service in ACTION

Colorado State University Cooperative Extension

no. .514

Nitrogen and irrigation management—keys to profitable yields and water quality

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Quick Facts

Good nitrogen and irrigation management practices increase yields and reduce the probability of nitrate, pesticides and salt leaching into ground water.

Best management practices for nitrogen and irrigation management preserve the quality of ground water.

In 1987, the U.S. Congress enacted *The Water Quality Act of 1987,* which requires states to assess their waters and develop nonpoint source management programs to control and reduce specific nonpoint sources of pollution. The Cooperative Extension comprehensive water quality plan of work will assess the quality of ground water in Colorado and educate the public in methods that can be used to reduce the impact of nitrogen fertilizers on ground water quality. Therefore, the objective of this sheet is to list the best nitrogen and irrigation management practices that reduce the probability of nitrate leaching into ground water and simultaneously result in profitable yields. It should be emphasized that the best nitrogen and irrigation management practices recommended here must be fitted to specific crop-soil-climate conditions of individual farms. Farmers should check with their county Cooperative Extension agent for additional information.

Nitrogen Management

Discontinuing the use of nitrogen fertilizer typically decreases crop yields by one-third in the first year. Therefore, nitrogen use is a must for most crops but should be managed carefully.

1) Use soil analysis to assess nitrogen needs (see Service in Action sheet .500 *Soil sampling—the key to quality fertilizer recommendations* for procedures). If a soil is already high in residual nitrogen, decrease fertilizer nitrogen rate accordingly.
2) Choose a realistic yield goal. Selection of a high-yield goal that is not attainable results in fertilizer recommendations that are excessive and inefficient.
3) Use irrigation water analysis to give credit to nitrate nitrogen content in the water. Multiply parts per million of nitrate nitrogen by 2.7 to get pounds of nitrate nitrogen per acre foot of water. Then multiply by acre feet of water applied to get total nitrogen application.
4) Split nitrogen applications. Apply half of the nitrogen requirement at planting and the balance at the critical growth stage of a particular crop. This is especially important for sandy soils that may leach nitrates.
5) Use ammonium nitrogen fertilizers, such as anhydrous ammonia, to reduce nitrate leaching. The efficiency can be enhanced by use of nitrification inhibitors (chemicals that prevent change of non-leachable ammonium to leachable nitrate).
6) Give nitrogen credit for manure and previous legumes. A credit of 5, 30 and 50 pounds per acre should be given per ton of manure and to previous bean and alfalfa crops, respectively.
7) Use slow release nitrogen fertilizers such as sulfur-coated urea or urea formaldehyde on golf courses, lawns, etc.
8) Incorporate urea, urea ammonium nitrate and ammonium sulfate into the soil to prevent

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Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth R. Bolen, director of Cooperative Extension, Colorado State University, Fort Collins, Colorado. Cooperative Extension programs are available to all without discrimination. To simplify technical terminology, trade names of products and equipment occasionally will be used. No endorsement of products named is intended nor is criticism implied of products not mentioned.

volatilization losses of ammonia gas, which reduces nitrogen efficiency and necessitates higher nitrogen application rates.

9) Place nitrogen and phosphorus in the same band to increase yields and nitrogen and phosphorus uptake efficiencies.
10) When applying nitrogen to irrigation water, do not allow the runoff to enter surface waters or lakes. Reuse the runoff for irrigation. For tailwater recovery systems refer to SIA 4.709, *Tailwater recovery for surface irrigation.*
11) Follow soil conservation practices such as minimum till, strip cropping, contour planting, etc. to prevent soil erosion that results in pollution of surface waters with nitrogen. When necessary improve drainage to increase nitrogen use efficiency.
12) Do not apply manure to frozen land, especially on slopes, which prevents nitrogen loss in runoff waters.
13) Under sprinkler and drip irrigation, nitrogen can be split into appropriate quantities determined by crop growth stage. This is especially good on sandy soils.
14) Do not allow back flow of fertilizers into the well head. See SIA 4.714, *Home sprinkler systems: backflow prevention devices.*
15) Avoid application of high rates of nitrogen in the fall or at planting time. Remember the rates can be adjusted during the season if conditions warrant the addition of more nitrogen fertilizer.
16) In crops such as malting barley and sugarbeets, excessive nitrogen fertilizer rates reduce crop quality and profits.
17) All farm practices that increase yields result in larger nitrogen uptake and less leaching of nitrates.

Irrigation Management

Irrigation water management (irrigation scheduling) can save 30 percent to 50 percent of water and energy. Good water management also increases yields.

Over-irrigation can result in leaching of fertilizers to the ground water and reduces the efficiency of nitrogen fertilizers. Therefore, irrigation water management is essential for profitable yields and good water quality. Scheduling irrigations (the decision when and how much to irrigate) should be done according to the guidelines described below. Refer to SIA 4.708, *Irrigation scheduling,* for definitions and explanations of terminology.

1) Knowledge of crop, growth stages, soil characteristics and irrigation system efficiency is needed to properly schedule irrigations.
2) Know your crop water uses: how much water the crop uses on a daily or weekly basis. Crop water use is the actual evapotranspiration that can be estimated from weather data or from evaporative devices such as an atmometer. Evapotranspiration rates also are published by local Cooperative Extension, newspapers and Soil Conservation Service offices in some areas.
3) Determine the moisture content of the soil in the effective root zone by measurement or the feel method. See SIA 4.700, *Estimating soil moisture for irrigation.*
4) The maximum water-holding capacity in the effective root zone can be estimated as described in SIA 4.700.
5) The difference between the maximum water-holding capacity and the actual water content is the net amount of water to be applied.
6) Determine the application efficiency of your irrigation systems. Consult a qualified irrigation technician.
7) If feasible, use irrigation systems that give higher application efficiencies.

Table 1: Typical application efficiencies of irrigation systems.

Type	Percent
Micro sprinklers and drip	85-95%
Low pressure center pivots	80-90%
High pressure center pivots	75-85%
Side roll/hand move sprinklers	60-70%
Flood irrigation	20-50%
Border irrigation	40-60%
Furrow no cutback	40-60%
Furrow with cutback	60-80%
Furrow with surge	70-90%

8) The gross amount of water to be applied is the net amount divided by the application efficiency of the irrigation system.
9) Use measuring devices such as flumes and water meters to determine how much water you apply. When using syphon tubes or gated pipes to determine the amount of water applied multiply the stream flow rate by the irrigation duration.
10) Use a soil probe to monitor soil moisture. Probe the field during and after irrigation to determine depth of water penetration.
11) With surface irrigation, use cutback practices to reduce deep percolation and runoff. Cutback practices are explained in SIA 4.706, *Cutback surface irrigation systems.*
12) With sprinkler irrigation, operate sprinklers at proper pressure and avoid irrigating during windy conditions. Night irrigation is encouraged when feasible because there is less wind.

References

Broner, I. *Irrigation scheduling: the water balance approach.* Colorado State University Cooperative Extension, Service in Action sheet 4.707, Dec. 1989.

Environmental Protection Agency, *Nonpoint Sources, Agenda for the Future,* EPA Office of Water (WH-556), Jan. 1989.

Soltanpour, P. N. *Fertilizer practices and efficiency of use.* Colorado State University Cooperative Extension, Service in Action sheet .553, Sept. 1979.

Soltanpour, P. N., R. H. Follett and D. G. Westfall. *Guide to Fertilizer Recommendations in Colorado.* Colorado State University Cooperative Extension, Bulletin XCM-37, 1985.