Department of
LAND, AIR AND WATER RESOURCES
University of California, Davis
Climate Change • Sustainable Agriculture
Environmental Quality • Landscape Processes

FERTILIZER RESEARCH AND EDUCATION PROGRAM
FREP

Accessing FREP Nutrient Management Information

Daniel Geisseler, William R. Horwath

Department of Land, Air and Water Resources,
University of California, Davis

Content

- Objectives
- Accessing FREP data:
  - Past: Full reports
  - Present: Searchable database
  - Future additions: Fertilization guidelines for major crops
- Summary

Project objectives

Make research data and findings from FREP-funded projects readily available to growers and crop advisors through a user-friendly, web-based, database.

- ⇨ Develop a database together with CDFA IT.
- ⇨ Enter key information from technical reports, including a summary of the methods used and the major findings into the database.
- ⇨ Research additional data for each report.

Previous presentation of FREP data: Access through homepage

FERTILIZER RESEARCH AND EDUCATION PROGRAM

1220 N Street, Sacramento, CA 95814 • 916-900-5022 • Fax: 916-900-5349 • frep@cdfa.ca.gov

INFORMATION ABOUT FREP

- FREP Fact Sheet
- 2012 Request For Project Solicitation (RFPS)
- 2012 Full Proposal Submittal Requirements
- 2011 CDFA/WPHA Conference November 16 & 17 Tulare, CA
- 2011 Conference CEU's
- FREP Conference Proceedings
- FREP Competitive Grants Program
- FREP Research Projects – Completed
- FREP Research Projects – Ongoing
- FREP Publications
- FREP Videos
- About Fertilizer
- Other Related Links

Our Mission

Laws & Regulations

Search Staff Directory

FFLDRS Database

MORE RESOURCES

The American Society of Agronomy - California Chapter

Association of American Feed Control Officials

Association of American Plant Food Control Officials

CA Dept. of Health Services

CA Dept. of Pesticide Regulation

California Certified Crop Advisor Program

California Fertilizer Association

California Grain and Feed Association

National Grain and Feed Association

U. S. Department of Agriculture

U. S. Food and Drug Administration

Western Plant Health Association

CALIFORNIA AND THE 2012 Farm Bill

Previous presentation of FREP data: List of completed projects

FIELD CROPS (1991 - 2008)

2008

- **Fertility Management in Rice**
  Project Leaders: Chris van Kessel and B. Linquist

2007

- **Effects of Cover Cropping and Conservation Tillage on Sediment and Nutrient Losses to Runoff in Conventional and Alternative Farming Systems**
  Project Leader: William R. Horwath
- **Practical Soil Test Methods for Predicting Net N Mineralization**
  Project Leader: William R. Horwath
- **Site-Specific Variable Rate Fertilizer Nitrogen Application in Cotton**
  Project Leader: Richard E. Plant, et. al.
- **Soil-Solution Partitioning of Trace Elements in Cropland Soils of California: Estimating the Plant Uptake Factors of As, Cd, and Pb**
  Project Leader: Andrew C. Chang

2006

- **Ammonia Emissions Related to Nitrogen Fertilizer Application**
  Project Leader: Charles F. Krauter
- **Crop Nitrate Availability and Nitrate Leaching under Micro-Irrigation for Different Fertigation Strategies**
  Project Leaders: Blaine Hanson, Jan W. Hopmans

Previous presentation of FREP data: Final reports

Effects of Cover Cropping and Conservation Tillage on Sediment and Nutrient Losses to Runoff in Conventional and Alternative Farming Systems

Project Leaders

William R. Horwath
Dept. of Land, Air, and Water Resources
University of California
Davis, CA

Wes Wallender
Dept. of Land, Air, and Water Resources
University of California
Davis, CA

Aaron Ristow
Dept. of Land, Air, and Water Resources
University of California
Davis, CA

Samuel Prentice
Dept. of Land, Air, and Water Resources
University of California
Davis, CA

Zahangir Kabir
Dept. of Land, Air, and Water Resources
University of California
Davis, CA

Jeff Mitchell
Dept. of Plant Sciences
University of California
Davis, CA

OBJECTIVES

1. Quantify discharge from research plots and grower fields to compare alternative management practices with conventional ones.
2. Quantify non-point source pollutions (NPSP) concentrations and loads in discharge.
3. Inform farmers, policymakers, and the general public about the usefulness of cover crops (CC) and conservation tillage (CT) in addressing nutrients losses.

40 Pages

The new database:
Access through homepage

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- 2012 FREP Conference Mailer
- 2012 FREP Conference Registration Form
  Use this PDF form to submit your conference registratio
- Searchable Database of FREP Research Projects
- FREP Fact Sheet
- 2012 FREP Special Request for Proposal
- 2012 FREP Full Proposal Submittal Requirements - Special RFP
- 2012 FREP Grant Outreach and Reporting Requirements
- 2011 CDFA/WPHA Conference November 16 & 17 Tulare, CA
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GENERAL INFO

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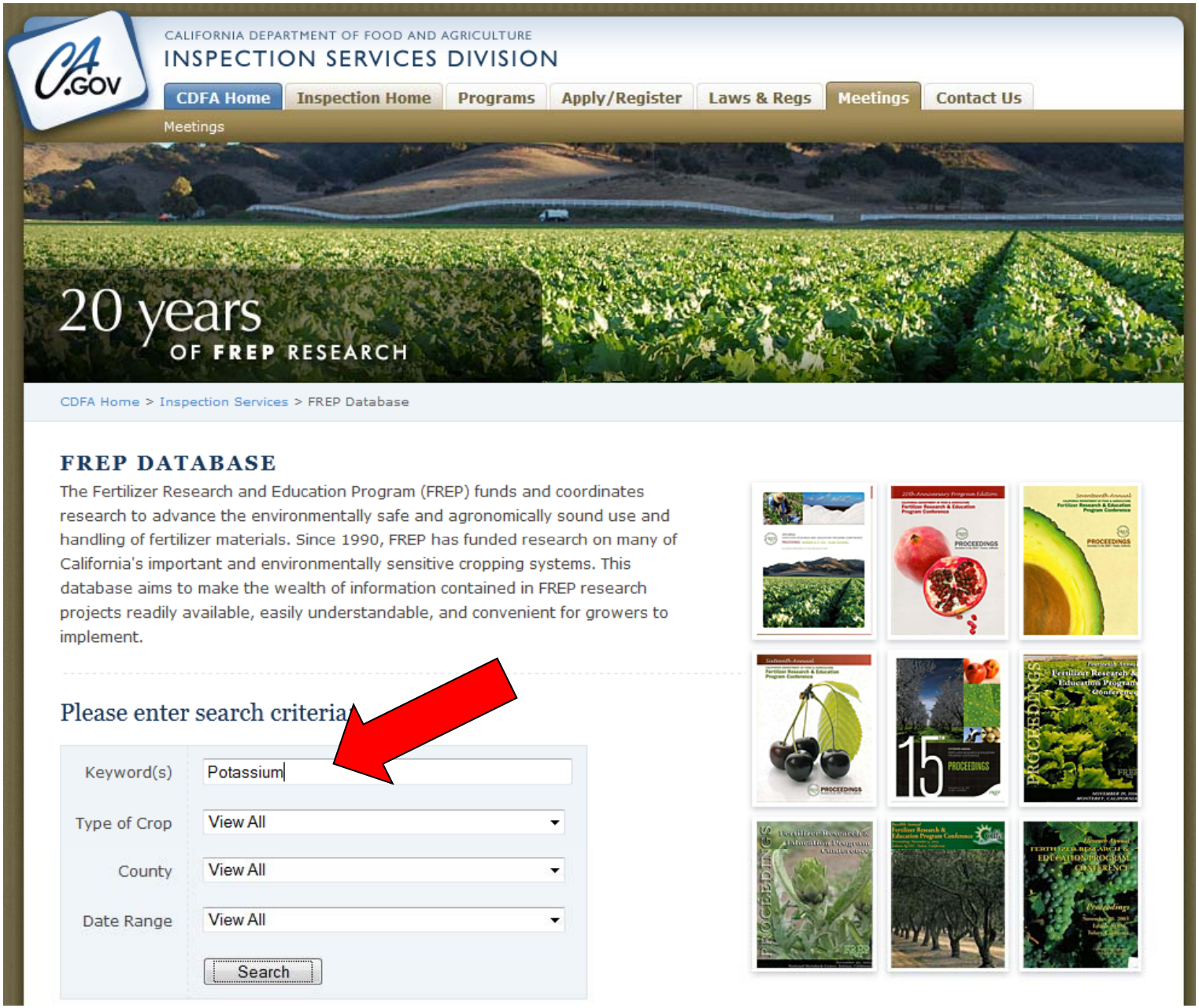
- California Grain and Feed Association
- National Grain and Feed Association
- U. S. Department of Agriculture

The new database: Search options

The new database:
Search options

The new database: Search options



The new database:
Level 1: List of FREP reports

FREP DATABASE

Search results:

Study Title	County	Crop Type
Can We Predict K Fixation in the San Joaquin Valley from Soil Texture and Mineralogy?	Fresno, Kings, Tulare, Kern	Cotton
Citrus Yield and Fruit Size Can Be Sustained for Trees Irrigated with 25% or 50% Less Water by Supplementing Tree Nutrition with Foliar Fertilization	Riverside	Citrus
Crop Management for Efficient Potassium Use and Optimum Winegrape Quality	Napa, Sonoma	Grapes
Crop Nitrate Availability and Nitrate Leaching under Micro-Irrigation for Different Fertigation Strategies	Site-independent computer simulation	Tomato, Strawberry, Grape, Citrus
Determination of Nursery Crops Yields, Nutrient Content, and Water Use for Improvement of Water and Fertilizer Use Efficiency	Yolo	Nursery crops
Development of Fertilizer and Irrigation Practices for Commercial Nurseries	Yolo	Nursery crops
Effect of Cover Crop or Compost on Potassium Deficiency and Uptake, and on Yield and Quality in French Prunes	Butte	Prune

The new database:
Level 2: Report summaries

STUDY RECORD

Can We Predict K Fixation in the San Joaquin Valley from Soil Texture and Mineralogy?

Pettygrove G.S., and Southard R.J., Department of Land, Air and Water Resources, University of California, Davis

Highlights

- Soils formed in Sierra Nevadan alluvium tend to fix K.
- Samples with exchangeable K levels of 50 ppm or less always fixed K, while samples with >200 ppm exchangeable K did not fix K.
- Soils formed in Coastal Range alluvium do not fix K.

Introduction

Vermiculite is the soil mineral present in San Joaquin Valley soils that is responsible for making potassium (K) unavailable or less available to the cotton plant during flowering and boll fill. In spite of much research to relate this problem to field symptoms and to develop diagnostic criteria, no one has described the location of K-fixing soils.

The objective of this research was to use information from digitized USDA country soil survey databases to map the location of soils in the San Joaquin Valley cotton production areas that potentially possess a high capacity to fix K in mineral interlayers.

Methods/ management

The study covered the cotton production areas of Fresno, Kings, Tulare, and Kern counties in the southern San Joaquin Valley.

Crop
Cotton

County
Fresno, Kings, Tulare, and Kern

Years of study
1997-1999

Fertilization guidelines
- Cotton

FREP Article
Final Report

FREP Proceedings 2001: Page 75

FREP Proceedings 2002: Page 61

FREP Proceedings 2003: Page 107

External links:
Pettygrove et al. 2011: Better crops

The new database:
Level 3: Final reports

Completed

CAN WE PREDICT K FIXATION IN THE SAN JOAQUIN VALLEY FROM SOIL TEXTURE AND MINERALOGY?

M. Murashkina, R.J. Southard, G.S. Pettygrove, A.T. O'Geen
Department of Land, Air & Water Resources
University of California
Davis, CA
B.A. Roberts, D.S. Munk, B.H. Marsh, and S.D. Wright
University of California Cooperative Extension
(respectively) Hanford, Fresno, Shafter, and Tulare, CA

Abstract

We developed a map showing the location of potentially K-fixing soils in cotton-producing areas of Fresno, Tulare, Kings, and Kern Counties in the southern San Joaquin Valley, California. The map was produced from seven digitized soil surveys (NRCS SSURGO database) and a California Department of Food & Agriculture cotton database. The criteria for soil map unit selection included (1) age of soil as indicated by degree of horizonation, with younger soils presumed to have more potential for K fixation (2) formation of the soil on Sierra Nevadan parent material, which is more likely to contain vermiculite (the K-fixing mineral) formed from biotite mica, and (3) coarse to medium texture, as indicated by soil taxonomy family level texture. Laboratory measurement of K fixation by a modified Cassman incubation method and conventional x-ray diffraction supports this model, but further studies, including measurement of K fixation in a larger number of fine-textured soils with Sierra Nevada genesis and measurements across a chronosequence must be completed in order to confirm it.

Introduction

Forty to fifty years ago, University of California researchers proved that vermiculite is the soil mineral present in San Joaquin Valley soils that is responsible for making potassium unavailable or less available to the cotton plant during flowering and boll fill. In spite of much research conducted over the past 50 years to relate this problem to field symptoms and to develop diagnostic criteria, no one has described the location of K-fixing soils. Miller et al. (1997) state that 60% of the cotton-producing land in the San Joaquin Valley (SJV) is vermiculitic; however, they do not cite the source of this estimate. With the introduction of digital soil surveys by the USDA, we asked whether it might be possible to identify and produce maps showing potentially K-fixing soils based on soil texture, mineralogy or other soil properties contained in the electronic database.

The new database:
Accessing fertilization guidelines

STUDY RECORD

Can We Predict K Fixation in the San Joaquin Valley from Soil Texture and Mineralogy?

Pettygrove GS, Southard RJ, Department of Land, Air and Water Resources, University of California, Davis

Highlights

- Soils formed in Sierra Nevadan alluvium tend to fix K.
- Samples with exchangeable K levels of 50 ppm or less always fixed K, while samples with >200 ppm exchangeable K did not fix K.
- Soils formed in Coastal Range alluvium do not fix K.

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The objective of this research was to use information from digitized USDA country soil survey databases to map the location of soils in the San Joaquin Valley cotton production areas that potentially possess a high capacity to fix K in mineral interlayers.

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Crop
Cotton

County
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Years of study
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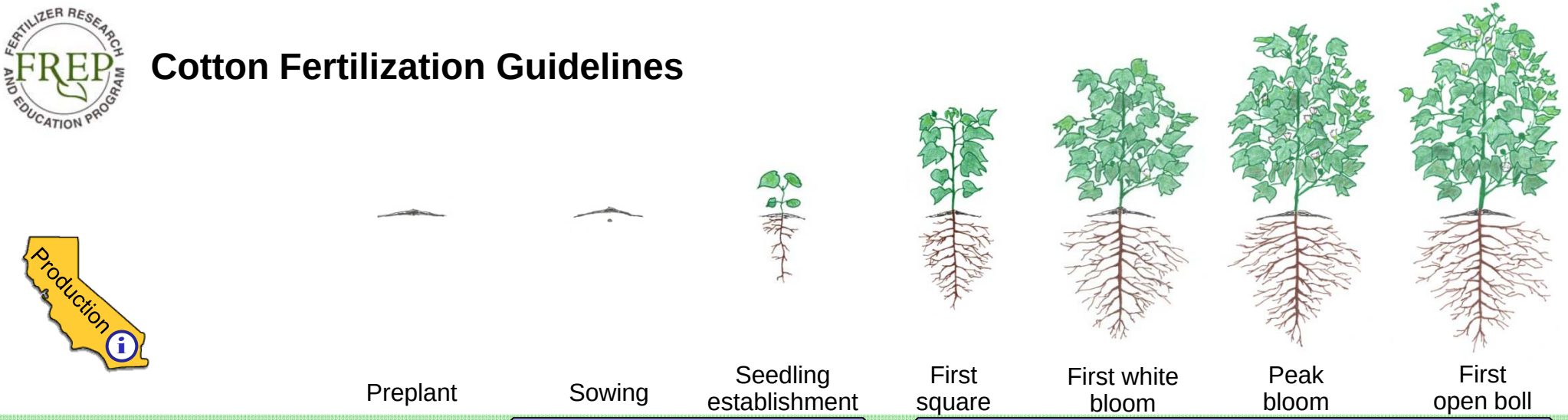
External links:
Pettygrove et al. 2011: Better crops

Cotton Fertilization Guidelines



Nitrogen (N)

- Soil test
- Petiole analysis
- Pre-plant N
- Starter N
- Sidedress N
- Foliar N

Potassium (K_2O)

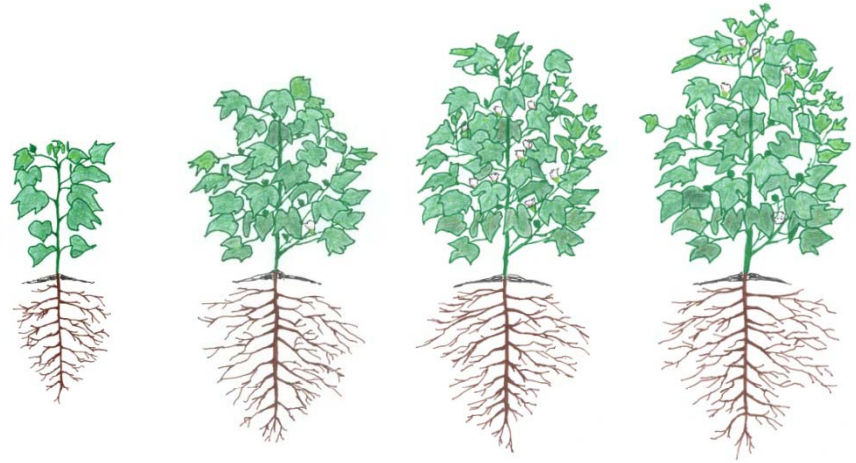
- Soil test
- Petiole analysis
- Pre-plant K
- Starter K
- Sidedress K
- Foliar K

List of references

Links:

- University of California Cotton Production Information
- National Cotton Council of America
- The Cotton Pickin' Web
- California Cotton Ginners and Growers Associations (CCGGA)

Cotton Fertilization Guidelines



Production

Nitrogen (N

Potassium

ng
ment

First square

First white bloom

Peak bloom

First open boll

Petiole analysis

Sidedress N

Foliar N

Petiole analysis

Sidedress K

Foliar K

Sidedress Nitrogen

Application Rate

N requirement of cotton strongly depends on the yield level. The N fertilization rates for different cotton yield levels grown in soils with nitrate-N levels below 50 lbs/acre are listed below [43]. Approaches to determine a realistic yield goal are discussed here.

Yield goal (bales/acre)	Yield goal (lbs lint/ acre)	N fertilization (lbs N/acre)
1.5	750	55
2	1000	115
2.5	1250	170
3	1500	200
3.5	1750	200

Adapted from [43].

Another factor that needs to be taken into account is the type of cotton grown. In general, N application rates to Pima cotton are lower compared to Acala cotton due to slightly lower yields and the sensitivity of Pima cotton to excess N [37]. A 2-year study in the San Joaquin Valley found no increase in Pima cotton yield when the available N (residual soil nitrate-N plus fertilizer N) exceeded 150 lbs/acre [4, 15].

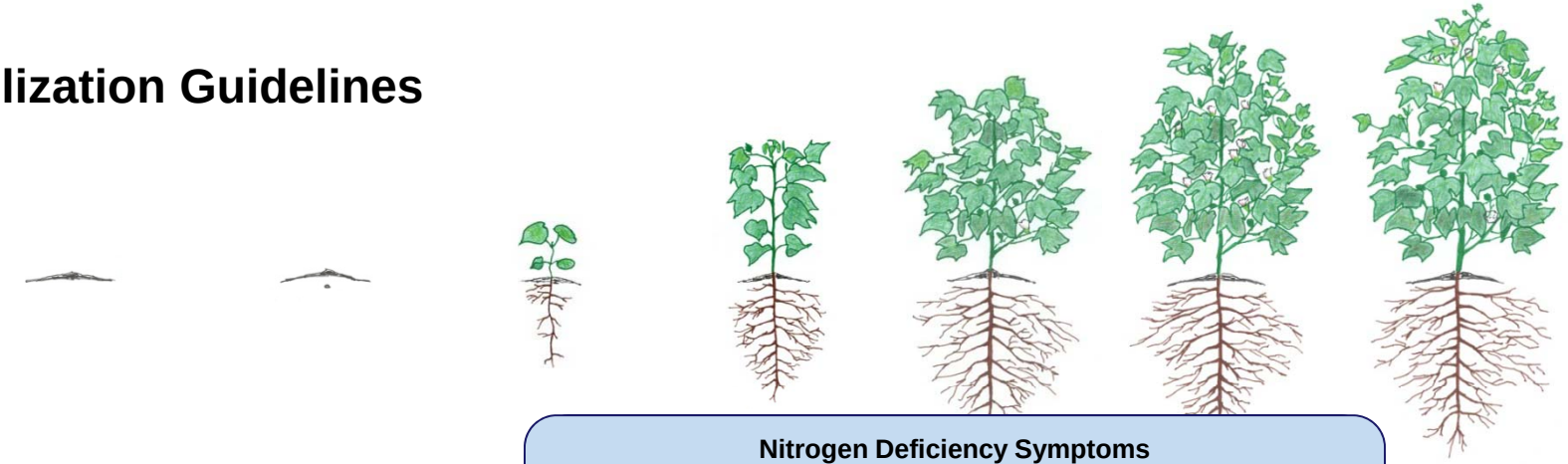
The optimal fertilizer rate also depends on the fertilizer application costs relative to the price of cotton that can be realized. The maximum yield is generally not the most profitable yield, as the yield increase diminishes with each additional pound of N added. Therefore, the economically optimal yield may be considerably below the maximum yield.

Mode of Application

Fertilizer Type

Time of Application

Cotton Fertilization Guidelines



Production

Preplant | Sowing | Se estab | First open boll

Nitrogen (N)

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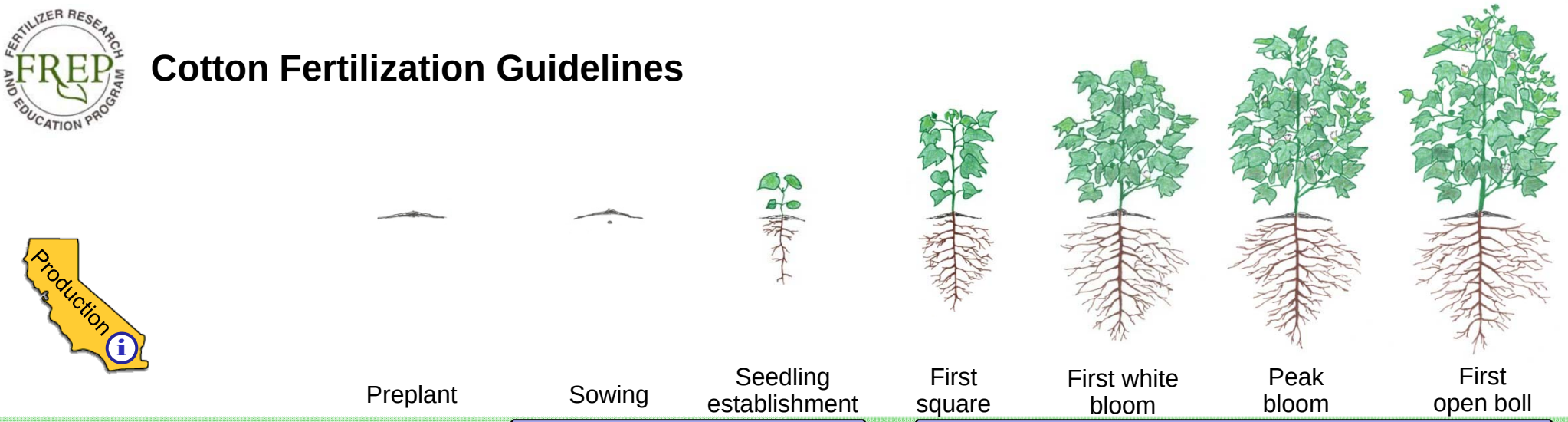
Nitrogen Deficiency Symptoms

Nitrogen deficiency results in pale green leaves (see picture). The symptoms first appear on the older leaves. In addition, growth of the plant is stunted and the development of vegetative branches reduced. Bolls may be shed soon after flowering. When N deficiency occurs later in the season, leafs may turn purple, and bolls at late fruiting positions may be shed [43].

A healthy (left) and a nitrogen deficient cotton leaf (right; photo provided by the International Plant Nutrition Institute; www.ipni.net).

While insufficient N reduces crop growth and lint yield, excessive N can cause difficulties in defoliation, harvest, and may reduce lint yield [22]. Furthermore, high N application rates may increase aphid populations. In a FREP-funded study carried out in the San Joaquin Valley, Godfrey and Hutmacher found that cotton aphid infestations were more severe with 200 lbs N/acre than with lower N application rates [1]. Aphid levels were especially high in plots where high N rates and the pyrethroid insecticide Capture (to control lygus bug populations) were applied.

Cotton Fertilization Guidelines



Soil Nitrate Test

Soil samples for nitrate analysis should be taken near planting time or at least 3 weeks after the last N application [43]. As cotton is a deep rooting crop, samples should be taken to a depth of at least two feet. The distribution of nitrate in the soil profile is very variable. For this reason, the estimation of the potentially available N is improved by taking samples deeper than 2 feet [2]. The Cotton Production Manual recommends taking samples from the top 3 feet of soil [43]. Due to the variability of nitrate in the soil, care must be taken that the sample is representative for the field (see Sampling for Soil Nitrate Determination).

The soil nitrate test measures the plant available N at the time of sampling. Its level depends on a number of factors (see Factors Affecting Soil Nitrate Concentrations in Spring). Therefore, the test result is field specific and needs to be determined every year.

In a study with FREP support carried out in the San Joaquin Valley between 1996 and 2000, Hutmacher and collaborators found that the residual nitrate–N level in spring can be fully subtracted from the crop N requirements to determine the amount of fertilizer N that needs to be applied [2].

Additional information

Sampling for Soil Nitrate Determination

Daniel Geisseler

Time of sampling

- Soil samples for nitrate are either collected near planting time (generally referred to pre-plant nitrate test; PPNT), or just before the main N application is due (pre-sidedress nitrate test; PSNT).
- In both cases, samples should be taken at least 3 weeks after the last nitrogen (N) application.

Sampling procedure

- The nitrate content in the soil is spatially very variable. For this reason, a minimum of 20 cores need to be taken for one sample [5]. When soil properties or plant development differ within a field, the field should be divided into different management areas with similar characteristics and a sample from each area should be taken [5].
- Cores are taken with a sampling probe or auger from the entire area of the field or management area by walking a zigzag course around or through the area (Figure 1). For a representative sample, (i) do not sample where fertilizer has been applied recently, (ii) do not sample unusual areas, such as corners, edges of former fields or fence rows that are now in the field, and (iii) remove surface residues before taking a core [2].
- Collect the samples in a clean plastic bucket [5].
- The sampling depth depends on the rooting depth of the crop.

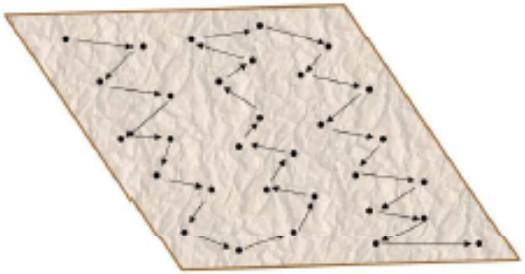
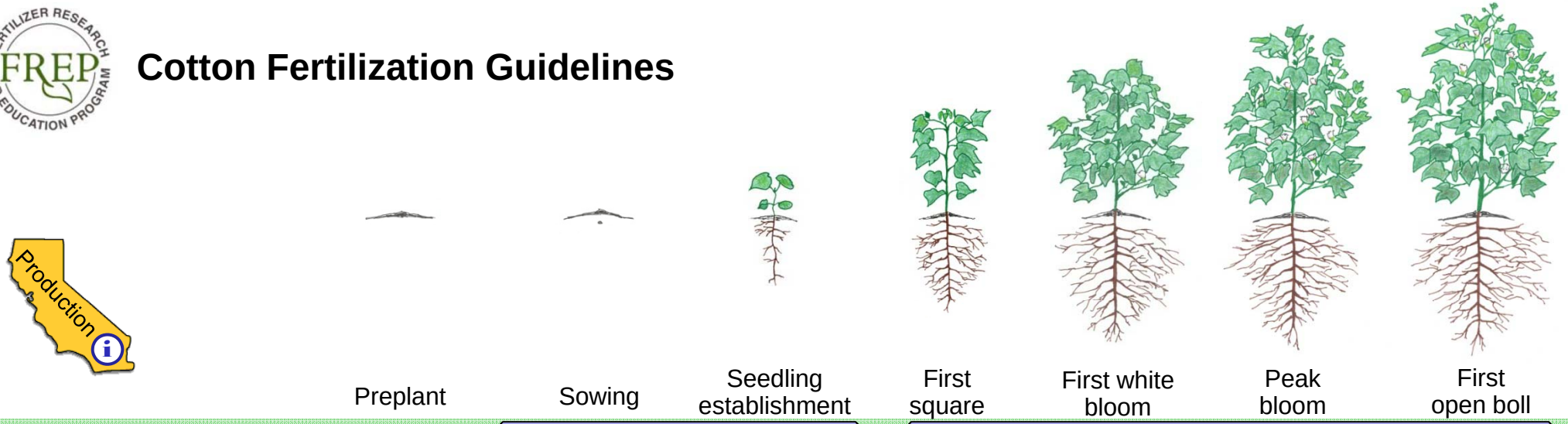


Figure 1: Soil sampling plan for a representative sample from a field or management area.

Sample handling

Cotton Fertilization Guidelines



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- National Cotton Council of America
- The Cotton Pickin' Web
- California Cotton Ginners and Growers Associations (CCGGA)

Summary

- Data from completed projects has been entered into database
- The database is accessible online:

www.cdfa.ca.gov/is/frep/

- Fertilization guidelines for major crops are being written
- Guidelines and database will be linked with each other

Acknowledgements

- FREP
- Asif Maan
- Amrith Gunasekara
- FREP team
- Hence Philipps from CDFA-IT