NUTRIENT MANAGEMENT IN A REGULATED ENVIRONMENT

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ABSTRACT

Laws and regulations mandate nutrient management that good managers have long practiced or should have. Prior to governmental regulations, economics was a major regulator. However, high returns on nitrogen inputs led to over application, causing environmental issues and human health concerns, which led to legal regulation. The Federal Clean Water Act (CWA) and the California Porter-Cologne Act provide for regulation of pollution of surface waters, groundwaters, and wetlands. The statewide Water Resources Control Board and nine Regional Water Quality Control Boards (Boards) have issued Discharge Requirements for point and non point pollution. Virtually all of Central Valley agriculture is regulated by Board Orders through nutrient management on dairies, other animal operations, irrigated lands and storm water runoff. A range of nutrient management practices are available to assist in meeting Board Discharge Requirements. Some of those practices are discussed in light of the Orders.

INTRODUCTION

Plant response to nitrogen has long been understood. Hydroponic solutions were used to create substrates with nitrogen concentrations from zero to low to high. The classical growth response starts with a small amount of vegetative growth. Some nitrogen occurs in seeds, cuttings or other propagules; therefore, some vegetative growth occurs even with no nitrogen in the substrate. Each increment of added nitrogen increases vegetative growth in smaller amounts until maximum growth occurs. At this point, no additional growth occurs or vegetative growth decreases with additional nitrogen inputs.

Because the amount of nitrogen that will be plant available in a given soil during a given growing season may be difficult to predict, the manager may not know with certainty how much nitrogen to apply. Compared to the value of the crop produced, the cost of nitrogen is usually minuscule. For many crops the financial risk of applying too little nitrogen is far, far greater, than the risk of applying excessive amounts of nitrogen. Many managers have simply put more on. The small cost for the extra nitrogen was considered a very inexpensive insurance. No consideration was given to environmental impacts.

The excess nitrogen not removed by the crop has to go somewhere. It may remain in the root zone for a future crop, become incorporated into perennial crops, be lost to the atmosphere or percolate from the root zone and into a drinking water supply. The federal state government considers all water drinking water and regulates it as such.

News during the last year makes it clear why there is concern about drinking water quality, and there should be a concern. The lead tainted drinking water in Flint Michigan that caused harm to many people was no trivial matter. Regulators dropped the ball when their action was needed. A number of people will be impacted for their entire lives. Then there was cloudy water

in Northeast Fresno. In both cases there was a change of water quality due to a change in water source. Both situations were predictable and should have been prevented.

Why the concern with nitrates effect on water quality in drinking water? Excess nitrate in animal diets leads to methemoglobinemia, the reduced ability of blood to transport oxygen throughout the body. Without cellular oxygen, metabolism is disrupted. The blue color of anaerobic hemoglobin led to the term "blue baby syndrome." Infants and pregnant females are most sensitive to methemoglobinemia.

Contrary to animal physiology, plants can readily utilize nitrate. Nitrate is the primary nitrogen species imbibed and utilized by plants.

HISTORY OF REGULATION

During the 1940s, numerous outbreaks of waterborne diseases and impairment of fishing grounds and recreational waters raised concerns. Existing local and regional agencies with various jurisdictions were unsuccessful in coping with the issues. The Federal Water Pollution Control Act (FWPCA), the first US Law to address water pollution, was enacted in 1948. The Dickey Water Pollution Control Act of 1949 established the State Water Pollution Control Board and nine Regional Water Pollution Control Boards in California to deal with sewage and industrial pollution.

In recognition that water supply as well as water quality was critical, the State Water Pollution Control Board and the State Water Rights Board were merged to form the State Water Resources Control Board in 1967. Recognition that existing laws needed revision, the Porter-Cologne Water Quality Control Act was enacted in 1969. It remains the foundation of water protection in California.

The FWPCA was amended in 1972 and became known as the Clean Water Act (CWA). The California State Boards (Boards) issue Waste Discharge Requirements (WDRs) to individuals and general orders to groups such as dairies, composters, poultry producers, growers, etc. that assists in the enforcement of the CWA. Some examples are:

- Sun Maid Growers, Kingsburg
- General Order for Existing Milk Cow Dairies
- General Waste Discharge Requirements for Composting Operations
- Waste Discharge Requirements General Order for Poultry Operations
- General Order for Growers within the Tulare Lake Basin that are Members of a Third Party Group (The Irrigated Lands Regulatory Program (ILRP) regulates such discharges.)

Orders have several things in common;

Findings: A description of the operation and its environmental setting and actions taken.
Discharge Prohibitions: Action of forbidding something such as discharges to land.
Discharge Specifications: Limitations such as maximum daily effluent flow.
Solids Disposal: Specifics of how solids may or may not be disposed.
Ground Water Limitations: How ground water can and cannot be altered.
Disposal Field Limitations: Agricultural reuse of wastewater is limited to agronomic rates.
Provisions: Other requirements such as nutrient and salinity management plans.
Monitoring and Reporting Program: A description of what soil, effluent, ground water and other substrate samples must be collected, how often and what analysis to perform as well as what reports must be submitted to the Board.

NITROGEN MANAGEMENT

Nitrogen management is required directly or by inference. What are some of the things required and what are some of the things that trigger enforcement?

Discharging nitrogen or nitrogenous materials in places that contaminate waters of the state or create nuisances are not considered best management practices. A dairy person south of Sacramento was discharging dairy wastewater into a slough that flowed through a residential area. Residents detected odors and reported the same. The Board's first step was to issue a cease and desist order, which the discharger complied. A few days later a Board employee inspected the slough and found ongoing discharge. The dairy person was fined several tens of thousands of dollars.

A neighbor of my father's, a Madera County farmer, was discharging dairy wastewater to land near a rural community. Mosquitoes reproducing in the discharge were observed by a mosquito abatement district employee. It was reported to the Board.

WDRs directly or indirectly require nitrogen management through the use of planning and budgeting. The 2013 General Order for Existing Milk Cow Dairies (R5-2013-0122) limits nitrogen application from all sources to <1.65 times the amount of nitrogen removed in the crop. Originally, the Board started with 1.0 times the amount removed. No system is one hundred percent efficient. Additional nitrogen could be applied provided there was evidence (soil or plant tissue analysis) to show more was needed.

General Orders for growers within the Irrigated Lands Regulatory Program require planning and budgeting tools which includes a Farm Evaluation, Nitrogen Management Plan, and a Nitrogen Management Plan Summary. The Farm Evaluation includes:

1. Identification of each field, its location size and crop.
2. Identification of irrigation practices such as drip, furrow, etc. used on the farm.
3. Irrigation efficiency practices used such as ET based scheduling, soil probes, sensors, etc.
4. Management practices used to minimize leaching including cover crops, split applications, soil testing, foliar application, etc.
5. Measures taken to protect wellheads and to properly abandon wells.
6. Identification of sediment and erosion control practices including in-furrow dams, time between pesticide application and irrigation, vegetated ditches and filter strips, sediment basins, cover crops, etc. Not only are soil sediments regulated but so are pesticides adsorbed or absorbed on soil or organic particles.

The Nitrogen Management Plan includes crop unit information prior to and following each crop season. A unit consists of fields or areas with the same crops and subjected to the same management. Information required includes:

1. Locations.
2. Crop.
3. Production units: lbs, tons, cartons, bales etc.
4. Area: acres.
5. Recommended N rate (planned and actual).
6. Rate of each mineral fertilizer applied (planned and actual).
7. Rate of each organic fertilizer applied (planned and actual).
8. Carry over in soil (planned and actual).
9. Nitrogen in irrigation water (planned and actual).
10. Total nitrogen available (planned and actual).

Following harvest, a Nitrogen Management Plan Summary Report is required and includes:

1. Locations.
2. Crop.
3. Total acres.
4. Total nitrogen available.
5. Total nitrogen available per yield unit.
6. Production Unit (yield unit).
7. Nitrogen removed.

An objective is to calculate a ratio between the amounts of nitrogen available to the amount removed. To assist with estimating the amount of nitrogen removed Daniel Geisseler, a University Cooperative Extension Specialist with the Department of Land, Air and Water Resources, was asked to conduct a literature review. *Nitrogen Concentrations in Harvested Plant Parts* is currently under review. The pounds of nitrogen per ton of harvested part, the number of observations, and the coefficient of uniformity (CV) are listed for numerous crops. CVs ranged from 3.7 to 114. It is difficult to understand how such variability can be used as a measure of legal compliance. Simply stated the regulations require that a nutrient manager create and submit a plan, execute the plan and evaluate the efficiency of the plan.

Completed plans and reports are submitted to a local coalition. This coalition is a local entity created to manage the irrigated lands program. It serves as a buffer between the manager and the Board and thus the public. It is intended that farming plans and reports not be available through the Freedom of Information Act.

Plans and reports must also be available on the farm. Board staff may physically inspect individual farms. During such times plans and reports must be available to the inspector. An inspector can be very critical of methods used to develop information for plans or reports. During a recent on farm inspection an inspector questioned the basis for carry over nitrogen values. There was none. Failure to use soil testing or some other defensible method could be considered a violation subject to a substantial fine.

SUMMARY

Some of the things the Regional Water Quality Control Board is requesting are things nutrient managers should be doing. If the regulations induce improvement of nutrient management the program can be good for all of us. How the Board proceeds is a concern. Based on my fifty two years of working with plant nutrient management, we can not have economically fertilized crops and runoff and percolate that meet drinking water standards. If that is the expectation, society may be expected to make a choice between protecting water quality and producing food.

REFERENCES

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