California Regional Water Quality Control Board
Colorado River Basin Region

Winston H. Hickox
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Gray Davis
Governor

September 12, 2002

TO: TAC Members and Interested Parties

RE: Salton Sea Nutrient Total Maximum Daily Load Technical Advisory Committee Meeting

Enclosed is a copy of the information that was distributed at the Salton Sea Nutrient Total Maximum Daily Load (TMDL) Technical Advisory Committee (TAC) meeting. The meeting was held on Wednesday, August 28, 2002.

If you have any questions, please contact me at (760) 776-8931 or Dr. Francisco Costa at (760) 776-8937.

for Teresa Gonzales, Senior Environmental Scientist
Chief of TMDL Development

FC/hs

Enc: As noted above

cc: Regional Board Members

File: TMDL SS N
TMDL SS N TAC

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DEVELOPMENT AND IMPLEMENTATION OF
NUTRIENT TOTAL MAXIMUM DAILY LOAD FOR THE
SALTON SEA

TECHNICAL ADVISORY COMMITTEE
Meeting Agenda

Wednesday, August 28, 2002, 10:00 AM -12:00 PM.

Regional Water Quality Control Board
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260

- Introductions

- Salton Sea Background Information
  Phosphorus fertilization/fertigation practices in the Imperial Valley by
  Herman Meister, UC Cooperative Extension

- TAC Workgroup Break-Out Sessions
  - Organization
  - Strategy of how to meet the required TMDL milestones
  - Recommendations

- Action Items
  - Set date and agenda for next meeting
  - Attendance
  - Questions and comments
  - Adjournment

Phosphorous

Herman Meister
Agronomy Advisor
Field Crops
University of California Extension Service
Imperial Valley

What is Phosphorus?

- A naturally occurring rock which is mined and formulated into liquid and dry fertilizers.
- Principal reserves are in North Africa and North America.
- In North America, the main deposits are in the rocky mountain states, Florida, and the Tennessee-Carolina areas.

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Common Phosphorus Fertilizers

- Superphosphate 0-20-0
- Triple superphosphate 0-45-0
- Mono-ammonium phosphate 11-52-0
- Di-ammonium phosphate 18-46-0
- Ammonium polyphosphate 10-34-0
- "P" analysis is expressed as % P_2O_5 (phosphate)

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Facts About Phosphorus

- The total amount of phosphorus in our soils is very low-less than .05% of the soil mass.
- Only about .01% of the total P is available at any one time.
- Phosphorus is mobile in the plant and immobile in the soil.
- Studies show plant recovery after a P fertilizer application is generally less than 5 %.

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Why do Plants Require Phosphorus?

- Utilized by plants at the cellular level to form nucleic acids (DNA & RNA).
- Necessary to stimulate early vegetative growth
- Necessary for promoting root growth
- Ensures and enhances normal maturity of the plant
- Important for promoting seed production

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Phosphorus Deficiency

Corn Tomato

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How do Plants Obtain Phosphorus?

- Phosphorus is absorbed by the plants roots primarily as H_2PO_4(orthophosphate ion) from the soil solution.
- The very tips of the feeder roots are responsible for P uptake.

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Factors Affecting P Availability

- Solubility
- Type of clay and clay content
- Soil Temperature
- pH
- Organic matter
- Size of the root systems
- Mobility
- Reversion

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Solubility

- Most of the soil P is tied up chemically in compounds of very limited solubility.
- Not necessarily a negative characteristic of P, because the limited solubility prevents it from being leached.

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Clay Content

- Some types of clays retain or "fix" P more than others.
- In general, clay soils have more exposed surface area and retain P more than lighter soils.

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Temperature

- The governing effect of temperature is somewhat variable.
- In general, cool temperature can induce P deficiency in vegetables by reducing the already low solubility.

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pH

- In most soils, the maximum availability of soil P is in the range of a pH of 7.
- At lower pH values, soil P retention is due to the adsorption of the phosphate ions to Fe and Al oxides.
- At higher pH values, soil P retention is due to the phosphate ions being strongly adsorbed to calcium carbonates in alkaline soils

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Organic Matter

- The presence of organic matter generally increases levels of phosphorus.
- Basically, the decomposition of organic matter produces acids which lower the pH of calcareous soils.
- Lowering the pH closer to 7 results in more P availability.

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Nature of the Root Systems

- The size and structure of the root systems of plants vary.
- For example, alfalfa, sugar beets, and cotton have extensive root systems enabling these crops to "mine" for P.
- Other crops have limited root systems and require high concentrations of P placed in the root zone. e.g. various vegetable crops

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Mobility

- Phosphorus is immobile in soils as compared to Nitrogen in the nitrate form.
- Studies indicate phosphorus moves only minute distances, actually just millimeters in cool, clay soils.

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Reversion

- Reversion is the process where available soluble forms of P applied in fertilizers chemically transforms back into less soluble forms over time.
- Basically, soluble fertilizers transform back to the original "rock phosphate" over time(months and years).
- Once P has chemically converted to a less soluble or insoluble form, it is unavailable to the plant.

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How Much P do Plants Remove?

Field Crops

- Harvesting 8 tons of alfalfa removes about 42 lbs P per acre annually.(about 100lbs P_2O_5)
- Harvesting five to 6 tons of bermudagrass hay annually removes about 41 lbs of P per acre.
- Harvesting 2.5 tons of wheat, barley or oats removes about 18 lbs per acre of P.
- Harvesting 40 tons of sugar beets removes about 50 lbs of P per season.
- Harvesting 2.5 bales of cotton per acre removes about 40 lbs of P per season.

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U C Guidelines for Phosphorus

Field Crops

- Alfalfa-65 lbs P preplant; 44 lbs P per year (About 100 lbs P_2O_5)
- Bermudagrass hay-43 lbs preplant(annual?)
- Wheat and sudangrass-not recommended if following a produce crop where applications were made for winter vegetables
- Sugar beets-55 lbs of P preplant
- Cotton-43 lbs preplant

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How much P do Plants Remove?
Vegetable Crops

- Harvesting 600 cartons of broccoli per acre removes 10 lbs of P.
- Harvesting 800 cartons of cabbage or lettuce per acre removes 18 lbs of P.
- Harvesting 800 cartons of melons per acre removes 11 lbs of P.
- Harvesting 1000 sacks of onions per acre removes 15 lbs of P.

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U C Guidelines for Phosphorus
Vegetable Crops

- Cole crops 113 lbs P preplant(230lbs P_2O_5) or 500 lbs of 11-52-0.
- Lettuce-113 lbs preplant
- Melons-113 lbs preplant
- Onions-113 lbs preplant

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U C Guidelines for Phosphorus
Vegetable Crops

- "The desert valley soils of southern California require heavy applications of P fertilizer for winter production. The suggested ranges for P fertilizer in Table 1. should be approximately doubled for desert valley winter vegetable crops." *

*Fertilizer Guide for California Vegetable Crops
http://vric.ucdavis.edu

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How to Determine How Much Phosphate to Apply?

- Soil sampling and lab analysis to determine the available "P" present.
- Consult established guidelines for your area for recommendations pertaining to the crop and the time of year it will be planted.
- Tissue samples are more helpful on long term established crops.

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How is Phosphorus Applied?

- Broadcast as dry 11-52-0, 0-46-0, and occasionally sprayed as 10-34-0 broadcast prior to disking and listing for row crops.
- Injected as a "starter fertilizer" on row crops at planting and sidedressed around thinning time occasionally(10-34-0 or various formulations).
- As a "water run" in flat, furrow, sprinkle, or drip irrigation(10-34-0, 0-52-0).

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Timing of Phosphorus Applications

- As a general rule for best results, all of P and K and part of N should be applied before or at planting with the remaining N split during the season on annual crops.
- Perennial crops like alfalfa will require split applications of P during the spring growing season.

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What Have We Learned About P?

- It is a very essential nutrient for plant growth and reproduction
- The amount naturally occurring in soils is very low.
- Very little P is available to the plant at any one time.
- Phosphorus does not leach due to its insolubility.
- Phosphorus is immobile in the soil; therefore placement is critical.

What Have We Learned About P?

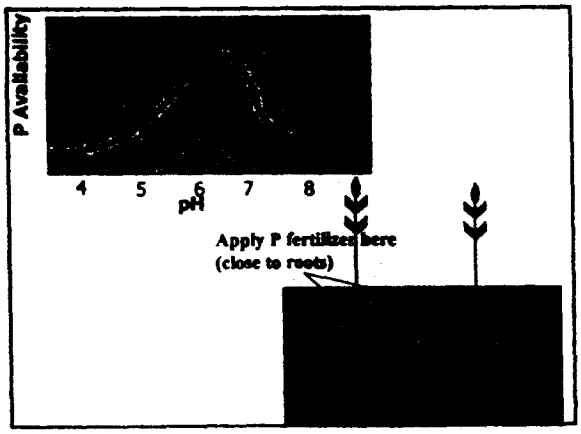
- Several factors limit the availability of soil P to the plant.
- When applied as a available fertilizer, fixation and reversion begin immediately which over time reduces the amount available to the plant.
- Vegetable crops require higher rates of P applications.

Suggested Strategies to Improve the Utilization of Phosphorous

- Utilize formulations of P in combination with ammonium N, e.g. 11-52-0.
- Minimize irrigation run-off when applying P in water-run applications on alfalfa.
- Improved water-run P application practice(75% method).
- Investigate broadcast topical applications of 11-52-0 instead of water runs of phosphoric acid (0-52-0) on alfalfa.

Strategies Continued

- Consider alternative preplant formulations of such as 5-35-0 or 3-35-0.
- Consider reducing broadcast preplant application rates on vegetables(11-52-0) and increasing preplant injection rates with 3-35-0
- Employ the "Grid Sampling" technique for sampling followed with variable application technology.
- Utilize tissue sampling on crops where it is appropriate to determine rates of phosphate application.



Conclusions

- Phosphorus is a very necessary element for plant growth that must be applied sufficiently in order for plants to obtain adequate amounts.
- Some suggestions have been presented that can be implemented in the short term.
- Other techniques will have to researched to determine if they are effective and economical.

Conclusions

- Phosphorus is a critical issue relative to the Salton Sea's eutrophication problems.
- The more immediate problem is how to maintain the "salinity" of the Salton Sea in light of the recent proposal which moves the water transfer a step closer to fallowing.