
Central Coast Regional Water Quality Control Board

IRRIGATED LANDS REGULATORY PROGRAM

RESOURCES FOR GROWERS IRRIGATION AND NUTRIENT MANAGEMENT AGENCY RESOURCES, SERVICES AND USEFUL INFORMATION Updated February 28, 2014

The purpose of this document is to provide growers with information that will assist them in implementing irrigation and nutrient management practices, including agency resources, services and other useful information.

AGENCIES, SERVICES, AND RESOURCES

The organizations and agencies below can provide services and assist growers in preparing irrigation and nutrient management plans and implementing practices. Contact the local office for more information.

1. National Resources Conservation Service (NRCS)

The National Resources Conservation Service (NRCS), part of the United States Department of Agriculture (USDA), works with landowners through conservation planning and assistance designed to benefit the soil, water, air, plants, and animals that result in productive lands and healthy ecosystems. As part of their EQIP program, NRCS provides guidance, local assistance, and funding to develop and implement conservation plans and agricultural practices. To access information about California NRCS services and resources, go to: <http://www.ca.nrcs.usda.gov/>

The NRCS Field Office Technical Guide (FOTG) contains technical information about the conservation of soil, water, air, and related plant and animal resources. This guide includes a list of management practices recommended by counties in the continental United States. The recommended practices include irrigation and nutrient management. Information about the FOTG can be found at: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/>
The guide can be accessed electronically. The recommended practices and their specifications, are found in Section IV of the Electronic- eFOTG at:
http://efotg.sc.egov.usda.gov/efotg_locator.aspx

The NRCS “Nutrient Management Conservation Practice Standard 590” is considered the corner stone for Nutrient Management in the Natural Resources Conservation Service. In addition to the Nutrient Management Standard, NRCS provides further guidance on the application of nutrient management via the National Nutrient Management Policy and National Instruction. This information, a list of management tools, and a complete section on Nutrient Management can be found at:
<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/npm/>

The NRCS "Irrigation Water Management Practice Standard 449" is defined as the process of determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner. To access the Practice Standard 449, go to:

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_025834.pdf

For a list of NRCS 2013 Conservation Activity Plans Criteria (including nutrient and irrigation management plans criteria) Plan Templates, and other resources, go to:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/tsp/>

For NRCS disciplines involved with water quality, information and videos, go to:

<http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/quality/?cid=stelprdb1042846>

Access the NRCS Web Soil Survey Website to determine the soil series and soil properties of farmed land, at:

<http://websoilsurvey.nrcs.usda.gov/>

To locate an NRCS qualified Technical Service Provider (specialist) in your area, go to:

<http://techreg.sc.egov.usda.gov/CustLocateTSP.aspx>

Search by county, assistance provider category (example: irrigation or nutrient management plans), and by specific services.

The local NRCS District Conservationists may be able to provide technical assistance in the development of irrigation and nutrient management plans. If you are interested in getting additional support from NRCS in nutrient management, please contact your local NRCS office and enquire about programs available. To locate your local NRCS office, go to:

<http://offices.sc.egov.usda.gov/locator/app?service=page/CountyMap&state=CA2&stateName=Southern%20California&stateCode=06>

2. Resource Conservation Districts (RCDs)

The California Resource Conservation Districts provide assistance to local ranchers and farmers to implement conservation practices. The core mission of all RCDs is to promote the conservation of California's natural resources. Many local RCDs provide irrigation system performance evaluations through the Irrigation Mobile Lab services. Currently, there are a few Central Coast RCDs providing Mobile Irrigation Lab services to the farmers: including the Cachuma RCD in Santa Maria, the Coastal San Luis Obispo RCD in Morro Bay, and the Monterey County RCD in Salinas. For a list of all the RCDs in California and information about the Irrigation Mobile Labs available services, go to: http://www.carcd.org/rcd_directory0.aspx

Irrigation Mobile Lab information of Monterey County RCD:

http://www.rcdmonterey.org/Growers_Ranchers_Landowners/Planning_Design/irrigation_design.html

Irrigation Mobile Lab information of Coastal San Luis RCD:

http://www.coastalrcd.org/images/cms/files/FINAL_Mobile%20Lab_Coastal%20RCD.pdf

Irrigation Mobile Lab information of Upper Salinas-Las Tablas RCD, provides irrigation evaluations free of charge: <http://us-ltrcd.org/services/mobile-water-lab/>

Irrigation Mobile Lab information of Cachuma RCD:

http://www.waterwisesb.org/uploadedFiles/sbwater/brochures/Irrigation%20System%20Evaluations%20for%20Agriculture_English.pdf

Irrigation Mobile Lab information of Loma Prieta RCD:

Call Susan Meyer, RCD Director, at (408) 847-4171 or Michael Johnson at (831) 325-3376 or at delsol@calcentral.com

In 2012, the Resource Conservation Districts of the Central Coast updated and distributed the Handbook of Agricultural Conservation Practices. The handbook provides a description of management practices best suited for Central Coast conditions, with explanations, photos, and food safety considerations. The English version can be found at:

http://www.rcdmonterey.org/pdf/AgPracticesHandbook_english_2012.pdf

The Spanish version can be found at:

http://www.rcdmonterey.org/pdf/AgPracticesHandbook_spanish_2012.pdf

3. University of California, Division of Agriculture and Natural Resources (UCANR) and Cooperative Extension (UCCE)

The University of California, Division of Agriculture and Natural Resources (UCANR), and its 200 locally based UCCE farm advisors and specialists work with the agricultural industry to address environmental concerns, protect plant health, and provide farmers with scientifically tested production techniques with increased food safety. For a list of the counties UCCE offices go to: http://ucanr.edu/County_Offices/

UCANR specialists and farm advisors have developed a series of free general publications addressing all aspects of farming and management practices. To access all the free publications, go to: <https://ucanr.org/freepubs/freepubsub.cfm?cat=11>

UCANR has also developed a complete Farm Water Quality Planning Series, including publications related to irrigation, soil, water management practices, nutrient management goals and practices for cool-season vegetables, nursery and floriculture, strawberries, and for reducing nonpoint source pollution from irrigated agriculture. These publications can be found at: <https://ucanr.org/freepubs/freepubsub.cfm?cat=11&subcat=15>

For a list of UCANR newsletters for the vegetable production by crop type or topic, go to: http://vric.ucdavis.edu/main/veg_info.htm

Monterey County UCCE Irrigation and Water Resources, and the Vegetable Crop Programs provide information and education to address vegetable production issues such as nitrogen nutrient management. Every year they organize an Irrigation and Nutrient Management meeting, to provide updates on the latest information and technologies for irrigation and nutrient management. To access the meeting materials and presentations, and videos, go to:

http://cemonterey.ucanr.edu/Vegetable_Crops/

Blog: http://cemonterey.ucanr.edu/Vegetable_Crops/?search=yes

Santa Cruz County UCCE Strawberry and Caneberry Program provides information and education to address berry production issues such as nutrient management. Every year they organize strawberry and caneberry production meetings that covers information on nutrient management. For information, go to: http://cesantacruz.ucanr.edu/UC_Blogs/

4. The International Plant Nutrition Institute (IPNI)

The International Plant Nutrition Institute (IPNI) has developed scientific information about the responsible management of plant nutrition for the benefit of the human family. IPNI has promoted the use of the “4R Nutrient Stewardship”, an innovative approach for fertilizer best management practices adopted by the world’s fertilizer industry. The “4Rs” concept is a simple approach – apply the right source of nutrient, at the right rate, at the right time, and in the right place – but the implementation is knowledge-intensive and site-specific. This approach considers economic, social, and environmental dimensions of nutrient management and is essential to sustainability of agricultural systems. To learn more about the 4Rs approach or to access other publications and information, go to: <http://www.ipni.net/>

Information about the 4Rs approach in Spanish can be found at:
<http://nla.ipni.net/article/NLA-3007>

To download the “Usos Eficientes de Nutrientes” and other Spanish materials for free go to:
<http://nla.ipni.net/article/NLA-3008>

5. The California Department of Food and Agriculture (CDFA)

The California Department of Food and Agriculture (CDFA) is currently working on developing nutrient management plans and budget worksheet templates, which are important tools that growers can use to address nitrogen movement to waters of the state, including groundwater. The plans incorporate the “pump and fertilize” technique, that takes into account the nitrogen content of irrigation water prior to crop use so that any nitrogen fertilizer applied to the land can be reduced to prevent over-fertilization. CDFA is also currently developing a training and certification program on nutrient management plans coordinating with the California Certified Crop Advisor program. For information about the templates and the training programs, go to: http://www.cdfa.ca.gov/environmentalstewardship/Nutrient_Management.html

CDFA Fertilizer Research and Education Program (FREP) funds and facilitates research to advance the environmentally safe and agronomically sound use and handling of fertilizing materials, serving growers, agricultural supply and service professionals, extension personnel, public agencies, consultants, and other interested parties. For information about the FREP program, go to:
<http://www.cdfa.ca.gov/is/ffldrs/frep/index.html>

FREP has compiled extensive experimental field data related to plant nutrient efficiency and management over the past 20 years, to address the dual need of improving nutrient deficiencies and enhancing environmental stewardship. The information contained in the final FREP research reports can be found on the FREP web-based database. To access the research final reports and the database, go to: <http://www.cdfa.ca.gov/environmentalstewardship/FREP.html>

For a link to Fertilization Guidelines for Major Crops Grown in California based on research results from studies carried out in California and elsewhere, go to:
<http://apps.cdfa.ca.gov/frep/docs/intro.html>

6. Certified Crop Advisers (CCAs)

The Certified Crop Adviser Program (CCA) is a voluntary professional certification programs offered by the American Society of Agronomy (ASA). The CCAs are competent in all aspects of crop production and are up to date on the latest in crop management. They are best suited to

advise producers on fertilizer issues and use. To obtain information about the CCAs program, go to: <https://www.certifiedcropadviser.org/>

In California, there are over 400 CCAs providing advice to growers. For a link to the California CCA program and materials, go to: <http://www.cacca.org/>

To locate one of the 13,000+ Certified Crop Advisers (CCAs) or Certified Professional Agronomists (CPAGs) within your area, go to: <http://thatssoundadvice.com/find-a-cca> and search by Certification, Area of Expertise, City, State, Region or Zip code.

7. The Western Plant Health Association (WPHA)

The Western Plant Health Association (WPHA) promotes the environmentally safe and agronomically sound use of products for the production of safe and high quality food, fiber, and horticultural products. To access information about WPHA, go to: <http://www.healthyplants.org/index.html>

WPHA offers a variety of programs and committees. The Soil Improvement Committee promotes best management practices, hosts four nutrient education seminars each year, provides expertise, and writes and edits the various editions of the Western Fertilizer Handbook. The Western Fertilizer Handbook provides information about the amount of nutrients removed in the harvested portion of different crops. For a link to the Western Fertilizer Handbook and other WPHA educational materials, go to: <http://www.healthyplants.org/publications.html>

8. The Irrigation Association (IA)

The Irrigation Association (IA) is a national voluntary association of irrigation specialists. The IA promotes efficient irrigation technologies, water management and water use, provides information about state of the art products and services, and develops and organizes education materials and seminars for both water users (irrigators) and irrigation specialists. For general information about the IA and its educational programs, go to: <http://www.irrigation.org/>

For a list of online agricultural irrigation seminars, go to: <http://store.irrigation.org/SearchResults.aspx?Category=OLCLA>

To find a certified irrigation professional, go to: <http://www.irrigation.org/hirecertified/>
And search by last name, State, County, Zip code, or Distance.

NUTRIENT MANAGEMENT PRACTICES – USEFUL INFORMATION

The purpose of this section is to provide general information and references regarding irrigation and nutrient management practices, measures, and controls that can protect water quality. This list has been developed for general guidance and is not intended to be complete. Growers and professional consultants must evaluate all site specific recommendations in determining appropriate practice implementation.

Nitrogen Application Recordkeeping – Crop Manage

The amount of Nitrogen applied to crop land (from all sources) is one of the most important pieces of information that growers and professional consultants need to know to estimate the potential amount of Nitrogen lost to the environment. Nitrogen applied includes any product, form or concentration, of organic and inorganic fertilizers, slow release products, compost, compost teas, manure, extracts, and nitrate in irrigation water. Any amount of Nitrogen applied that exceeds the amount that can be taken up by the crop will be lost to the environment, and likely will leach to groundwater.

UC Cooperative Extension of Monterey County Irrigation, Water Resources advisor, developed an online recordkeeping tool for lettuce crops (now including other crops) available to all users. The online recordkeeping tool is called “CropManage”. CropManage uses farm/ranch information to develop recommendations on irrigation and nitrogen fertilizer management. The purpose is to help growers manage Nitrogen fertilizers efficiently while still maintaining commercial production. To learn more about CropManage, go to:

<http://ucanr.edu/blogs/CropManage/index.cfm>

To sign-up and start using CropManage, go to: <https://ucanr.edu/cropmanage/login/>

CropManage notes:

- 1) Crop Manage is currently available only for lettuce crops. Other tools for cole, strawberries, and caneberry crops are being evaluated and will be incorporated soon.
- 2) Recommendations will help a grower reduce nitrate leaching by better managing water and fertilizer, but will not assure that leaching of nitrate will not occur.
- 3) Currently, the nitrate contribution from irrigation water is not being considered in CropManage. Trials have begun to determine an algorithm for this calculation and is expected to be functional by 2014.

Application of Fertilizer and Other Products Converted to Units of Nitrogen

Total fertilizer applications must be converted to Pounds of Units of Nitrogen or Pounds of Nitrogen per acre, to be properly accounted in the nitrogen budget.

- A. Estimate the Nitrogen Contribution from Irrigation Water Containing Nitrate. Michael Cahn and Richard Smith from UCCE of Monterey County explain how to estimate Nitrogen contribution from irrigation water containing nitrate: <http://ucanr.edu/blogs/CropManage/index.cfm>
- B. Calculate Nitrogen Present in Conventional and Organic Certified Fertilizers (liquid, dry, pellets, etc.). The pounds of Nitrogen applied can be calculated by multiplying the % of Nitrogen content, found on the products label, by the amount of fertilizer applied to the field. Example: <http://www.oldhouseweb.com/gardening/analysis-or-fertilizer-grade.shtml>
- C. Estimate Nitrogen in Composted Materials.

The University of California Cooperative Extension has prepared a Series of Technical Bulletin regarding Manure management, under the Manure Management for California Certified Crop Advisers Program <http://manuremanagement.ucdavis.edu/>

The Manure Nitrogen Mineralization bulletin, has important information regarding mineralization rates and calculations to obtain the total amount of Nitrogen in compost: http://manuremanagement.ucdavis.edu/Resources/Manure_Technical_Guidance/

D. Use Organic Nutrient Sources.

The College of Agricultural Sciences, Agricultural Research and Cooperative Extension of Penn State prepared a guide on how to use N sources, which can be found at: http://www.aasl.psu.edu/using_organic_nutrient_soruces.pdf

Measurement of Soil Nitrogen/Nitrate Content – Nitrate Quick Test and Test Strips

Nitrate-form Nitrogen (NO₃-N) can build up in fields to levels high enough to supply crop nitrogen demand for an extended period. Sampling the root zone soil for NO₃-N concentration before Nitrogen fertilizer applications (or prior to side-dressing) can identify fields in which Nitrogen application can be delayed or reduced without affecting crop productivity.

Laboratory analysis is the most accurate method of soil nitrate determination, but a semi-quantitative estimate of soil nitrate concentration can be made using the on-farm 'nitrate quick test' procedure. The advantages of this procedure are: a) results can be obtained in less than an hour for most soils, and b) no weighing or drying of soil is required, although the user needs to estimate the soil(s) texture and moisture content.

Using the Nitrate Quick test has demonstrated that growers in the Salinas Valley are able to apply less Nitrogen fertilizers: <http://hortsci.ashspublications.org/content/37/7/1061.full.pdf>

For a simple explanation of the test procedure, go to:

<http://www.awqa.org/pubs/waterqual/soilnproced.pdf>

A more detailed explanation of the quick test is found in this newsletter article:

<http://cemonterey.ucdavis.edu/files/153199.pdf>

For a detailed explanation and the procedures to Use the Pre-Sidedressing Soil Nitrate 'Quick Test' to Guide Nitrogen Fertilizer Management, go to:

http://vric.ucdavis.edu/pdf/FERTILIZATION/fertilization&soil_Using%20the%20Pre-Sidedressing%20Soil%20Nitrate%20%E2%80%98Quick%20Test%E2%80%99%20to%20Guide%20N%20Fertilizer%20Management.pdf

Cachuma and Loma Prieta RCDs, can provide nitrate quick test kits to growers. Contact:

Cachuma RCD - Kevin Peterson at (805) 928-9269 x 106

Loma Prieta RCD - Susan Meyer at (408) 847-4171.

Nitrate-Nitrite test strips can be purchased from the following companies:

COMPANY NAME	CONTACT	PRODUCT NAME	WEB LINK
Macherey-Nagel	Phone: (484) 821-0984 Phone: (888) 321-6224 toll free Fax: (484) 821-1272 E-mail: sales-us@mn-net.com www.mn-net.com	QUANTOFIX® Nitrate / Nitrite test strips	http://www.mn-net.com/Testpapers/QUANTOFIXteststrips/QUANTOFIXNitratNitrit/tabid/10327/language/en-US/Default.aspx
Ben Meadows	Phone: (800) 241-6401 Fax (800) 628-2068 E-mail: mail@benmeadows.com www.benmeadows.com	Nitrate / Nitrite Nitrogen Test Strips	http://www.benmeadows.com/teststrips_36817065/?searchterm=nitrate%2bquick%2btest
LaMotte	Phone: (410) 778-3100 Phone (800) 344-3100 toll free Fax: (410) 778-6394 www.lamotte.com	Nitrate & Nitrite Insta-Test® Test Strips	http://www.lamotte.com/water_wastewater/product_line/test_strips.html
Hach	Phone: (800) 227-4224 Fax: (970) 669-2932 E-mail: techhelp@hach.com www.Hach.com	Nitrate and Nitrite Test Strips	http://www.hach.com/teststrips/category-products?productCategoryId=14371222342&secondPageNumber=1&piContext=USen&cfSectionOpen=0
VWR	Phone: (800) 932-5000 Email: technicalproductSupportNA@vwr.com us.vwr.com	Nitrate and Nitrite Test Strips	https://us.vwr.com/store/catalog/product.jsp?catalog_number=97026-442

Typical Nitrogen Crop Uptake

The amount of Nitrogen uptake (from the soil) by the crop is defined as the Typical Nitrogen Crop Uptake, and is an important piece of information that growers should consider as part of the Nitrogen Budget. This typical amount of Nitrogen uptake by the crop is the amount necessary to grow and produce the crop.

Growers should obtain specific information from industry and commodity groups and other local assistance providers regarding Crop Typical Nitrogen Uptake values by the different crop varieties, local conditions, and growing market goals. A single Nitrogen Uptake can significantly overestimate or underestimate the actual amount, and different values should be calculated based on genetics, soil conditions, environment, other. In the case where locally developed Typical Nitrogen Crop Uptake values are not available, growers should use information from published agronomic literature and research trials. Growers can also develop their own Typical Nitrogen Uptake values based on site specific analysis of the nitrogen concentration in the dry biomass of the crop(s).

The Central Coast Water Board has funded a series of grant projects to determine the Typical Amount of Nitrogen uptake for lettuce and strawberries. The results of the projects and a link to the final reports can be found at:

http://www.waterboards.ca.gov/centralcoast/water_issues/programs/grants/pge_grants.shtml

IPNI Multilingual Crop Nutrient Removal Calculator

This tool provides crop nutrient removal estimates for a broad, and continually expanding, list of field crops. The nutrient removal calculator shows the amount of nutrient(s) the crop or a part of crop (grain, seed, nuts etc.) will remove/uptake from the soil. Results are calculated based on user-selected yield goals and can be displayed in either metric or US/Imperial units; is also fully accessible in six languages including English, French, Spanish, Portuguese, Russian, and Chinese (Mandarin).

Compatible with all computer and mobile devices, the Crop Nutrient Removal Calculator is freely available at: <http://ipni.info/calculator>

Nitrogen Removed at Harvest

During harvest, certain parts of the plant are removed from the field to be consumed. The parts removed contain amounts of Nitrogen and other nutrients in them. These nutrients are defined as the nutrients removed in the harvested portion of the crop or nutrients removed at harvest. The Typical Nitrogen Crop Uptake value is different than the amount removed at harvest, since the first includes the Nitrogen stored in parts of the plants that are not removed from the field, such as the roots.

The parts of the plants that are not removed at harvest remain on the field(s) and ultimately, are re-mineralized into single nutrient elements by the act of bacteria and other soil organisms decomposing the residues of the crop. These re-mineralized nutrient elements can be uptaken by subsequent crops as long as they remain in the root-zone and are available at the time of uptake.

The Western Fertilizer Handbook, from the Soil Improvement Committee, provides information about the amount of nutrients removed in the harvested portion of different crops. For a link to the Western Fertilizer Handbook and other WPHA educational materials, go to: <http://www.healthyplants.org/publications.html>

General information regarding the amount(s) of nutrient removed at harvest by different crops can be obtained from the following databases:

1. NRCS: USDA tool for calculating the approximate amount of nitrogen, phosphorus, and potassium removed by the harvest of agricultural crops: <http://plants.usda.gov/npk/main>
2. IPNI: nutrient removal or the quantity of nutrients removed in the harvested portion of the crop: <http://www.ipni.net/article/IPNI-3346>
3. University of California Fruit, Nuts and Vegetable Research & Information Centers: <http://ucanr.org/sites/nm/Crop/>

Organic Farms – Soil Available Nutrients

The philosophy of organic food production maintains certain natural principles: biodiversity, ecological balance, sustainability, natural plant fertilization, natural pest management, and soil integrity. The organic farming philosophy promotes the idea that long-term soil health depends on high levels of organic matter (which are thought to be more readily usable to plants than

chemical fertilizers) to restore nutrient balance and retain moisture. Nutrients for the plant are applied to the soil as organic amendments, like compost, are stored as soil organic matter, and slowly released for the roots uptake. Because the source of nutrients is the soil organic matter, it's important for growers to estimate the amount of nutrient released (mineralized) during the crop growing season.

There are two (2) methods that can be used to estimate the amount of Nitrogen released (mineralized) from the soil organic matter:

1. Currently employed. The total soil organic matter (SOM) measurement, includes a calculation to estimate the amount of Nitrogen available.
2. The Soil Respiration or soil biological CO₂-burst method. The amount of soil respiration is an indicator of nutrients contained in organic matter being converted to forms available to crops (e.g., phosphate as PO₄, nitrate-nitrogen as NO₃, and sulfate as SO₄). The method measures the amount of CO₂-C released in 24 hours from soil microbes after the soil has been dried and rewetted. Note: This is only a measure of the microbial activity in the soil - highly related to the fertility of your soil. The Solvita soil respiration test, while theoretically useful, has not been calibrated for California soils, and the results do not give a quantitative estimation of soil N mineralization potential. The laboratories provide a numerical score that cannot be translated to an actual estimate of Nitrogen mineralization.

For more information about soil respiration measures and Nitrogen release estimation, go to: http://pubs.ext.vt.edu/452/452-400/452-400_pdf.pdf

The following laboratories perform the Soil Respiration method in California:

1. Denele Analytical Laboratory. Located in Turlock Hanford, and Woodland.
Email: info@denelelabs.com
Website: <http://www.denelelabs.com/>
Phone: (209) 634 – 9055
Phone: (559) 584 – 2616
Phone: (530) 666 – 9056
2. Precision Agri-Lab. Located in Madera.
Email: scott.fichtner@cpsagu.com
Website: <http://www.precisionagrilab.com/>
Phone: (559) 661 – 6386

For general information on the amount of Nitrogen released from the soil organic matter, go to: [http://www.ipni.net/ipniweb/pnt.nsf/5a4b8be72a35cd46852568d9001a18da/11a3bd7928909c3a062579560056f104/\\$FILE/%236%20IPNI%20PNT%20Winter%202011.pdf](http://www.ipni.net/ipniweb/pnt.nsf/5a4b8be72a35cd46852568d9001a18da/11a3bd7928909c3a062579560056f104/$FILE/%236%20IPNI%20PNT%20Winter%202011.pdf)

NRCS has developed a simple tool to calculate the amount of Nitrogen and Phosphorus available from Composted Manure using a decay series. The spread sheet uses the decay series prepared by Dr. Merle F. Vigil. To use the USDA–Agricultural Research Services tool, go to: <http://www.ars.usda.gov/Services/docs.htm?docid=19206>

Phosphorus Management

The use of animal manure as a primary source of nitrogen commonly results in applications of phosphorus and potassium at rates that exceed crop needs. Over time, these elements build up in the soils and can cause adverse impacts. For example, phosphorus will leave the land application area in surface runoff and contribute to excessive algae growth in receiving waters. Application of Phosphorus at agronomic levels, along with reasonable erosion control and runoff control measures, should prevent such problems.

Soil Phosphorus concentrations measurement. The sampling of Phosphorus-Phosphate concentration in the soil should be measured field by field. Ideally, the samples should be taken block by block every 2 year to determine the concentration of P-Phosphate in the root zone.

Recommended Methodology:

For Acidic soils: pH < 6.0, the Bray-1 method is recommended;

For Slightly acid to slightly alkaline soils: pH 6.0 to 7.2, the Bray-1 and the Olsen methods are recommended;

For Alkaline, calcareous soils: pH > 7.2, the Olsen method is better suited.

Soils with concentrations between 60 to 100 ppm, should be managed such that an average concentration of 60-80 ppm is maintained. Applications of Phosphorus fertilizer on soils with values above 100 ppm, should be based on professional recommendation, such as the CCA, before the application is made.

Program to Predict Field-Scale Phosphorus Loss In Runoff

Scientists from the Agricultural Research Service (ARS) developed a comprehensive and consistent system for modeling phosphorus loss. The spreadsheet program can predict field-scale phosphorus loss in runoff for a whole year, and can also be used in many different states to quantify field-scale phosphorus loss and soil phosphorus changes over 10 years for a given set of runoff, erosion, and management conditions. To access this tool, go to: <http://www.ars.usda.gov/is/pr/2013/130418.htm>

IRRIGATION MANAGEMENT PRACTICES – USEFUL INFORMATION

Irrigation System Evaluations – Irrigation Mobile Labs

Irrigation System Distribution Uniformity

The Mobile Irrigation Labs assist growers by evaluating the distribution uniformity (DU) of their irrigation system. DU calculates how evenly water is applied to the field during an irrigation event. It is proven that a better DU can lead to better fertilizer application, irrigation efficiency, help reduce water losses and therefore minimize the potential for nitrate leaching. Improving the irrigation system DU is the first step towards improving irrigation efficiency, the second piece of information that must be considered is the irrigation application scheduling, or frequency and duration of the irrigation sets.

Irrigation Scheduling

There are different approaches for improving the irrigation scheduling, for example by:

- Evaluating weather information and crop water demand,
- Monitoring soil moisture content, or
- Monitoring the crop water status

Evaluating Weather Information and Crop Water Demand

1. California Irrigation Management Information System (CIMIS)

The California Irrigation Management Information System (CIMIS) is a program of the Office of Water Use Efficiency (OWUE), California Department of Water Resources (DWR) that manages a network of over 120 automated weather stations in the State of California. CIMIS was developed in 1982 by DWR and the University of California, Davis to assist irrigators in managing their water resources efficiently. For more information, go to:

<http://www.cimis.water.ca.gov/cimis/welcome.jsp>

2. Terrestrial Observation and Prediction System (TOPS) Satellite Irrigation Management Support (SIMS)

Earth-resource satellites were used to map crop development and crop water demand throughout California's Central Valley, Central Coast, and North Coast at quarter acre resolution during the 2010-2012 time period. Through this prototype interface, users may view maps and inspect/download time-series trends of selected data layers at user-specified locations. The datasets are intended to provide additional information about crop canopy conditions and irrigation demand for agricultural producers and water managers. For more information, go to:

<https://nex.nasa.gov/nex/projects/1309/>

3. Cal Poly Irrigation Training and Research Center

This website offers two types of evapotranspiration data:

Monthly Crop Evapotranspiration (ET_c) used for Water Balances and Irrigation Scheduling and Design. Evapotranspiration values in this water balance category have been adjusted for decreases in vigor and bare spots. These values are best estimates of evapotranspiration throughout California. <http://www.itrc.org/etdata/etmain.htm>

4. Wateright

The Wateright site was developed by the Center for Irrigation Technology at California State University, Fresno with support from the US Bureau of Reclamation. An important resource of the site is the irrigation scheduling programming that helps users develop site-specific, seasonal irrigation schedules. Wateright is connected to the California Irrigation Management Information System (CIMIS). These weather stations provide the scheduling routines with reference evapotranspiration data for specific areas. <http://www.wateright.org/>

Monitoring Soil Moisture Content

For information about soil moisture monitoring and irrigation scheduling, go to:

<http://www.extension.org/sites/default/files/w/d/db/SoilWaterSensors.pdf>

http://agwaterstewards.org/index.php/practices/irrigation_management/

http://aginnovations.org/agwaterstewards.org/uploads/docs/Hal_Warner_measuring_soil_moisture.pdf

Monitoring the Crop Water Status

This method is mostly used on deciduous orchards and vineyards. For more information, go to:

<http://www.practicalwinery.com/novdec01p42.htm>

http://fruitsandnuts.ucdavis.edu/pressure_chamber/