data and analysis

Mean effect sizes were calculated for each variable of interest and data-set category, and bias-corrected 95% confidence intervals (CIs) were generated by a bootstrapping procedure (5000 iterations). Mean effects were considered significantly different from zero if the 95% CI did not overlap zero, and different from one another if their 95% CIs were non-overlapping.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
44	Irrigated agricultural cropping system	Replacing winter fallow by a non-legume CC (39 experiments); Replacing winter fallow by a legume CC (20 experiments)	No cover crops	Metric: Yield of subsequent crop; Effect size: Square root of ratio of the considered metrics in the intervention to the considered metrics in the control	68.75

Results

- Replacing a fallow with a legume cover crops had a positive effect on crop yield (Y) in all observations, with a mean increase of 25%. If the fallow was replaced by a non-legume CC, in more than half of the observations there was a Y decrease in the subsequent cash crop and the mean effect on Y was not significant.
- Non-legume Cover crops (CC) had a clearly positive effect on nitrate-leaching-scaled yield (i.e. kg of yield per kg of NO_3-N leached), which means that the benefits of non-legume CC for reducing NL far outweighed the cost of Y reductions associated with this practice. The effect of legume CC on nitrate-leaching-scaled yield was not always positive and the mean effect was not different from the fallow.
- NULL
- NULL
- NULL

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

Replacing a fallow with a legume cover crop had a positive effect on crop yield, with a mean increase of 25%. If the fallow was replaced by a non-legume CC, the mean effect on Y was not significant.