Educational Assistance in the Arroyo Colorado

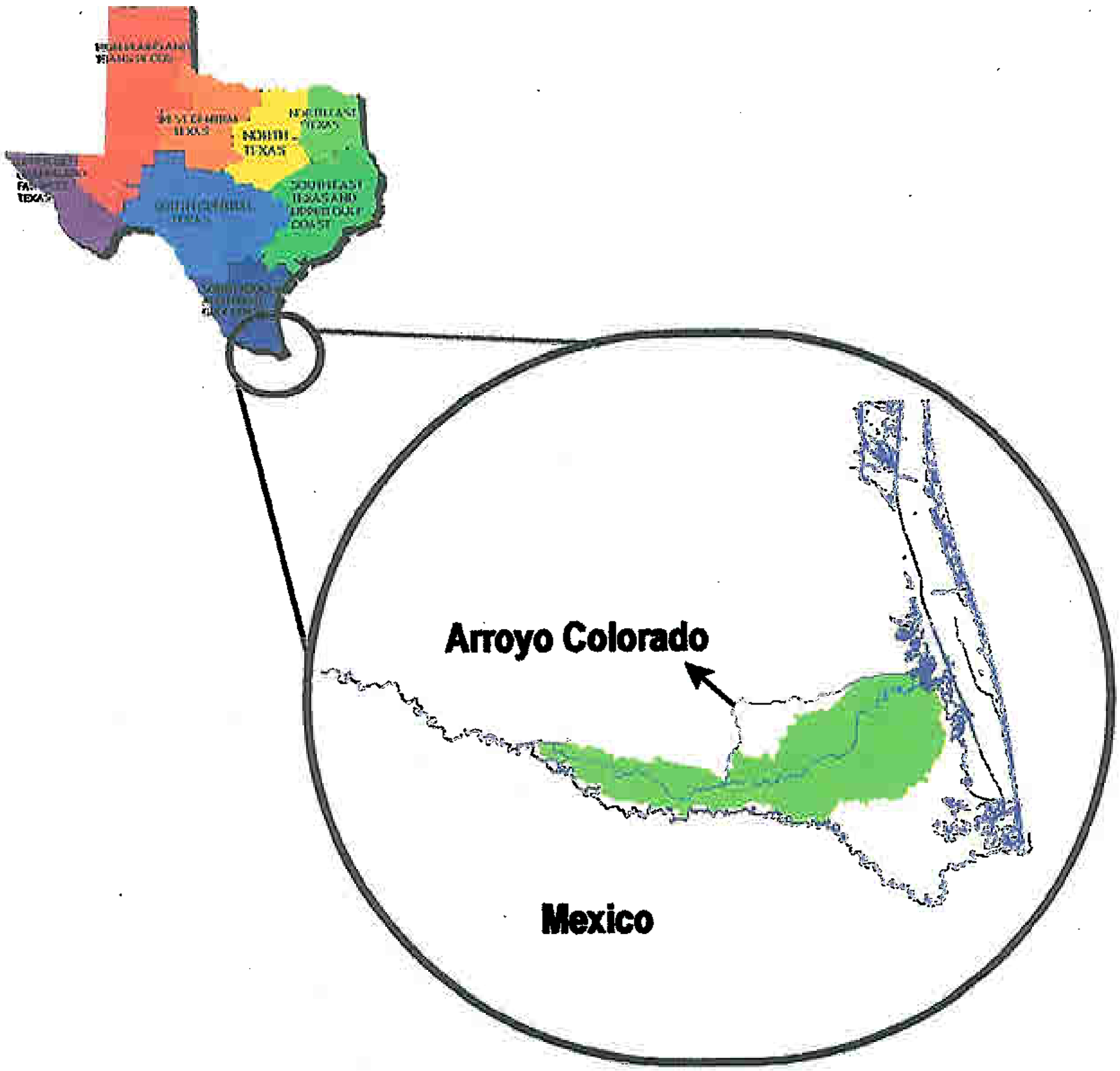
(Primera.tamu.edu/ir4/ARR2.htm)

Final Report

Project Number 97-7;Contract Number C9-996236-04-0 CWA Section 319 (h)
Prepared for the Texas State Soil and Water Conservation Board

Educational Assistance in the Arroyo Colorado

(Primera.tamu.edu/ir4/ARR2.htm)



Final Report, August 2001

Texas State Soil and Water Conservation Board

CWA Section 319 (h)

Project Members:

Mr. Charles Stichler, TAEX, Professor and Extension Agronomist
Dr. Mark McFarland, TAEX, Associate Professor and Soil Fertility Specialist
Dr. Leonel Espinoza, TAEX, Extension Associate - Water Quality
Mr. Brian Rigsby, TAEX, Extension Associate - Water Quality

EDUCATIONAL ASSISTANCE IN THE ARROYO COLORADO

FINAL REPORT

PREPARED FOR THE TEXAS STATE SOIL AND WATER CONSERVATION BOARD
PROJECT NUMBER 97-7;CONTRACT NUMBER C9-996236-04-0
CWA SECTION 319 (h)
AUGUST 2001

Final report prepared by Leonel Espinoza, Texas Agricultural Extension Service

Texas Agricultural Extension Service
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(956) 968 5581 • FAX (956) 969 5639

EDUCATIONAL ASSISTANCE IN THE ARROYO COLORADO

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August 2001

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FY98 EPA CWA Section 319(h)

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FY98 EPA CWA Section 319(h)

Executive Summary

The Texas State Soil and Water Conservation Board initiated a project entitled "Water Quality Management Plan Implementation Assistance in the Arroyo Colorado River Basin." The project was designed to work cooperatively with local Soil and Water Conservation Districts in the Arroyo Colorado Watershed to provide technical and financial assistance to landowners in implementation of Water Quality Management plans (WQMPs).

The overall objective of the Educational Assistance in the Arroyo Colorado project was to provide educational assistance to agricultural producers implementing water quality management plans, including one-on-one training and support to enhance the effectiveness and sustainability of the nutrient management components of the WQMPs.

Between November 1998 and April 2001, $309,659 of EPA 319(h) funds and $206,349 of Texas Agricultural Extension Service matching funds enabled the Educational Assistance in the Arroyo Colorado project to:

Employ two Extension Associates in Water Quality (EAWQ) to provide technical assistance to TSSWCB personnel and educational assistance to farmers implementing Water Quality Management Plans.

Conduct demonstration trials on Best Management Practices for water and nutrient use, enhance implementation and sustained use.

Deliver educational programs on soils, nutrients and irrigation management, and sound production practices to more than 1400 farmers and other Ag-related individuals.

Develop and produce 100 copies of a Crop Reference Manual (+ 400 pp) with information on Best Management Practices for economically and environmentally efficient crop production in the Lower Rio Grande Valley.

Design a web page (primera.tamu.edu\ir4\ARR2.htm) to enhance the delivery of information on relevant topics.

Develop an educational fact sheet addressing economic and environmental management of nitrogen fertilizer entitled "Nitrogen and Crop Production"

Develop an educational fact sheet addressing economic and environmental management of nitrogen fertilizer entitled "Phosphorus and Crop Production"

Assist with the development and distribution of a video on conservation tillage which received national recognition (800 copies distributed).

Generate soils maps in ArcView GIS format for participating counties for use in planning and educational efforts.

Present youth education programs on water quality and water conservation to over 83 elemental and middle school children and their teachers.

Develop and deliver educational programs on nutrient management to Spanish-speaking clientele.

Task 1: Coordination with Project Participants

Objective: To foster coordinated educational program activities among cooperating agencies including TAEX, TSSWCB, NRCS, local SWCDs and other groups.

Subtask 1.1: Project meetings will be held as needed with project participants to discuss the educational assistance activities and progress. These meetings will be planned and coordinated by the project leader and EAWQs.

Accomplishments:

An organizational project meeting was held to plan and coordinate efforts on September 2, 1999. After this meeting, issues pertaining to project activities were addressed during county crops committees meetings, with participation of producers, TAEX, NRCS and TSSWCB personnel.

Meetings were held on the following dates:

September 23, 1999; January 20, March 16, April 20, September 28, and October 19, 2000; January 18, and April 5 2001.

Appendix A present additional information, including attendance list.

Subtask 1.2: TAEX will complete and submit quarterly reports to the TSSWCB in Temple, TX. At the conclusion of the project, TAEX will complete a final report summarizing project accomplishments.

Accomplishments:

Quarterly reports were submitted to TSSWCB in Temple as planned and have been used to facilitate development of this final project report.

See Appendix B for copies of the quarterly reports.

Task 2 :Direct Producer Educational Assistance

Objective: Provide direct one-on-one educational assistance to agricultural producers to assist them with the nutrient and irrigation management components of the water quality management plans.

Subtask 2.1: TAEX will employ, provide project and any subject matter training and provide administrative and technical support for two Extension Associates.

Accomplishments:

Two Extension Associates were hired to provide educational assistance in implementation of Water Quality Management Plans. Mr. Brian Rigsby (M.S. in agronomy) was a member of the project during the period of March 1999 to October 2000. Dr. Leonel Espinoza (Ph.D. in Soil and Water Science) joined the project in August 1999.

Both Extension Associates were housed at the Agricultural Research and Extension Center in Weslaco and were responsible for the day-to-day activities of the project.

Mr. Rigsby attended a training workshop on Soil Quality held in North Carolina in September 1999. This workshop was offered by the Sustainable Agriculture Research and Education (SARE) initiative.

Both EAWQs participated in a nutrient management workshop in Weslaco offered by the NRCS Zone Conservation Agronomist.

TAEX area and state agronomist provided support to the project and EAWQs.

Subtask 2.2: The EAWQs will work closely with TSSWCB staff during WQMP development and then provide direct educational assistance to participating agricultural producers. This will include assessments of initial production system components and nutrient and irrigation water management recommendations consistent with the WQMP.

Extension associates regularly assisted TSSWCB personnel and participating producers in proper soil sample collection and handling methodology, interpretation of soil test results, and appropriate fertilizer application practices on the more than 12,000 acres containing nutrient management component.

EAWQs made routine visits to some project participants to monitor crop development and address any production related issues.

A short guide dealing with soil sampling was written in both English and Spanish and subsequently distributed to all cooperating agencies and project participants (Fig. 1).

SOIL SAMPLING

A soil sample should be representative of the area you intend to cultivate.

Fertility recommendations are based on soil samples, such recommendations are as good as the samples you take. So take good samples!! Also, they will be the basis for your fertility program for the next 3 years!

Record keeping is critical to understand trends and abnormalities.

HOW TO TAKE SOIL SAMPLES

1. You can use a soil probe or a spade.Make sure they are clean! Clean it between samples.

2. Take samples from uniform, similar areas, keep individual samples to areas smaller than 40 acres.

3. Collect 10 - 20 slices or cores at random from each area (could follow a zig-zag pattern). Collect soil to plow depth, on top of bed, avoiding any plant residue. Remove top 2 inches of soil if the land is under reduced tillage.

3. Mix samples thoroughly and fill the Soil Sample Bag (available at your County Extension Office). Send as soon as possible

EDUCATIONAL ASSISTANCE IN THE
ARROYO COLORADO PROJECT
Leonel Espinoza
Brian Rigsby
(956)968-5581

URL:www.primera.tamu.edu/ir4/Arroyo.htm

Muestreo del Suelo

Una muestra de suelo debe ser representativa del area que se va a sembrar

Las recomendaciones de fertilizacion estan basadas en las muestras de suelos, estas recomendaciones seran tan buenas como las muestras que colecte. Asegurese de tomar buenas muestras! Ademas, ellas son la base de su programa de fertilizacion para los proximos 2 anos

Asegurese de mantener records para detectar cualquier anomalia o tendencia.

Como Tomar Muestras de Suelo

1. Puede usar una pala o barra para tomar muestras, asegurandose de que esten limpias.

2. Tome muestras de areas uniformes y similares, una muestra debe representar no mas de 40 acres.

3. Collecte suelo de 10 - 20 puntos de la parcela, hagalo en zig-zag. Tome las muestras a 6-8 pulgadas de profundidad, sobre la cama, remueva el rastrojo. Remueva 2 pulgadas de arriba si la parcela esta bajo labranza minima.

3. Mezcle bien el suelo que colecto y llene una de las bolsas para muestras de suelo (disponible en la Agencia de Extension de su comunidad). Envielo tan pronto como pueda.

EDUCATIONAL ASSISTANCE IN THE
ARROYO COLORADO PROJECT
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Fig 1. Soil sampling guide.

A field day was organized on October 16, 1999 by TAEX, in collaboration with NRCS. EAWQs proper soil sampling and handling techniques to an audience of approximately 25 producers.

Soils maps delineating soil textures were generated in ArcView GIS format for participating counties. Copies of these maps were distributed among cooperating agencies and also were incorporated in the Reference Manual (Figures 2 and 3).

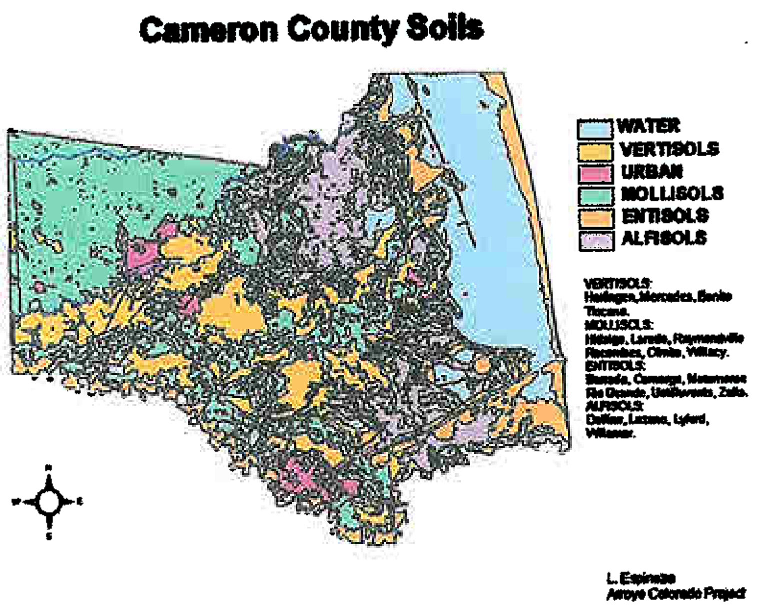

Fig. 2. Cameron County soils.

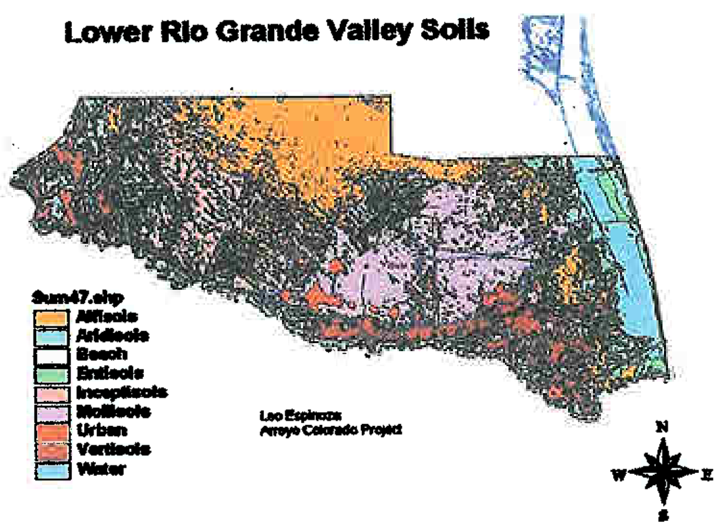

Fig.3. Lower Rio Grande Valley soils.

Subtask 2.3: Predict the impacts of implementation of nutrient and crop management provisions in WQMPs on nutrient loading reductions in the Arroyo Colorado watershed.

Accomplishments:

Soil testing is the most important part of a nutrient management program. Participating producers were required to have soils tested and fertilize accordingly. Growers were provided training and educational resource which enabled them to employ appropriate soil testing methodology and continue using it on the more than 12,000 acres signed for nutrient management incentives.

Task 3: Regional Nutrient and Irrigation Management Education Program.

Objectives: Coordinate a regional educational program to promote adoption of recommended nutrient and irrigation water management practices by all growers in the Arroyo Colorado Watershed, and which will include BMP assessment sites, regional workshops and crop specific production guides.

Subtask 3.1: Project participants will select specific cooperators to implement specific practices for five field demonstrations of critical Best Management Practices. These BMP assessment sites will be used as training tools for annual field tours and workshops. The demonstration will include system level implementation of nutrient and irrigation water management BMPs such as source, rate, method and timing of fertilizer and irrigation application, filter strips and vegetative buffers and cropping systems management. TAEX will assist cooperators in implementation of BMPs and complete evaluation based on fertilizer and water use efficiency, crop yield and quality, and economic return.

Accomplishments:

Several sites in Cameron and Hidalgo County were selected to establish demonstration trials. Due to the high degree of spatial variability in of soil textures in the Lower Rio Grande Valley, it was decided to select benchmark soil types. The following demonstration trials were conducted:

Population study to demonstrate the best seeding rate for cotton in the Rio Grande Valley.

Soil fertility under irrigated and dryland conditions to demonstrate the benefits of proper nutrient management.

Sorghum fertility trial conducted at 4 locations to show the value of soil testing and applying the recommended rate and type of fertilizer.

Cotton fertility study to calibrate a new soil test for N fertilizer.

Corn fertility trial to compare recommendations among different soil testing Labs.

A rate and timing study to demonstrate the importance of using a growth regulator in conjunction with sound fertilization practices.

See Appendix C for additional information on the above mentioned studies.

Subtask 3.2: TAEX in cooperation with TSSWCB, NRCS and other project participants will conduct annual crop production management workshops with emphasis on nutrient and irrigation BMPs for agricultural producers throughout the region.

Below is a listing of educational programs conducted through the project. Numbers in parentheses represent the approximate number of attendees to each event.

October 28 1999, Leonel Espinoza presented an educational program called "Understanding our soils" at the Grounds Maintenance workshop. This presentation was given in Spanish (40).

January 18 2000, Leonel Espinoza presented a poster about the fertilizer value of sewage sludge at the Rio Grande Valley Hort Meetings (50).

January 26 2000, Charles Stichler presented an educational program at the Pre-plant conference in Weslaco about managing cotton under water shortages (75)

February 3 2000, Brian Rigsby presented an educational program at the Irrigation Conference in Mercedes, TX about water quality in the Arroyo Colorado watershed (91).

March 31 2000, Brian Rigsby presented an educational program called "Soil Health and Water Quality" during a South Texas AmeriCorps training session (30).

April 26 2000, Leonel Espinoza and Charles Stichler presented educational programs at the Rio Grande Valley Conservation Tillage Field Day about fertilizer placement and timing in corn, cotton and grain sorghum (250).

May 4 2000, Charles Stichler presented an educational program during a turn row tour in Cameron County about conservation tillage and crop physiology (15)

July 7 2000, Leonel Espinoza and Charles Stichler participated in the Weslaco Center's annual field day and presented an educational program on cotton fertility and sound crop production practices (75).

October 18 2000, Charles Stichler presented an educational program at the Mercedes Livestock show about forage management under reduced water availability (75).

January 23 2001, Leonel Espinoza presented a poster on citrus fertilization during the Rio Grande Valley Horticultural Meetings (50).

April 26, 2000. Leonel Espinoza and Charles Stichler presenting educational programs on nutrient and crop management during the Conservation Tillage Field day.

Scene from the Conservation Tillage Field day held on April 26, 2000.

Charles Stichler talking about crop management during a turn row tour on May 4, 2000.

January 25 2001, Leonel Espinoza presented an educational program at the Pre-plant conference in Weslaco about cotton fertility (60).

January 29-31 2001 Leonel Espinoza presented an educational program during the National Conservation Tillage Conference in Houston, TX about cotton fertility under reduced tillage systems (200).

January 29-31 2001. Charles Stichler presented an educational program during the National Conservation Tillage Conference in Houston, TX about implementing conservation tillage (200).

February 22 2001, Leonel Espinoza presented an educational program on non-point source pollution in Weslaco (30).

April 25 2001, Leonel Espinoza presented an educational program at the Conservation Tillage Conference about fertility considerations in reduced tillage systems (60).

April 25 2001. Charles Stichler presented an educational program at the Conservation Tillage Conference about production practices under reduced tillage systems (100).

Project personnel also participated in the following events:

Rio Grande/Rio Bravo Environmental Conference Organizing Committee.

December 22, 1999, Leonel Espinoza talked to high school students about the activities of the Arroyo Colorado Project.

January 2000, Charles Stichler presented a talk at the Beltwide Conference in Saint Antonio, TX.

May 5, 2000, Leonel Espinoza spoke during the Texas A&M Soil and Crop sciences Dept. Soils Critique about the activities of the Arroyo Colorado Project.

December 11, 2000, Leonel Espinoza co-authored a presentation about citrus best management practices at the International Citriculture conference held in Orlando, FL.

February 8, 2001, Leonel Espinoza spoke to a group of students from Roosevelt Elementary School in Weslaco, TX about the water situation in the region.

March 28-30, 2001, Leonel Espinoza participated in an International Conference on water issues held in Monterrey, Mexico.

See appendix D for additional information on the events listed above.

Subtask 3.3: TAEX will develop and provide a reference manual for producers to include information in soils, nutrients, tillage, appropriate farm chemical use and safety, soil and water quality and conservation and conservation practices, and crop specific nutrient and irrigation management production guides for crops commonly grown in he Rio Grande Valley.

Accomplishments:

A crop reference manual was developed and 100 copies were printed. The manual contains information on best management practices for efficient and environmentally sound production of major crops in the area. Copies are being distributed to participant producers and will be distributed at future educational events.

An educational fact sheet addressing economic and environmental management of nitrogen fertilizer entitled "Nitrogen and Crop Production"

An educational fact sheet addressing economic and environmental management of nitrogen fertilizer entitled "Phosphorus and Crop Production"

Results of the cotton demonstration trials were published in the yearly demonstration handbook "Rio Grande Valley Cotton Blue Book" compiled by the local Integrated Pest Management Agent.

Results from the sorghum trials were published in the Cameron County result demonstration handbook.

Assisted with the development and distribution of a video on conservation tillage practices which received national recognition (800 copies distributed).

See appendix E for supporting information.

Educational Assistance in the Arroyo Colorado

Agenda
September 2, 1999
10:00a.m.

I. Introductions

II. Reports from cooperating agencies
   1. Texas Agricultural Extension Service
   2. Texas Soil and Water Conservation Board
   3. Natural Resource Conservation Service

III. Discussion on Project Direction
   1. Goals and objectives
   2. Set priorities

IV. Adjourn

956-421-[illegible]

Name	Organization
Charles Stichler	Extension Service
Dr. Leo Espinoza	Arroyo Colorado
Jim Childers	USDA-NRCS
Gary Gregory	USDA NRCS
Tony Gonzales	USDA, NRCS
Jim Smart	USDA ARS
Larry Zibilske	USDA - ARS
Marco Ponce	TAEX - Cameron
B. Eduardo Méndez	TSSWCB
Hector Gonzales	Southmost S&W CD
Andy Garza	TSSWCB
NOE G GARZA	NRCS
[illegible]	TAEX
ENRIQUE PEREZ	TAEX
John Drawe	TAES
Brian Rigsby	TAEX
BRAD COWAN	TAEX

EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: September 23, 1999
Time: 10:00 a.m.
Location: County Extension Office

I. Call the meeting to order
Charles Eubanks

II. Reading of the minutes
Tony Gonzales

III. Business

1. Dr. John Robinson, Economist, TAEX
   a. Survey Intrument (Draft Copy)

2. Brain Rigsby, Extension Associate,
   a. Nutrient Management Status

3. Fall Program or International Tour- Perez

4. Program schedule (Tentative program planning for 2000) - Eubanks
   -Pre-Plant Program
   -Turn-Row Tour
   -Conservation Tillage Tour

5.Computer Cost Share- Water Quality and Conservation Grant; July 13, 1998

6.Conservation Tillage Field Day Status - Jim Smart

7. Stock Showgrounds - Tony Gonzales

8. NRCS/TAEX Tour - Tony Gonzales

9. Adjourn

EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: January 20, Thursday
Time: 10:00 a.m.
Location: County Extension Office

I. Call the meeting to order
   Charles Eubanks

II. Reading of the minutes
   Marco Ponce

III. Business

1. Dr. John Robinson, Economist, TAEX
   a. Agriculture Survey Report-Cameron County

2. Dr. Jim Smart, USDA-ARS
   a. Committees Report on Conservation Tillage Field Day
   b. Sponsorship for the event-Cameron County

3. John Norman
   a. Cotton varieties

4. Cris Perez, USDA-FSA
   a. Update on program activity

5. 2000 Program schedule
   -Pre-Plant Program- January 26, 2000 @ Weslaco
   -Irrigation Conference- February 3, 2000 -Rio Grande Livestock Showgrounds
   -Pesticide Applicators Training- February 9, 2000 @ Weslaco
   -Re-Certification Training for CEU's- February 24, 2000 @ Weslaco
   -Post Planting Options- March 30, 2000 @ La Feria Gin / CO-OP
   -RGV Conservation Tillage Field Day- April 26, 2000 @ Weslaco
   -Turn-Row Tour- May 4, 2000 @ La Feria Gin / CO-OP
   -Pesticide Applicators Training- May 10, 2000 @ Weslaco
   -Pesticide Applicators Training- August 16, 2000 @ Weslaco
   -Annual Field Crops Committee Program Planning Meeting- September 28, 2000 County Extension Office
   -Field Crops Committee and NRCS Committee Field Day- October, 2000
   -Pesticide Applicators Training- November 8, 2000 @ Weslaco

8. NRCS and Field Crops Committee Expenses for October 1999 Field Day

9. Adjourn

Texas Agricultural Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Field Crops Meeting
Location: County Extension Office
San Benito
Date: January 20, 2000
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	[illegible]		
2.	Ben [illegible]		
3.	C. A. Eubanks		
4.	Nicanor Vasquez		
5.	Rhonda Schreiber		
6.	Johnie Norman Jr		
7.	Leo Espinoza		
8.	Brian Higsby		
9.	[illegible]		
10	James [illegible]		
11	Marco Ponce		
12	Bruce Snider		
13	Enrique Perez		
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EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: March 16, Thursday
Time: 10:00 a.m.
Location: County Extension Office

I. Call the meeting to order
 Charles Eubanks

II. Business
 1. Dr. John Robinson, Economist, TAEX
  a. Agriculture Survey Report-Cameron County

 2. Charles Eubank, Rhonda Schreiber
  a. Committees Report on Conservation Tillage Field Day
  b. Sponsorship for the event-Cameron County

 3. John Norman
  a. Cotton varieties

 4. USDA-FSA
  a. Update on program activity

 5. 2000 Program schedule
  -Pre-Plant Program- January 26, 2000 @ Weslaco
  -Irrigation Conference- February 3, 2000 -Rio Grande Livestock Showgrounds
  -Pesticide Applicators Training- February 9, 2000 @ Weslaco
  -Re-Certification Training for CEU's- February 24, 2000 @ Weslaco
  -Post Planting Options- TBA
  -RGV Conservation Tillage Field Day- April 26, 2000 @ Weslaco
  -Turn-Row Tour- May 4, 2000 @ La Feria Gin / CO-OP
  -Pesticide Applicators Training- May 10, 2000 @ Weslaco
  -Pesticide Applicators Training- August 16, 2000 @ Weslaco
  -Annual Field Crops Committee Program Planning Meeting- September 28, 2000 at the Extension Office.
  -Field Crops Committee and NRCS Committee Field Day- October, 2000
  -Pesticide Applicators Training- November 8, 2000 @ Weslaco

 6. Adjourn-

Texas Agricultural Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Field Corp Meeting
Location: County Extension Office San Benito
Date: March 16, 2000
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	Edward MATHERS		
2.	C.A. OUBANKS		
3.	Oui Atkinson		
4.	[illegible signature]		
5.	[illegible signature]		
6.	Rhonda Schreiber		
7.	Tony Gonzales		
8.	Ben Hanawa		
9.	ENRIQUE PERE		
10			
11			
12	Reporters		
13	S. B.		
14	UMS.		
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Extension programs serve people of all ages regardless of socioeconomic level, ra
Department of Agriculture, and the County Commissioners Courts of Texas Coo

EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: Thursday, April 20, 2000
Time: 10:00 a.m.
Location: County Extension Office

I. Call the meeting to order
Charles Eubanks

II. Old Business
1. Dr. John Robinson, Economist, TAEX
   a. Complete Agriculture Survey Report-Cameron County

2. Charles Eubanks, Rhonda Schreiber
   a. Report-Sponsorship for the event-Cameron County

3. Conservation Tilllage Field Day
   a. Jim Smart

4. USDA-FSA
   a. Chris Perez Update on program activity

5. 2000 Program schedule
   -RGV Conservation Tillage Field Day- April 26, 2000 @ Weslaco
   -Turn-Row Tour- May 4, 2000 @ La Feria Gin / CO-OP
   -Pesticide Applicators Training- May 10, 2000 @ Weslaco
   -Pesticide Applicators Training- August 16, 2000 @ Weslaco
   -Annual Field Crops Committee Program Planning Meeting- September 28, 2000 at the Extension Office.
   -Field Crops Committee and NRCS Committee Field Day- October, 2000
   -Pesticide Applicators Training- November 8, 2000 @ Weslaco

6. Adjourn-

Texas Agricultural Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Extension Field Crop Committee Mee...
Location: County Extension Office
San Benito
Date: April 20, 2000
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	C.A. EUBANKS		
2.	J. Smart		
3.	Frank C. Russell		
4.	[illegible]		
5.	Ben Hanna		
6.	Tony Gonzales		
7.	B. Eduardo Méndez-González		
8.	Enrique Pérez		
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xtension programs serve people of all ages regardless of socioeconomic level, r
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EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: September 28, 2000
Time: 10:00 am
Location: County Extension Office

- Call the meeting to order
  Charles Eubanks

- Minutes
  Marco Ponce

- Business
  Nutrient Management Evaluation- Dr. Leo Espinoza, TAEX
  Program Planning for 2001
  Result Demonstration Work
  Joint-Committee Planning (Cameron and Hidalgo)
  Member Recruitment Efforts

- Other
  Disaster Declaration Review
  (NRCS, FSA, TAEX)

- Adjourn

Texas Agricultural Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Extension Field Crop Meeting
Location: County Extension Office
San Benito
Date: September 28, 2000
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	C.A. EUBANKS		
2.	Andreas Westphal, TAEX		
3.	James Smart USDA ARS		
4.	Leonel Espinoza TAEX		
5.	Tony Gonzalez		
6.	BEN HANAWA		
7.	Richard [illegible]		
8.	Ori [illegible]		
9.	Edward Mathers		
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EXTENSION FIELD CROP COMMITTEE MEETING
AGENDA

Date: October 19, 2000
Time: 10:00 a.m.
Location: County Extension Office

I. Call the meeting to order
Charles Eubanks

II. Reading of the minutes

III. Business
1. County Disaster Report- Chris Perez, FSA
2. Conservation Tillage Task Force
Objective: To coordinate efforts between all in identifying the recommended practices and products that are currently working and help develop and effective educational program to help the industry. As help identify potential products in order to seek special use status or assist in encouraging development of other alternatives.

IV. Other
1. National Beltwide Conference
2. National Conservation Tillage Conference

V. Adjourn

FROM : Cameron County Ex

Texas Agricultural
Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Extension Field Crop Meeting
Location: County Extension Office
San Benito
Date: October 19, 2000
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	BEN HANAWA		
2.	CHARLES A EUBANKS		
3.	Leonel Espinoza		
4.	Bruce Snider		
5.	Andy Diaz		
6.	Cristobal Perez		
7.	ENRIQUE PEREZ		
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FROM : Cameron County Exte

Texas Agricultural Extension Service
The Texas A&M University System

Cameron County
650 East Highway 77
San Benito, Texas 78586
Phone: 956-399-7757
Fax: 956-361-0034

Activity: Extension Field Crop Meeting
Location: Extension Office
Date: January 18, 2001
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	[illegible]		
2.	Leo Espinoza		
3.	[illegible]		
4.	Tony Gonzales		
5.	Marco Ponce		
6.	Ovi Atkinson		
7.	Enrique Perez		
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Activity: Extension Field Crop Meeting
Location: San Benito
Date: April 5, 2001
Agent(s): Enrique Perez

Meeting and Event Registration List

	Name	Address	Phone
1.	Charles A. Eubanks		
2.	Leo Espinoza		
3.	[illegible]		
4.	Andy Diaz		
5.	Enrique Perez		
6.	Tony Gonzalez		
7.			
8.			
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Educational Assistance in the Arroyo Colorado
Monthly Report
April 1, 1999-June 30, 1999

Past Activity Summary

TAEX hired one EA-WQ (start date March 15, 1999).

Task 1:

Subtask 1.1:

Informal meetings have been held between myself and the County Extension Agents (CEA) from Hidalgo and Cameron Counties to discuss project progress and ideas for possible result demonstrations. Informal meetings have also been held between Brian Rigsby and Andy Garza of the Texas State Soil and Water Conservation Board (TSSWCB), and Jim Childers of NRCS. These meetings were held to discuss the direction of future activities of the project. Extension personnel along with Andy Garza also traveled to Austin in May to meet with Roger Mirand and Gale Rothe of the TNRCC. This meeting was held to get an idea of what each agency planned to contribute to this project. Formal meetings of all project participants have not been held at this time. 20% completed.

Subtask 1.2:

In progress. 20% completed.

Task 2:

Subtask 2.1:

One Extension Associate-Water Quality has been hired (myself). The other is anticipated to begin mid-July. 50% completed.

Subtask 2.2:

TSSWCB has not begun WQMP development at this time. At such a time as development begins EA-WQ's will be involved in this process. 0% completed.

Subtask 2.3:

No activity. 0% completed.

Task 3:

Subtask 3.1:

Identification of specific growers to participate is ongoing. Two growers have tentatively agreed to cooperate thus far (Richard Plata, Gary Mack). We are currently planning a result demonstration to be placed on the TAMU Hiler Farm in Weslaco. This result demonstration will examine fertilizer placement on irrigated cropland. 20% complete.

Subtask 3.2:

No activity. 0% completed.

Subtask 3.3:

I am currently compiling literature for inclusion in the reference manual. This activity is ongoing. 15% completed.

Future Activities

During the next quarter, we plan to conduct a result demonstration dealing with fertilizer placement and nutrient loss associate with different types of fertilizer application. We also plan on continuing the compilation of a comprehensive reference manual for growers in the LRGV dealing primarily with nutrient management but also including reference material for crop management and cultivation practices. We will also continue to identify growers to participate in result demonstrations and to assist with implementation of nutrient management BMP's.

We also plan to have hired the second EA-WQ by the end of this quarter.

Educational Assistance in the Arroyo Colorado
Quarterly Report
July 1, 1999-September 30, 1999

Past Activity Summary

Informal meetings were held with County Extension Agents (CEA) from both Cameron and Hidalgo Counties. Informal meetings were also held between myself and members of the TSSWCB in Harlingen as well as members of the TNRCC in Austin. TAEX personnel were in the process of compiling reference material for the comprehensive grower handbook. A result demonstration project was in the planning stages to be conducted at the TAMU Hiler Farm in Weslaco.

Task 1:

Subtask 1.1:

A formal meeting was held in Weslaco between members of TAEX, USDA-NRCS, USDA-ARS and TSSWCB to discuss the direction of the project and areas of expertise that each agency could bring to the project 40% complete.

Subtask 1.2:

In progress. 40 % complete.

Task 2:

Subtask 2.1:

TAEX hired the second EA-WQ in mid July. Dr. Leonel Espinoza joined the project on August 16, 1999. Dr. Espinoza comes to TAEX from the University of Florida where he recently completed a post-doctoral research project in soil fertility. 100% complete.

Subtask 2.2:

The sign-up period for growers who would like to participate in the cost share program being conducted by TSSWCB is ongoing. When the sign-up period is concluded, TAEX personnel will work directly with growers implementing nutrient management plans to insure that accurate soil samples are taken and to assist in writing nutrient management plans.
10% complete.

Subtask 2.3:

No activity. 0% complete.

Task 3:

Subtask 3.1:

Identification of growers is ongoing. We anticipate working with several growers who will be implementing NMP's as part of the TSSWCB cost share program. 30% complete.

Subtask 3.2:

An irrigation and nutrient management workshop for growers in all 4 counties of the

LRGV is currently in the planning stages. Cooperators will primarily be TAEX, NRCS, and ARS. 5% complete.

Subtask 3.3:

Compilation of materials for a comprehensive reference manual is ongoing. Some publications to be included are currently being re-written specifically for this manual. 20% complete.

Future Activities:

Results from a fertilizer trial conducted by EA-WQ's will be analyzed and written up as a result demonstration. EA-WQ's will be working with growers signed up by TSSWCB to implement NMP's and to insure that accurate soil samples are taken for soil test analysis. Compilation of reference materials for the grower manual will be ongoing. EA-WQ's will be delivering presentations on nutrient management to various groups though out the LRGV. EA-WQ's will be assisting in the planning of the Valley wide irrigation and nutrient management seminar tentatively to be held in January of 2000.

Educational Assistance in the Arroyo Colorado
Quarterly Report
October 1, 1999-December 31, 1999

Past Activity Summary

As of December 31, 1999 all personnel required for the completion of this project have been hired and are actively working on the goals of the project. The sign up period for the TSSWCB project has been concluded and growers have been approved to participate in the project. TAEX personnel are in the process of compiling information for the grower reference manual.

Task 1:

Subtask 1.1:

No formal meetings were held this quarter. TAEX personnel did meet several times with TSSWCB personnel from Harlingen to discuss growers who would be impementing NMP's. EA-WQ's also met several times with county extension personnel from both Cameron and Hidalgo counties to discuss growers that would be willing to cooperate with result demonstration projects. 50% complete

Subtask 1.2:

In progress. 50% complete.

Task 2:

Subtask 2.1:

All personnel hired and working on project. 100% complete.

Subtask 2.2:

TAEX personnel are working closely with growers to implement NMP's. Including providing training on soil sampling techniques, assisting with soil sampling and interpretation of soil test results. 20% complete.

Subtask 2.3:

No activity. 0% complete.

Task 3:

Subtask 3.1:

At this time three growers have agreed to cooperate on result demonstration projects. The growers are providing a total of five fields in which to conduct result demonstrations. Result demonstration subjects will include factors such as cropping system, fertilizer source and fertilizer rate. 50% complete.

Subtask 3.2:

An irrigation and nutrient management workshop will be conducted for the benefit of growers in the four valley counties on February 3, 2000. TAEX personnel will be conducting a session specifically on nutrient management. TAEX personnel will also be presenting information on nutrient management to growers during the valley wide conservation tillage field day on April 26, 2000. 20% complete.

Subtask 3.3:

Compilation of materials for a comprehensive grower reference manual is ongoing. 30% complete.

Future Activities:

EA-WQ's will be working with growers signed up by TSSWCB to implement NMP's and to insure that accurate soil samples are taken for soil test analysis. Compilation of reference materials for the grower manual will be ongoing. EA-WQ's will be delivering presentations on nutrient management to various groups though out the LRGV. EA-WQ's will be making presentations on nutrient management at regional field days and seminars including the Rio Grande Valley Irrigation Conference and Trade Show on February 3, 2000 and the LRGV Conservation Tillage field day on April 26, 2000.

Educational Assistance in the Arroyo Colorado
Quarterly Report
January 1, 2000-March 31, 2000

Past Activity Summary

In the past quarter TAEX personnel have been in the process of establishing several nutrient management result demonstrations with growers in the Arroyo watershed area as well as on the TAMU Weslaco Experiment station. EA-WQ's have participated in and presented information on nutrient management at several different conferences in the watershed area including the LRGV Irrigation conference, The 2000 Cotton Pre-plant conference and other various conferences. TAEX are in the proces of compiling and editing information for the grower reference manual.

Task 1:

Subtask 1.1:

No formal meetings were held this quarter. 50% complete

Subtask 1.2:

In progress. 60% complete.

Task 2:

Subtask 2.1:

All personnel hired and working on project. 100% complete.

Subtask 2.2:

TAEX personnel are working closely with growers to implement NMP's. Including providing training on soil sampling techniques, assisting with soil sampling and interpretation of soil test results. 30% complete.

Subtask 2.3:

No activity. 0% complete.

Task 3:

Subtask 3.1:

At this time three growers have agreed to cooperate on result demonstration projects. The growers are providing a total of five fields in which to conduct result demonstrations. Result demonstration subjects will include factors such as cropping system, fertilizer source and fertilizer rate. 60% complete.

Subtask 3.2:

TAEX personnel participated in a cotton pre-plant conference on January 26, 2000 as well as an area wide irrigation conference on February 3, 2000 (attendance list available upon request). Nutrient management and water quality information was presented to growers at both conferences. 50% complete.

Subtask 3.3:

Compilation of materials for a comprehensive grower reference manual is ongoing. 40% complete.

Future Activities:

EA-WQ's will be working with growers signed up by TSSWCB to implement NMP's and to insure that accurate soil samples are taken for soil test analysis. Compilation of reference materials for the grower manual will be ongoing. EA-WQ's will be delivering presentations on nutrient management to various groups though out the LRGV. EA-WQ's will be making presentations on nutrient management at regional field days and seminars including the LRGV Conservation Tillage field day on April 26, 2000.

Educational Assistance in the Arroyo Colorado
Quarterly Report
April 1, 2000-June 30, 2000

Past Activity Summary

In the past quarter TAEX personnel have been in the process of evaluating and harvesting result demonstrations within the watershed area. Result demonstrations were established both in grower fields as well as on the TAMU experiment station in Weslaco. At this time all but two of the result demonstrations have been harvested and data is being analyzed to determine the efficacy of treatments. EA-WQ's have participated in and presented information at several educational events for growers held in the area. These have included "Turn-Row meetings" in Cameron, Hidalgo and Willacy counties as well as the Weslaco Research Station field day.

Task 1:

Subtask 1.1:

No formal meetings were held this quarter. 50% complete

Subtask 1.2:

In progress. 70% complete.

Task 2:

Subtask 2.1:

All personnel hired and working on project. 100% complete.

Subtask 2.2:

TAEX personnel are working closely with growers to implement NMP's. Including providing training on soil sampling techniques, assisting with soil sampling and interpretation of soil test results. 50% complete.

Subtask 2.3:

No activity. 0% complete.

Task 3:

Subtask 3.1:

At this time three growers have agreed to cooperate on result demonstration projects. Currently the crops planted on the sites have been harvested and yield data is being evaluated to determine the effects of nutrient management practices. Further evaluation will be conducted on the soils in these fields as well on the effects of cropping system and nutrient application methods. 75% complete.

Subtask 3.2:

TAEX personnel participated in several county level educational programs during the past quarter. Information on nutrient management and proper placement and timing of fertilizer applications were presented at these conferences. 75% complete.

Subtask 3.3:

Compilation of materials for a comprehensive grower reference manual is ongoing. 60% complete.

Future Activities:

EA-WQ's will be working with growers signed up by TSSWCB to implement NMP's and to insure that accurate soil samples are taken for soil test analysis. Compilation of reference materials for the grower manual will be ongoing. EA-WQ's will be delivering presentations on nutrient management to various groups though out the LRGV. EA-WQ's will be making presentations on nutrient management at regional field days and seminars. EA-WQ's will also be establishing result demonstration sites both on the research station and in grower field to evaluate BMP's in fall crops, primarily fall corn.

Educational Assistance in the Arroyo Colorado
Quarterly Report
July 1, 2000-September 30, 2000

Past Activity Summary

Demonstration trials have been harvested and the data has been analyzed. Unfortunately, two of the demonstration trials were lost due to the severe drought and high insect pressure that affected this part of the state. Results of the demonstration trials will appear in the "Cotton Blue Book" which is a compilation of tests and results from around the LRGV. Results from the cotton and sorghum trials were also presented during the September meeting of the Cameron County Row Crops Committee. Project members participated in the Weslaco Center Field day held on July 7. A fall-corn demonstration trial was established in early August to assess the benefits of alternative fertilization practices.

Task 1:
Subtask 1.1:
Individual meetings have been held between EA-WQs and participating agencies to discuss accomplishments and future activities. 50% Complete.

Subtask 1.2:
In progress. 70% complete.

Task 2:
Subtask 2.1:
All personnel hired and working on the project. 100% complete.

Subtask 2.2:
Project personnel continue working closely with growers and participating agencies to implement WQMPs. Assistance is provided on proper soil sample collection and submission protocols and interpretation of associated soil test results. 50% complete.

Subtask 2.3:
No activity. 0% complete.

Task 3:
Subtask 3.1:
A fall-corn demonstration trial was initiated. This trial deals with the effect of fertilizer timing, placement and source on yields and economics.75% complete.

Subtask 3.2:
Project personnel participated in the Weslaco Center Field Day and monthly Crop Committee meetings during the reporting period and delivered information on nutrient management to an estimated group of 100 participants. 75% complete.

Subtask 3.3:

Compilation of materials for a comprehensive grower reference manual is ongoing. 80% complete.

Future Activities:

Project personnel will continue working with growers signed up by TSSWCB to implement WQMPs, and to insure that soil samples are collected following accepted protocols and fertilizer recommendations are followed accordingly. EA-WQ will continue attending Cameron County's Crop Committee meetings to provide updates on project activities, as well as news on issues of concern to farmers such as the TMDL process. EA-WQ will start collaborating with state Extension specialists and ARS scientists to establish demonstration trials to assess the differences on surface runoff among contrasting cropping systems. Compilation of reference materials for the grower manual is ongoing. Maintenance of existing demonstration trials will continue.

Appendix C

Subtask 3.1. Results of demonstration trials.

Dryland Plant Population Trial
TAMU Annex Farm
Weslaco, Texas 1999

Charles Stichler, Extension Agronomist, Uvalde, Texas
Special Projects Group, TAMU Weslaco, Texas*
Brian Rigsby, Extension Associate, Weslaco, Texas

Summary:

Cotton plants are very responsive to plant density which causes changes in the structure of the plant and production. Dryland cotton cultivars D&PL 20B and South Texas Planting Seed Texas 224 was hand thinned to 1,2,4,6 and 8 plants/foot in replicated plots. The optimum plant spacing is 4-6 plants/foot as evidenced by yield.

Introduction:

Producers are caught in a quandary; water, planting conditions, fertility, cultivars, climate, insect pressure, etc. all cause reductions in yield. Transgenic cotton seed is more expensive than conventional varieties and plant characteristics change from variety to variety. The optimum plant spacing is enough to provide a good yield, but few enough to prevent excessive seed cost and reduced yield as a result of overcrowding or too few seed. This experiment was done at the request of producers wanting to know – "What is the best seeding rate for cotton in the Rio Grande Valley?"

Experimental Design

Two row plots 50 feet long were replicated four times (40 plots), established and cared for by the Special Projects Group on the Weslaco's Texas A&M Research and Extension Center farm. Two mid-season cultivars, D&PL 20B and Texas 224, were planted. Both of these cultivars are medium season cotton that should be harvestable before tropical storms and rain, which often is a problem in late July and early August. At the first true leaf, plots were hand thinned to 1,2,4,6 and 8 plants per foot. One pre irrigation and one irrigation at early bloom was applied to keep the crop from totally terminating. The production practices were as follows

- 1/13/99 Trifluralin was applied at 1 qt/ac. and incorporated with a Liliston on preformed beds.
- 1/19/99 A preplant irrigation
- 2/02/99 Cultivated with a Liliston
- 2/25/99 Planted at a rate of 10 seed/foot
- 3/1799 Plants hand thinned to desired population at first true leaf
- 3/19/99 Cultivated with a Liliston
- 4/05/99 Cultivated with a Liliston
- 4/14/99 Vydate applied @ 8.5 fl. oz/A for overwintered boll weevils
- 4/20/99 Vydate applied @ 8.5 fl. oz/A for overwintered boll weevils
- 4/26/99 Cultivated with a Liliston
- 4/30/99 Tracer @ 2 oz/ac applied for worm control
- 5/04/99 Irrigation to prevent total desiccation or crop
- 5/21/99 Pix @ 12 oz/acre
- 5/28/99 Guthion applied @ 1 pt/ac with ground rig for weevils
- 6/03/99 Guthion applied @ 1 pt/ac with ground rig for weevils
- 6/15/99 Guthion applied @ 1 pt/ac by air for weevils
- 6/23/99 Guthion applied @ 1 pt/ac by air for weevils
- 6/25/99 Dropp 50 WP @ 0.2 lbs/ac. + Def @ 0.5 pt/ac + surfactant

Rain fell twice between the defoliation treatment and July 7 & 8, the harvest dates. Three row feet of plants from each plot were pulled from each treatment and plant mapped. Due to the loss of cotton falling out of the burs from the rains, burs on the plant were mapped as an open boll. 13.3 feet of row was hand harvested for yield rather than machine harvested due to wet field conditions. (More rain was forecast - so we harvested while we could.)

Results and Discussion

The following tables shows the results of the plant mapping data.

Table 41. Plant Mapping Information for D&PL 20B

Plants/Foot D&PL 20B	Avg. Plant Height	Avg. Internode Length	Veg. Nodes	Fruiting Branches (FB)	Total Nodes	Open Bolls on VB	Open Bolls on FB
1	30.8	1.7	3.8	14.8	18.5	2.3	15.7
2	28.4	1.8	3.8	12.8	15.8	1.0	10.3
4	28.9	1.7	4.8	12.2	17.0	0.2	8.4
6	27.5	2.0	3.9	9.9	13.8	0.0	5.6
8	23.9	1.8	4.0	9.1	13.1	0.0	4.6

* VB = fruit produced on vegetative branches that arise from the nodes below the first fruiting branch.
FB = fruit produced on sympodial or fruiting branches - generally starting on nodes 4- 6

Table 42. Plant Map Information for Texas 224

Plants/Foot Texas 224	Avg. Plant Height	Avg. Internode Length	Veg. Nodes	Reprod. Branches (RB)	Total Nodes	Open Bolls on VB	Open Bolls on RB
1	27.6	1.6	3.8	13.2	16.9	2.7	14.9
2	29.5	1.8	3.8	12.4	15.1	1.4	15.7
4	24.4	1.8	3.6	10.2	13.8	0.0	6.9
6	24.8	1.7	3.7	10.5	14.3	0.0	6.0
8	23.5	1.8	3.7	9.4	13.0	0.0	4.8

Table 43. Average of D&PL 20B and Texas 224

Plants/Foot Average	Avg. Plant Height	Avg. Internode Length	Veg. Nodes	Reprod. Branches (RB)	Total Nodes	Open Bolls on VB	Open Bolls on RB
1	29.2	1.65	3.8	14.0	17.7	2.5	15.3
2	28.95	1.8	3.8	12.6	15.45	1.2	13.0
4	26.55	1.75	4.2	11.2	15.4	0.1	8.6
6	26.15	1.85	3.8	10.2	14.05	0.0	5.8
8	23.7	1.8	3.85	9.25	13.05	0.0	4.6

Table 44. Average Fruit Distribution for D&PL 20B and Texas 224

Fruiting Branch	1 Plant/Ft		2 Plants/Ft		4 Plants/Ft		6 Plants/Ft		8 Plants/Ft	
	Harv. Bolls	% Ret	Harv. Bolls	% Ret	Havr. Bolls	% Ret	Harv. Bolls	% Ret	Harv. Bolls	% Ret
Vegetative Branches	2.45	—	1.2	—	0.1	—	0.0		0.0	
1 - 5	9.54	53.3	6.68	50.0	4.73	44.5	4.13	47.3	3.48	46.1
6 - 10	5.17	37.9	3.65	34.3	2.71	30.3	1.67	23.8	1.16	21.6
11 - 15	0.57	10.3	0.47	13.0	0.20	11.9	0.015	1.08	0.03	6.3
16 - 20	0.015	2.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20 - 25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

* The fruit distribution between varieties was almost identical.

Table 45. Yield

Plant Spacing	D & PL 20B Sd. Ct.	% TO	Yield	Texas 224 Sd. Ct.	% TO	Yield	Average Yield
1	2195	35.2	773	2293	37.2	853	813
2	2389	36.8	879	2203	37.7	831	855
4	2965	37.1	1100	2967	39.6	1174	1137
6	2459	36.1	888	2652	37.2	987	938
8	2347	38.1	894	2656	38.4	993	952

TO = percent turnout at ginning

Conclusions:

Cotton responds dramatically to plant density, both physiologically and yield. Sunlight moisture and boll load drive the development of the plant. Long growing seasons like California allow 2-3 plants/ft. to produce 20 fruiting branches with water and fertilizer, while a short growing season in the valley will produce only 12 effective fruiting branches. The most optimum plant spacing for dryland cotton is 4-6 plants/ft. This is also the optimum plant spacing for irrigated cotton in the Rio Grande Valley as shown by a similar trial in 1998. (LRGV Blue Book: "1997-1998")

The other point that is critical to understand is found in Table 44 which shows the fruit distribution on plants by fruiting branches.

95% of the harvested crop is found on fruiting branches 1 - 10. The early crop is the most important. If a grower fails to set the early crop, the top crop will not fully make up the difference. In addition, moisture usually is deficient which means the plant cannot set a top crop.

Acknowledgments:

Special thanks to D&PL Seed Co. and South Texas Planting Seed Co. for seed for the trials and monetary support for costs associated for the project.

Also, thanks to the Special Projects Group at the Texas A&M Research and Extension Center in Weslaco. John Drawe, Lori Greg, Martin Barroso, Ralph Morgan, and Gualberto Garza.

Dryland and Irrigated Cotton Fertility Trial

TAMU Annex Farm
Weslaco, Texas 1999
Charles Stichler, Extension Agronomist
Special Projects Group – TAES
Brian Rigsby, Extension Associate, Nutrient Management

Summary

Although soil test recommendations did not suggest additional phosphorus, both dryland and irrigated cotton showed a response to additional phosphorus. A soil sample sent to the Texas A&M laboratory for analysis indicated very high levels of available phosphorus. Nitrogen alone increased yields, but maximum yields resulted in an application of 75-34-0 for both dryland and irrigated plots.

Introduction

Soil tests run on most soils in the Rio Grande Valley will show some phosphorus available. Depending on the laboratory used, some will report more available than others. Growers are told by some labs that additional phosphorus is needed, while others indicate that additional phosphorus is not. The purpose the investigation was to try to determine if cotton will respond to additional phosphorus, and is the Texas A&M test extracting too much phosphorus from soils in the Rio Grande Valley.

Experimental Design

Four row plots 50 feet long were replicated four times and established and cared for by the Special Projects Group on the Weslaco's Texas A&M Research and Extension Center's Heiler Farm . The cultivar planted was D&PL 20B. Plots were fertilized on the date of planting 2/25/99 as a side banded placement approximately 4 inches to the side and 3 inches below the seed. The production practices were as follows

- 1/13/99 Trifluralin was applied at 1 qt/ac. and incorporated with a Liliston on preformed beds.
- 1/19/99 A preplant irrigation
- 2/02/99 Cultivated with a Liliston
- 2/25/99 Planted at a rate of 10 seed/foot
- 2/25/99 Fertilizer treatments applied
- 3/1799 Plants hand thinned to desired population at first true leaf
- 3/19/99 Cultivated with a Liliston
- 4/05/99 Cultivated with a Liliston
- 4/14/99 Vydate applied @ 8.5 fl. oz/A for overwintered boll weevils
- 4/20/99 Vydate applied @ 8.5 fl. oz/A for overwintered boll weevils
- 4/26/99 Cultivated with a Liliston
- 4/30/99 Tracer @ 2 oz/ac applied for worm control
- 5/04/99 Irrigation to prevent total desiccation or crop
- 5/21/99 Pix @ 12 oz/acre
- 5/28/99 Guthion applied @ 1 pt/ac with ground rig for weevils
- 6/03/99 Guthion applied @ 1 pt/ac with ground rig for weevils
- 6/15/99 Guthion applied @ 1 pt/ac by air for weevils
- 6/23/99 Guthion applied @ 1 pt/ac by air for weevils
- 6/25/99 Dropp 50 WP @ 0.2 lbs/ac. + Def @ 0.5 pt/ac + surfactant

Rain fell twice between the defoliation treatment and July 7 & 8, the harvest dates. Three row feet of plants from each plot were pulled from each treatment and plant mapped. Due to the loss of cotton falling out of the burs from the rains, burs on the plant were mapped as an open boll. 13.3 feet of row was hand harvested for yield rather than machine harvested due to wet field conditions. (More rain was forecast - so we harvested while we could.)

Samples were ginned at an experimental gin in Weslaco.

Results and Discussion

Table 40 shows the results of the test. Although the yields were not statically significant due to plot variability, the trends are definite.

Table 40. Fertility impacts on cotton yields, 1999.

Treatment	Dryland Seed Cotton	Lint Yield	Irrigated Seed Cotton	Lint Yield	Fertilizer Cost/Acre	Dryland Income over cost	Irrigated Income over cost
UTC	2214 36.8 %	814	2105 38.8 %	817	———		
75 - 0 - 0 lbs/A	2494 37.0 %	922	2872 38.7 %	1111	14.10	$ 12.90	$ 59.40
10 - 34 - 0	2375 37.9 %	900	2529 39.7 %	1004	11.25	$ 10.25	$ 35.50
75 - 34 - 0	2687 38.1 %	1023	3013 38.8 %	1169	23.47	$ 28.78	$ 64.53

* Income reflects a $0.25 cost per pound of lint for picking, ginning and hauling over untreated check. N 32 priced at $120/ton and 10-34-0 at $225/ton. Cotton price figured at 0.50/lb.

Conclusions

Cotton like all crops need adequate phosphorus to obtain maximum yields. However, the goal of a producer should not be maximum yields, but maximum economic yields. All fertilizer treatments produced income over expenses with the 75-34-0 producing the most net income.

Acknowledgments:

Special thanks to the Special Projects Group at the Texas A&M Research and Extension Center in Weslaco – John Drawe, Lori Greg, Martin Barroso, Ralph Morgan and Gualberto Garza.

Sorghum Fertilization Rate and Timing Study

Cameron County, Texas 2000
Leonel Espinoza, Extension Associate
Charles Stichler. Extension Agronomist
Brian Rigsby, Extension Associate
Enrique Perez, County Extension Agent-Ag

Summary

A sorghum fertility study was conducted at three different locations in Cameron County. Fertilizer was applied following the recommendations of the Texas A&M Soil Testing Laboratory in College Station, and those of two commercial soil testing Labs. Under the conditions of this one-season demonstration trial, the adoption of TAEX fertilizer recommendations allowed for consistent maximum economic yields (MEY) with respect to fertilization. More rigorous studies are needed to fine-tune fertilizer recommendations under the LRGV particular weather and soil conditions.

Introduction

A successful soil fertility program includes the collection of a representative soil sample, the use of the appropriate soil test methodology, and the application of the correct rate, at the right time and placement. The amount of fertilizer recommended for a given soil and crop tend to differ among labs, in part due to the use of different procedures to estimate the amount of *available nutrient*, as well as the amount of fertilizer required to produce the expected yield. The significant increase in the price of chemical fertilizers (up to 100% increase) added to low crop prices, demand the highest degree of fertilizer use efficiency, including targeting for maximum economic yield (MEY). The objective of this *demonstration trial* was to do an economic comparison (returns) of the yields obtained from plots fertilized according to the TAEX Lab in College Station and from plots fertilized according to two commercial labs.

Materials and Methods

This study was conducted at three different locations in Cameron County. The soil at site1 is classified as a Harlingen clay, at site 2 is a Mercedes clay, and at site 3 is a Lozano fine sandy loam. Representative soil samples were collected from each site, mixed thoroughly, with sub-samples sent to three different labs for analysis and fertilizer recommendations.

Two liquid fertilizer sources were used: 11-37-0, and N32 to complement the required amount of nitrogen. Fertilizer was banded on March 3 at sites 1 and 2, and on February 10 at site 3. Planting was done on March 4 at sites 1 and 2 and on March 2 at site 3. Grain sorghum Asgrow A570 was planted at the rate of 6 lb/A, with plots being approximately one acre in size. Plots were managed according to the fármer's cultural practices. At harvest (6/15/2000), 2 25- ft long segments were hand-harvested at four locations within each plot for yield estimates.

Results and Discussion

As expected, the amount of fertilizer recommended for the particular sites varied among Labs. No fertilizer phosphorus was recommended for any of the sites by the TAEX Lab (Table 1). Labs 1 and 2, however, called for applications of @ 50 lb P_2O_5 per acre. The amount of nitrogen recommended by Lab 1 was between 33 and 40% higher than the rate recommended by the TAEX Lab. The N-rates suggested by Lab 2 were similar to those from TAEX. However, Lab 2 called for the side-dressing of most of the N fertilizer.

Table 2 is a summary of the results. **Only the production costs associated with fertilizer applications are included in the analysis**. Site 1 received more precipitation than site 2 which may explain the differences in yield (average yield at site 1 was 4463 lb/A, while at site 2 was 3528 lb/A). Yields at site 3 were considerably reduced by abnormally high weed pressure during the growing season, which may have masked any possible differences among recommendations.

Yields obtained following the fertilizer recommendations of Lab 1 were higher than those obtained following TAEX recommendations for sites 1 and 2 (Table 2). However, the cost of the extra application of fertilizer was larger than the monetary return. This may be a simple example of the difference between maximum yield and maximum economic yield (MEY). Although yields following TAEX recommendations were lower, they resulted in larger returns. This point is of especial importance for the 2001 season since the price of N-fertilizers has basically doubled in price. Table 2 also shows the magnitude of the return under 2001 fertilizer price scenarios.

Side-dressing of N-fertilizer at site 1 coincided with a rainfall event, it probably increased the efficiency of fertilizer use. At site 2, where little rainfall was received, yields were lower when the fertilizer was side-dressed. Timing of fertilization is of critical importance with a sorghum plant. Fertilization must be done in the first 20 days, right before the period of rapid growth (Fig.1). If fertilizer is applied past this stage, the plant may not use the fertilizer efficiently.

Conclusions

The philosophy of the TAEX Lab is not to maximize yields, but to maximize **economic** yields. Yield from plots fertilized according to Lab 2 tended to be higher than the rest. However, the cost of the extra application of fertilizer exceeded the return provided by the increase in yields. Side-dressing the fertilizer may be an option under optimum soil moisture conditions, and in situations where logistics allow the completion of this activity at the right growth stage. More detailed studies are needed to adapt available soil test methodology to the particular soil and climatic conditions in the Lower Rio Grande Valley.

Acknowledgments:

Special thanks to Mr. John Scaief and Mr. Ovidio Atkinson for their time and resources.

Table 1. Fertilizer recommendations according to each lab.

	Site 1		Site 2		Site 3	
	N	P_2O_5	N	P_2O_5	N	P_2O_5
TAEX	80	0	70	0	70	0
Lab 1	120	50	110	50	120	50
Lab 2	70	50	70	50	70	0

Table 2. Yield and return comparisons among Labs. Grain price estimated at $3.00/cwt.

	Lab	Yield lbs/A	Yield increase over TAEX	Net increase over TAEX	Fertilizer Cost 2000 $	Fertilizer Cost 2001 $	Return over TAEX 2000	Return over TAEX 2001
Site 1	TAEX	4071			16.00	28.00		
	Lab 1	4676	605	18.15	41.00	60.5	-6.85	-14.35
	Lab 2	4642	571	17.13	30.00	42.5	3.13	2.63
Site 2	TAEX	3530			15.00	26.00		
	Lab 1	3800	270	8.10	38.00	56.00	-14.9	-19.9
	Lab 2	3253	-277	0	30.00	42.5	-23.31	-22.81
Site 3	TAEX	2436			15.00	26.00		
	Lab 1	2211	-227	0	37.00	56.5	-28.81	-37.31
	Lab 2	2454	16	0.48	15.00	26.00	0.48	0.48

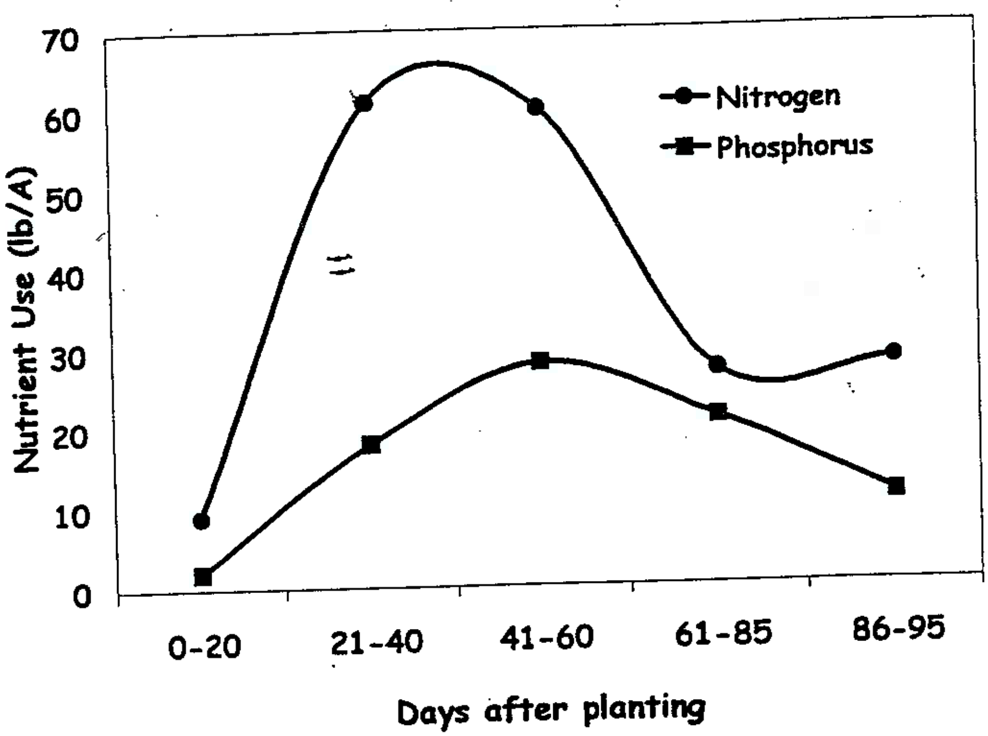


Figure 1. Estimated N and P requirements of grain sorghum for a yield of 7,500 lb/A. Adapted from: *"Crop Nutrient Needs in South and Southwest Texas"* TAEX Pub. B-6053.

Nitrogen and Phosphorus Fertilization Study
Weslaco, Texas 2000

Leonel Espinoza, Extension Associate
Charles Stichler, Extension Agronomist
Brian Rigsby, Extension Associate

Summary

A cotton fertility study was conducted to calibrate a new soil test for nitrogen. Lint yields obtained from plots fertilized with rates of 0, 50, 100, and 150 lbs. N per acre were not statistically different. High residual-N levels in the soil is the probable reason for the lack of response to this nutrient. However, lint yields from plots which were fertilized at a rate of 60 lb P_2O_5 per acre as a starter (1.5 inches below the seed), were significantly higher than corresponding plots where P was not applied. This same type of study needs to be repeated over several growing seasons and different soil types.

Introduction

Applying the correct rate and form of fertilizer is critical for optimal plant growth and profitable crop production. Current soil test methodology for nitrogen and phosphorus needs to be fine tunned or modified for the particular weather, soil, and cropping systems of the Lower Rio Grande Valley. The main objectives of this study were: a) to evaluate a new soil test to predict nitrogen availability throughout the season, and b) to assess any yield response to phosphorus fertilization.

Materials and Methods

This study was conducted at the Hiler farm, on a Willacy soil. Fertilizer nitrogen (liquid N32) was banded at rates equivalent to 0, 50, 100, and 150 lb. per acre. Phosphorus was applied as a starter (1.5 inches below the seed), at rates of 0 or 60 lb. P_2O_5 per acre, as granular 0- 46- 0. Experimental plots were 50 ft long by 13.3 ft wide (4 rows) with four replicates for each treatment.

Background soil samples were collected from several soil depths and subsequently analyzed for nutrients content by The Texas Agricultural Extension Soil Water and Forage Testing Laboratory in College Station.

At harvest (8/4/2000), one of the middle rows from each plot was selected for machine-harvesting. After seed yields from each plot were recorded, a representative sample was obtained to determine percent turnout and lint yields. Lint samples were also taken for fiber quality analyses.

Statistical analysis of the data was performed with the GLM procedure of PC SAS.

Production Practices:

2/07/2000 Trifluralin 4EC applied and incorporated with a Lilliston cultivator.
2/17/2000 Fertilizer was applied
3/23/2000 Cultivar D&PL 20B was planted at a rate of 10 seed/ft.
3/24/2000 Irrigation
3/31/2000 Cultivation with a Lilliston
4/07/2000 Plants were thinned at 6 plants/foot.
5/01/2000 Cultivation with a Lilliston
4/13 &19; 6/2, 5, 9,13, 16, 20, 23, 27 and 6/30/2000 Vydate applied with a high-clear sprayer.
5/04/2000 Pix application @12oz./acre using a CO_2 backpack sprayer.
5/25/2000 Pix application @12oz./acre using a high-clear sprayer.
7/18/2000 Dropp 50 WP @ 0.1 lbs/acre + Prep @ 1 pt/A with a high-clear sprayer.
7/25/2000 Dropp 50 WP @ 0.1 lbs/acre + Prep @ 1 pt/A with a high-clear sprayer.
8/04/2000 Harvest

Results and Discussion

Replanting was necessary due to the lack of soil moisture at planting time. Results of the soil analyses indicated high fertility levels of N, P and K. Nutrient concentrations in the top 1 foot of soil accounted for 70, 128 and 1172 lbs. of N, P and K per acre respectively (Table 1).

Percent turnouts were consistent among treatments, with average values being 30, 58, and 12% for lint, seed and trash respectively (Table 2).

The statistical analysis showed no significant differences in yields among those treatments where only nitrogen was applied. The residual N in the soil was sufficient to meet the plant requirements. However, a significant lint-yield increase, over the N-only treatments, was observed in plots where P was applied as a starter, with such increase ranging between 182 and 242 lbs of lint per acre. This difference resulted in net returns of 61 to 91 dollars per acre due to the application of P fertilizer (Table 4). The total production costs are not included in the analysis since they are basically the same for all the treatments, with the only difference being the extra application of fertilizer P.

Conclusions

Although the results of this trial are significant with respect to P fertilization (even with the soil test showing enough P in the soil profile), *they are not conclusive*. These results should serve as an indication of the need to further study the potential responses to N and P placement and rate under current soil test methodology for representative soils of the Lower Rio Grande Valley. Results of this trial also underscore the importance of a soil test since during this season it correctly predicted the lack of response to N fertilization. This fact should be of special importance due to the increasing cost of chemical fertilizers.

Acknowledgments:

Special thanks to Mr. Gene Tolbert from VALCO for providing the seed needed for this study and to Dr. R. Wiedenfeld for logistic support. Thanks to Juan Leija, John Drawe, Lori Gregg, Martin Barroso, Guadalupe Calvo, Ralph Morgan and Gualberto Garza for their valuable support.

Table 1. Background soil test results. Concentrations represent the average of four replicates.

Soil Test Results							
Depth (inches)	pH	Nitrate (lb/A)	Phosphorus (lb/A)	Potassium (lb/A)	Calcium (lb/A)	Zinc (lb/A)	Salinity (ppm)
0-6	7.7	42	78	624	3276	1.7	186
6-12	7.8	28	50	548	3572	0.82	161
12-24	8.3	18	14	556	3974	0.26	124
24-36	7.6	20	14	496	6010	0.22	212

Table 2. Percent turnouts and associated seed and lint yields. Yields represent the average of four replicates.

Fertilizer (lb/A)		Lint	Seed	Trash	Seed Weight	Lint Weight	Difference
N	P_2O_5	%	%	%	lbs / A		
0	0	29.3	56.1	14.6	1672	873	+154
0	60	30.7	57.2	12.1	1914	1027	
50	0	29.5	57.7	12.8	1512	773	+289
50	60	30.0	58.5	11.5	2070	1062	
100	0	31.2	60.5	8.3	1745	845	+237
100	60	29.6	57.9	12.5	2117	1082	
150	0	31.2	57.9	10.9	1649	889	+198
150	60	31.0	60.4	8.6	2117	1087	

Table 3. Fiber quality analysis.

Treatment N	P_2O_5	Mic	Length	Uniformity	Strength	Elongation
0	0	4.2	1.1	82.5	25.2	6.5
50	0	4.3	1.09	81.7	25.2	5.4
100	0	4.1	1.06	81.9	26.4	5.1
150	0	4.3	1.07	82.4	27.2	5.7
50	60	4.1	1.09	81.9	26	6.7
100	60	3.9	1.11	84	26.5	6.8
150	60	4.1	1.08	81	25.8	5.6

Table 4. Monetary return due to the application of P fertilizer.

Fertilizer (lb/A)		Lint Yield	Yield Increase Over Check	Cost[2] Increase	Return due to[3] additional P
N	P_2O_5	(lbs/A)	(lbs/A)	(Dollars/A)	(Dollars/A)
Check[1]		845	0	0	0
0	60	1027	182	30	61
50	60	1062	217	30	78.5
100	60	1082	237	30	88.5
150	60	1087	242	30	91

[1] Since there was no yield response to nitrogen, the check represents the average of all the plots were only N was applied.
[2] Includes a cost of @ $4.00 per application and $0.44 per lb. of P_2O_5 as 0-46-0.
[3] Cotton price estimated at $0.50 per lb.

Cotton Fertilization Rate and Timing Study

Cameron County, Texas 2000

Leonel Espinoza, Extension Associate
Charles Stichler. Extension Agronomist
Brian Rigsby, Extension Associate
Enrique Perez, County Extension Agent-Ag

Summary

A cotton fertility study was conducted in Cameron County. Fertilizer was applied following the recommendations of the Texas A&M Soil Testing Laboratory in College Station, and those of two commercial soil testing Labs.

Introduction

A successful soil fertility program includes the collection of a representative soil sample, the use of the appropriate soil test methodology, and the application of the correct rate, at the right time and placement. The amount of fertilizer recommended for a given soil and crop tend to differ among labs, in part due to the use of different procedures to estimate the amount of *available nutrient*, as well as the amount of fertilizer required to produce the expected yield. The significant increase in the price of chemical fertilizers (up to 100% increase) added to low crop prices, demand the highest degree of fertilizer use efficiency, including targeting for maximum economic yield (MEY). The objective of this *demonstration trial* was to do an economic comparison (returns) of the yields obtained from plots fertilized according to the TAEX Lab in College Station and from plots fertilized according to two commercial labs.

Materials and Methods

This study was conducted in Cameron County. The soil is classified as a Harlingen clay. Representative soil samples were collected, mixed thoroughly, with sub-samples sent to three different labs for analysis and fertilizer recommendations. Fertilizer recommendations ranged from 0 to 110 lb/A N and 0 to 60 lb/A P_2O_5 for an expected yield of 2 bales.

Two liquid fertilizer sources were used: 11-37-0, and N32 to complement the required amount of nitrogen. Fertilizer was banded on March 3, 2000.

Results and Discussion

This cotton crop was lost due to abnormally high boll weevil pressure which characterized the 2000 cotton season in the Lower Rio Grande Valley of Texas.

Corn Fertilization Study
Cameron County, Texas 2000

Leonel Espinoza, Extension Associate
Charles Stichler. Extension Agronomist
Brian Rigsby, Extension Associate
Enrique Perez, County Extension Agent-Ag

Summary

A corn fertility study was conducted in Cameron County. Fertilizer was applied following the recommendations of the Texas A&M Soil Testing Laboratory in College Station, and those of two commercial soil testing Labs.

Introduction

A successful soil fertility program includes the collection of a representative soil sample, the use of the appropriate soil test methodology, and the application of the correct rate, at the right time and placement. The amount of fertilizer recommended for a given soil and crop tend to differ among labs, in part due to the use of different procedures to estimate the amount of *available nutrient*, as well as the amount of fertilizer required to produce the expected yield. The significant increase in the price of chemical fertilizers (up to 100% increase) added to low crop prices, demand the highest degree of fertilizer use efficiency, including targeting for maximum economic yield (MEY). The objective of this *demonstration trial* was to do an economic comparison (returns) of the yields obtained from plots fertilized according to the TAEX Lab in College Station and from plots fertilized according to two commercial labs.

Materials and Methods

This study was conducted in Cameron County. The soil is classified as a Racombes sandy clay loam. Representative soil samples were collected, mixed thoroughly, with sub-samples sent to three different labs for analysis and fertilizer recommendations. Fertilizer recommendations ranged from 110 to 140 lb/A N and 0 to 60 lb/A P_2O_5 for an expected yield of 100 bushels. All the fertilizer-P was applies pre-plant. Two of the labs called for all the nitrogen to be applied pre-plant, with the other lab calling for sidedressing half of the recommended rate.

Two liquid fertilizer sources were used: 11-37-0, and N32 to complement the required amount of nitrogen. Fertilizer was banded on February 10, 2000.

Results and Discussion

Yields were severely affected due to the lack of water for irrigation. This site was discarded from continued monitoring.

Plant Growth Regulator Study

TAMU Hiler Farm
Weslaco, Texas 2000
Leonel Espinoza, Extension Associate
Charles Stichler, Extension Agronomist

Summary

A rate and timing study was conducted using Pix, Pix Ultra and Pix Plus to assess their effect on lint yields and associated quality. There were no significant differences between the check and the treatments due probably to the abnormally high boll weevil pressure during the 2000 season. Most of the yield was obtained from 1st positions on the ten lower fruiting branches, with such yield representing between 96-99 % of the total yield. This information can be of value when deciding about additional inputs late in the growing season.

Introduction

Mepiquat chloride (MC) (commercially known as Pix, Mepichlor or Mepex) is a product that helps manage the cotton plant to avoid rank growth, increase harvest efficiency and maximize lint quality. Although MC has been in the market for almost two decades, there is a need to constantly calibrate application rates due to new cultivars, and contrasting weather and growing conditions year after year. MC applied at the wrong time and rate does not only represent a waste of resources but could also affect cotton yield and associated lint quality. The objectives of this study were to test 3 products: Pix, Pix Plus, and Pix Ultra applied at different rates and physiological stages, and assess their effect on yield and lint quality.

Materials and Methods

A study was initiated at the Hiler farm, on a Willacy soil. Experimental plots were 40 ft long by 13.3 ft wide (4 rows), with 3 replicates for each treatment. A total of eight treatments were assigned to experimental plots. The nature of the treatments is described in Table 1.

Several plant measurements were taken during and at the end of the growing season. Those included nodes above white flower (NAWF), plant height, and number of nodes.
At harvest (8/4/2000), one of the middle rows from each plot was selected for machine-harvesting. After seed yields from each plot were recorded, a representative sample was obtained to determine percent turnout and lint yields. Lint samples were also taken for fiber quality analyses. Ten feet of each plot were hand-harvested to assess yield distribution according to individual branch number and fruiting position.

Statistical analysis of the data was performed with the GLM procedure of PC SAS.

Production Practices:

2/07/2000	Trifluralin 4EC applied and incorporated with a Lilliston cultivator.
2/17/2000	Fertilizer was applied
3/23/2000	Cultivar D&PL 20B was planted at a rate of 10 seed/ft.
3/24/2000	Irrigation
3/31/2000	Cultivation with a Lilliston
4/07/2000	Plants were thinned at 6 plants/foot.
5/01/2000	Cultivation with a Lilliston

4/13 &19; 6/2, 5, 9,13, 16, 20, 23, 27 and 6/30/2000 Vydate applied with a high-clear sprayer.

5/04/2000	Pix application
5/25/2000	Pix application
6/08/2000	Pix application
7/18/2000	Dropp 50 WP @ 0.1 lbs/acre + Prep @ 1 pt/A with a high-clear sprayer.
7/25/2000	Dropp 50 WP @ 0.1 lbs/acre + Prep @ 1 pt/A with a high-clear sprayer.
8/04/2000	Harvest

Results and Discussion

Replanting was necessary due to the lack of soil moisture at planting time. Results of the background soil analyses indicated high fertility levels of N, P and K.

Percent turnouts were consistent among treatments, with average values being 30, 59, and 11% for lint, seed and trash respectively (Table 2).

Although lint yields for the check plot were consistently lower than the rest of the treatments (differences oscillated between 9 and 85 lb lint /A), such differences were not statistically significant (Table 2). Yield distribution followed the same basic trend as previously reported by others, with 62-77 % of the lint yield obtained from the first five nodes, 26-34% from the second five nodes, and only 1-4% for the top 4 or 5 nodes (Table 3). This information should be of value when considering additional investments to protect or maintain such a low percentage of the total yield.

Most of the lint yield was found on 1st positions (Fig. 1), with such yield representing between 75% of the total plant yield for the lower branches, and 100% for the top fruiting branches. The number of nodes at harvest was similar among all the treatments, with the average number of nodes being 23 ± 0.95. Plant height at harvest was mostly under 40 inches (average of 39 inches), with plants from the check plot averaging 46.7 inches (Fig.2).

Conclusions

There were no significant differences among treatments, although there were obvious differences in terms of plant height, with plants in the check plots being 4-5 inches taller than plants from the rest of the plots. Yields were probably limited by the abnormally high boll weevil pressure which characterized the 2000 cotton season. Such a factor probably masked any potential effect of the plant growth regulators.

Cotton is a perennial plant that will keep growing if the conditions are optimal. Heat units for the 2000 season were higher than the average heat units for the last 10 years, that solely is an indication of the *potential* need for MC (Fig. 3). The fact that most of the yield and potential profits are found on 1st positions, on the lower branches, should prompt farmers to pay special attention during that critical growth stage to assure proper management of the cotton plant. If there is a need for MC, its application could also, indirectly, help with insecticide penetration and aeration through the canopy.

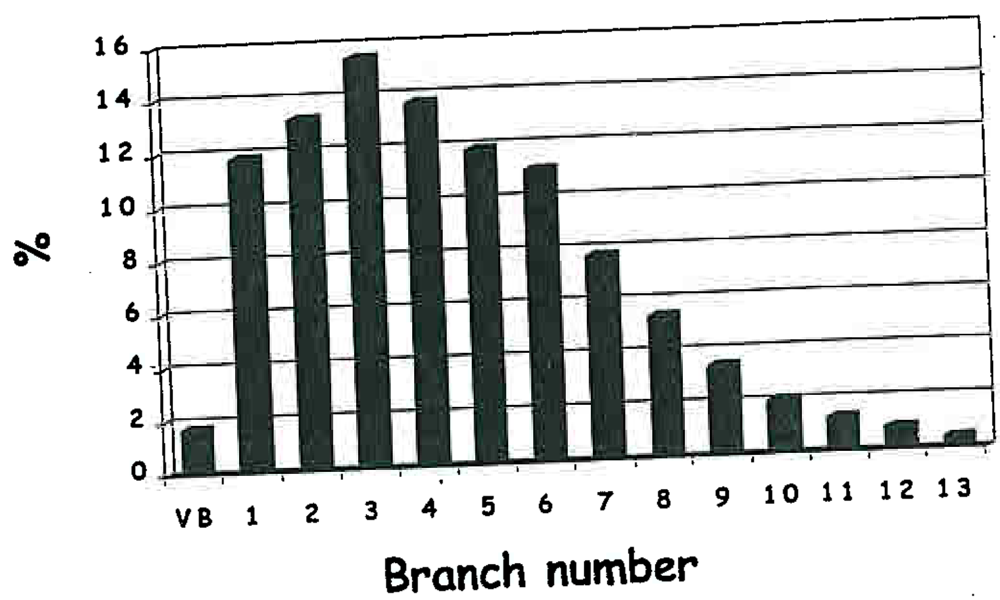
Acknowledgments:
Special thanks to Mr. Gene Tolbert from VALCO for providing the seed needed for this study. Thanks to Juan Leija, John Drawe, Lori Gregg, Martin Barroso, Guadalupe Calvo, Ralph Morgan and Gualberto Garza for their valuable support.

Table 1. Product, rate, and timing of MC application.

Treatment #	Rate and Timing
1	Check
2	Pix - 4oz. @ early square and 10oz. @ early bloom.
3	Pix Plus - 4oz. @ early square and 10oz. @ early bloom
4	Pix Ultra - 4oz. @ early square and 10oz. @ early bloom
5	Pix Ultra - 6oz. @ early square and 12oz. @ early bloom
6	Pix Ultra - 6oz. @ early square and 14oz. @ early bloom
7	Pix Ultra - 4oz. @ early square; 10oz. @ early bloom and 10oz. @ early bloom + 14 days
8	Pix Ultra - 4oz. @ early square; 10 oz. @ early bloom + 15 lb/A Urea, and 10oz. @ early bloom + 15 lbs/A Urea 14 days after early bloom.

Table 2. Percent turnout and average yields of 3 replicates for each treatment.					
Treatment	Lint %	Seed %	Trash %	Seed Weight lbs./A	Lint Weight lbs./A
1	30.3	58.7	11	1628	841
2	29.4	57.3	13.3	1805	926
3	29.7	59.3	11	1768	885
4	29.8	59.8	10.4	1793	893
5	31.4	58.7	9.9	1641	878
6	29.9	59.3	10.8	1719	867
7	30.4	58.5	11.1	1636	850
8	30.1	57.7	12.2	1692	883

Table 3. Yield distribution according to branch number for each treatment.										
	Treatment Number									
Branch #	1	2	3	4	5 (%)	6	7	8	Avg	Std
11-14	3	3	4	4	1	1	4	1	*2.6*	*1.4*
6-10	32	32	34	34	26	28	32	22	*30.0*	*4.3*
1-5	65	65	62	62	73	71	63	77	*67.2*	*5.7*



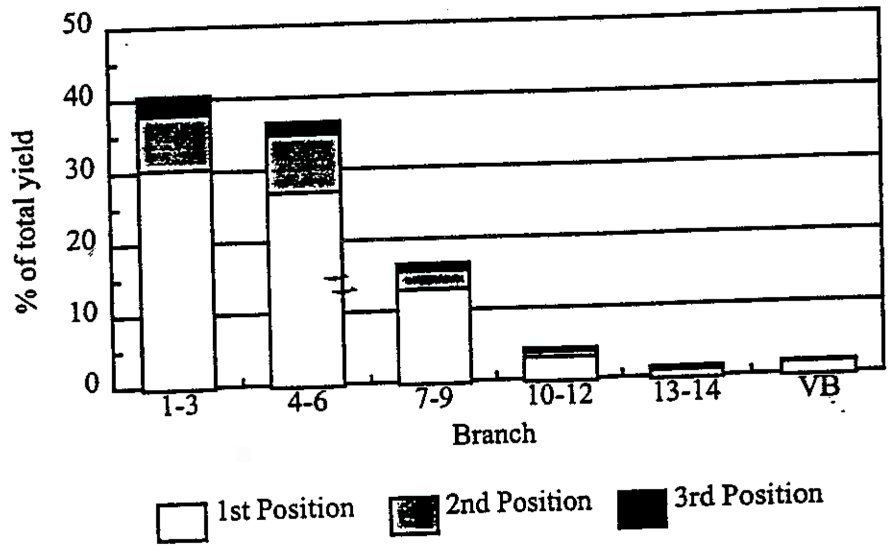
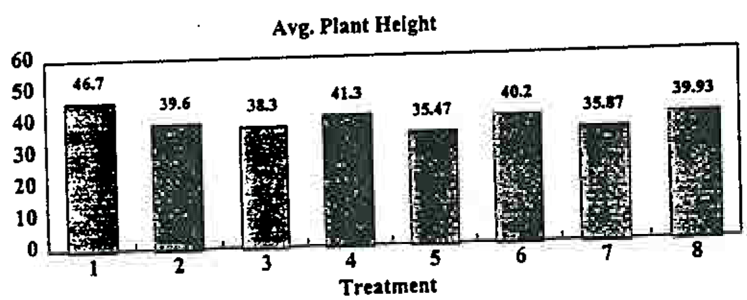


Figure 2. Yield distribution according to fruiting position.



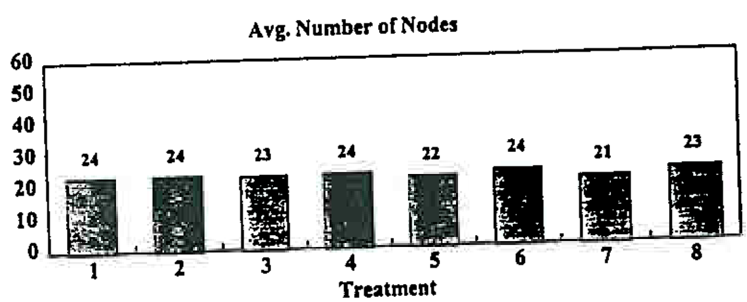


Figure 3. Average plant height and number of nodes at harvesting.

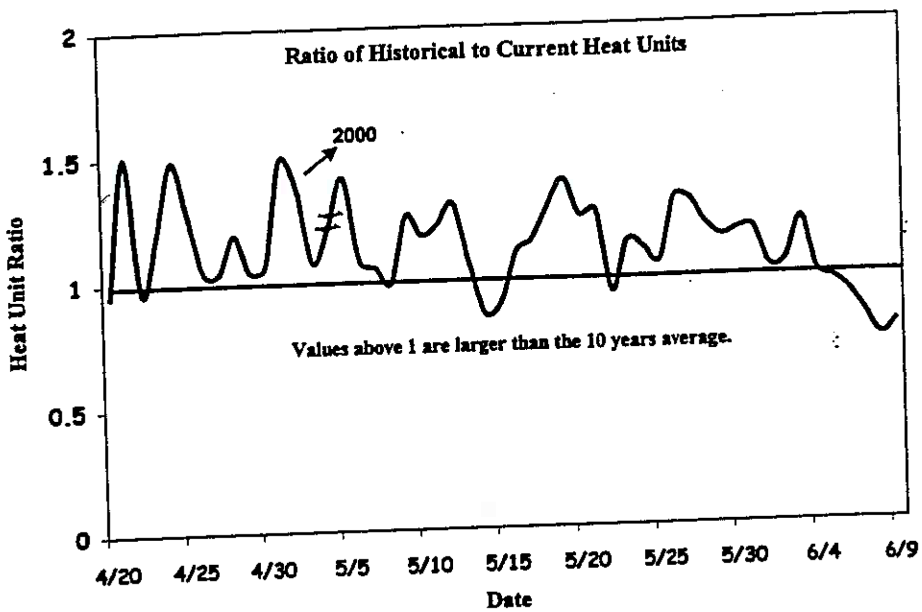


Figure 4. Ratio of the average heat units for the last ten years and heat units for the 2000 season.

Table 4. Fiber quality analysis.

Treatment	Mic	Length	Uniformity	Strength	Elongation
1	3.9	1.1	81.3	26.1	6.2
2	3.7	1.09	81.3	25.8	6.3
3	4.1	1.11	81	26.5	6.7
4	4	1.15	83.3	26.3	6.7
5	4.1	1.13	81.3	25.4	6.4
6	4	1.11	82.9	26.2	6.1
7	4.2	1.13	82.6	26.8	6.6
8	3.6	1.1	81.7	25.7	6.6

Appendix D

Subtask 3.2. Crop Production Management Workshops.

NOTES

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SEVENTH ANNUAL

RIO GRANDE VALLEY GROUNDS MAINTENANCE CONFERENCE

OCTOBER 28, 1999

MCALLEN INTERNATIONAL CIVIC CENTER
TOURIST CENTER
1300 SOUTH 10TH STREET
MCALLEN, TEXAS

54th Annual Horticultural Institute

Rio Grande Valley Horticultural Society

JANUARY 18, 2000

SCIENTIFIC POSTER PRESENTATION AWARD

[illegible]

L. A. Espinoza and B. L. McNeal

HAS/HAVE BEEN AWARDED THIRD PRIZE FOR THE BEST POSTER PRESENTED AT THE ABOVE MEETING.

J. Victor French

J. VICTOR FRENCH
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JESUSA C. LEGASPI
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Texas Agricultural Extension Service

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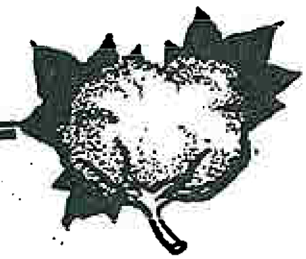
COTTON PRE-PLANT SEMINAR



Wednesday, January 26, 2000
Hoblitzelle Auditorium, A&M Research & Extension Center, Weslaco
Registration at 8:00 a.m.
Three hours of TDA CEU's available
Pre-registration is not required
Lunch provided by supporting agribusinesses

Topics:

- **Cotton Varieties for the Valley**
- **Risk Management**
- **Cotton Fertility**
- **Market Place Insights**
- **FSA Update**
- **Managing Cotton Through Another Season of Irrigation Shortages**
- **TDA Update**
- **Market Simulation Contest**
- **Transgenic Issue**
- **New Developments From Industry**
- **New Growers Organization**

Speakers:

John Norman, Extension Cotton IPM Entomologist, Weslaco
John Robinson, Extension Economist, Weslaco
William B. Dunavant, Dunavant Enterprises, Memphis, TN
Juan Garcia, FSA
Charles Stichler, Extension Agronomist, Uvalde
Ruben Rodriguez, TDA, San Juan
Tom Kilgore, Mercedes

We would like to invite all cotton growers to this seminar. As you can see, we have an excellent lineup of speakers to address very timely topics as planting time is approaching quickly. This meeting is free of charge and is open to the public. Sponsored by the Extension Crops Committees is Hidalgo and Cameron Counties. We look forward to seeing you there.

Sincerely,

Enrique Perez
County Extension Agent- Agriculture
County

Brad Cowan
County Extension Agent- Agriculture
Hidalgo County

...religion, disability or national origin

Program

a.m. **Trade Show Opens**
Breakfast Tacos served in the Trade Show area

) a.m. **Registration**

0 a.m. **Update on the Current Water Supply Situation, Forecast for the 2000 Season**
Cindy Martinez, Rio Grande Watermaster
McAllen

50 a.m. **Update on Proposed $90 million Federal Legislative Initiative for Rio Grande Valley Water Improvements**
Ray Prewett, Executive Director TCM/TVA
Mission

:00 a.m. **The Future of Irrigation in the Valley- Update on Work of Region M Planning Group**
Gordon Hill, Manager, Bayview Irrigation District and member of the Rio Grande Regional Water Planning Group- Region M
Bayview

9:30 a.m. **Modernizing District Accounting Systems**
Eric Leigh, Research Associate, Weslaco

10:00 a.m. **Break**

10:30 a.m. **Irrigation Selection and Costs**
Dr. Guy Fipps, Extension Agricultural Engineer
College Station

11:15 a.m. **Economics of Irrigation**
Dr. Larry Falconer, Extension Economist
Corpus Christi

11:45 a.m. **Water Quality in the Arroyo Colorado Watershed**
Brian Rigsby, Extension Associate for Water Quality, Weslaco

12:00 noon **Lunch**

1:30 p.m. **Concurrent Workshops**

Workshop A- Center Pivot/Sprinkler
Purchasing, Operating and Managing Center Pivot/Lateral Move Systems
Leon New, Extension Agricultural Engineer
Amarillo

Workshop B- Furrow/Surge Flow
Maximizing the Effectiveness of Furrow Irrigation
Alan Moore, NRCS Engineer
Edinburg

Surge Flow Irrigation
John Walker, Waterman Industries
Lubbock

Workshop C- Drip
Product Selection and Options
Dr. Jackie Robbins, President- Irrigation Mart
Ruston, Lousiana

Operation and Management of Drip Systems
Dr. Juan Enciso, Extension Agricultural Engineer
Fort Stockton

Rainfall Capture with Plastic Culture
Dr. Frank Dainello, Extension Horticulturist
College Station

South Texas AmeriCorps Initiative (STACI)

Texas Agricultural Extension Service

STACI Training in Starr County

Falcon State Park

March 31 & April 1, 2000

DRAFT

Agenda

Friday - March 31st

2:30 p.m.	Arrival at Falcon State Park....Recreation Center/Meeting Room Registration, Cabin Assignments
3:00 p.m.	Park Orientation & Tour *Calvin Snyder, Park Manager*
4:15 p.m.	Soil Health & Water Quality *Brian Rigsby, Extension Associate for Nutrient Management*
5:15 p.m.	Settle in. Need volunteers to help with dinner.
6:00 p.m.	Cook-out.....Idea Sharing
7:30 p.m.	Photography Tips *Esmer Pina, STACI Program Assistant*
8:00 p.m.	Leadership Activity *Trini Morales, STACI Member*
8:45 p.m.	Administrative Matters & Reflections
10:00 p.m.	Adjourn

Saturday - April 1

7:00 a.m.	Omelette Rodeo Breakfast
8:15 a.m.	Depart for Roma.....Everything already packed.
9:00 a.m.	Recycling & Composting *Tomas Cantu, Recycling Coordinator for City of Roma*
11:00 a.m.	Leave for RGC...Tour of STACI Project - Native Teaching Trail
12:00 p.m.	Arrive at Benito Trevino's Ranch... Tour & Lunch *Benito Trevino, Botanist and Conservationist*
4:00 p.m.	Adjourn

CAMERON AND HIDALGO COUNTIES CROPS COMMITTEES PRESENT

Conservation Tillage Field Day

8:30 a.m. -1:00 p.m. April 26, 2000 6th Annual

Lunch provided

Spanish language translation available

CEU's available

USDA, ARS Research Farm

F.M. 88 & Mile 12 North, Weslaco, Texas

Each stop will feature a scientist and a producer to present relative information and answer questions.

Some, but not all of the features of the program are listed below.

Implementation of Conservation Tillage, Decisions to Convert, First Steps	*Dr. Joe Bradford, Soil Scientist, ARS* *Charles Eubanks, Producer, Santa Rosa*
Costs of Making Conversions, Systems Net Returns	*Dr. John Robinson, Extension Economist, TAEX*
Cover Crops, Root Distribution with Tillage, Earthworms	*Dr. Larry Zibilske, Soil Microbiologist ARS* *Charles Loop, Producer, Brownsville*
Fertilizer Placement and Timing	*Charles Stickler, Extension Agronomist, TAEX* *Dr. Leo Espinoza, TAEX*
Planters and Seed Placement in No-till Coulters, Closing Wheels	*Dr. James Smart, Research Agronomist, ARS* *Gary Mac, Producer, San Benito*
Insect Identification and Beneficials in Conservation Tillage	*John Norman, Ext. Entomologist, TAEX* *Randy Coleman, Research Entomologist, ARS*
Economics of Conservation Tillage and How to Survive in Agriculture	*Dr. Larry Falconer, Extension Economist, TAEX*
Hooded Sprayers -vs- Cultivators, Cost Savings With No-Till	*Dr. John Bradley, Conservation Tillage Specialist, Monsanto*
Carbon sequesteration and equip programs	Gerry Lemmyon, Jimmy Childers, Tony Gonzales, Noe Gar[illegible] USDA, NRCS.
Cotton Stalk, How to Remove Them with Stalk Puller, Chemicals, Other Means	*Steve Bearden and Ed Gage* *Texas Department of Agriculture*
New Herbicide Products and Weed Management for Conservation Tillage	*Dr. Paul Baumann, Extension Weed Specialist, TAEX*

Agricultural Research Service | USDA NRCS | Texas Agricultural Extension Service

[illegible] language interpreters, should contact USDA, ARS offices at (956) 969-4812 [illegible] color, sex, religion, disability, [illegible]

Cameron County Turn Row Tour

Date: Thursday, May 4, 2000
Location: La Feria CO-OP Gin & Supply
Time: 1:30 p.m.

TOPICS:

- County Cotton Variety Tests
- Description of Cotton Crop Situation
- Plant Physiology
- Conservation Tillage Economic Outlook
- Pesticide Selection, Label Update
- Beneficial Insects/Pest Management
- Question and Answer Session

SPEAKERS:

- John Norman, Extension Agent, IPM
- Dr. Stormy Sparks, Extension Entomologist
- Dr. Charles Stichler, Extension Agronomist
- Dr. Jim Smart, USDA-ARS

The program is sponsored by the **Cameron County Field Crops Committee.** A wide variety of educational topics will be presented by experts in the field as listed in this flyer. Cotton and sorghum producers are welcomed to bring live specimens of plants showing problems for discussion. The tour will focus mainly on the cotton and sorghum crop's situation. We will begin promptly, (1:30 p.m.) at the CO-OP in La Feria with the introductions and presentations from speakers on certain topics. CEU's will be available to the participants.

See you then!

Sincerely,

Dr. Enrique Perez
County Extension Agent-Agriculture
Cameron County

See Reverse Side

TEXAS AGRICULTURAL EXTENSION SERVICE

TEXAS IPM
Partners with Nature

PEST CAST

The Integrated Pest Management (IPM) Newsletter for the Row Crops in the Lower Rio Grande Valley

2401 East Highway 83
Weslaco, Texas 78596
Telephone (956)968-5581
Fax (956) 969-5639
WebSite: http://entowww.tamu.edu
TPMA Newsletter Website: www.tpma.org

Alton "Stormy" Sparks, Jr.
Extension Entomologist

John W. Norman, Jr.
Ext. Agent-Entomology (PM)

Volume XXVI No. 14 June 30, 2000

GENERAL SITUATION: Cotton bolls are popping all over the place. Lots of fields were defoliated this week and even more will be defoliated next week. Grain sorghum harvest is nearly complete. Corn harvest is going strong, but with fewer acres of corn than any other crop, the corn harvest will end quickly. Hot and dry weather will keep the crops maturing rapidly.

Cotton and Grain Sorghum Field Day

There will be a field day on Friday, July 7, 2000, at the Texas A&M Research "Hiler Farm" annex north of Weslaco (See map included with this newsletter). The field day will begin with registration at 8:00 am. The tour of the field plots will begin at 8:30 and will conclude with lunch. The plans are to look at cotton variety trials, cotton fertility, pix test, insecticide studies, and cotton defoliation trials. We will also have some discussion on grain sorghum research, a sorghum midge trial and a new irrigation system on display. We plan to have CEU's available for those who need them. At present we plan to have ½ hour of laws and regs, 1 hour of IPM and ½ hour of general. We look forward to having everyone out and hope to see you there.

Boll weevils made additional gains on later maturing cotton this week
Punctured square counts continued to climb in later maturing fields. Puncture:
square counts ranged from 15 to 46 per 100 plants. Boll weevils trapped thi
week showed a decline at one site and increases at the other two sites.

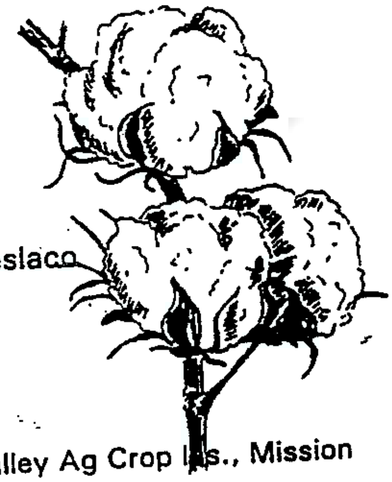
Boll Weevil Trap Records

Location	*6/07*	*6/14*	*6/21*	*6/28*
San Benito	12.2	19.5	11.5	9.0
Lyford	0.7	0.7	2.0	2.5
Weslaco	9.6	5.8	14.2	31.3

Silverleaf whiteflies were also increasing in some fields. Whiteflies did n appear to pose any significant concern to cotton this week. However, if there a fields which will be needing another month of protection to finish the season, th whiteflies and many other pests could be a serious threat to the crop.

Texas Agricultural Extension Service

The Texas A&M University System



COTTON PRE-PLANT SEMINAR

Thursday, January 25, 2001
Hoblitzelle Auditorium, A&M Research & Extension Center, Weslaco
8:00- 8:30 a.m. Registration (free of charge)
Program begins at 8:30 a.m. and concludes around 3:00 p.m.

Update on Water Related Issues In the Rio Grande Valley	Ray Prewett TCM, TVA, Valley Ag Crop Ins., Mission
Voluntary Weevil Management Zones	Tom Kilgore South Texas Planting Seed, Mercedes
Cotton Supply & Price Forecast . . . . Crop Insurance Changes for 2001	John Robinson Extension Economist, Weslaco
Yield and Fiber Quality Trends in the RGV . . . . 2000 Variety Trial Results	John Norman Extension Cotton IPM Entomologist, Weslaco
Terminating Conservation Tillage Cotton	Charlie Thomas Director of Pesticide Regulation Program Texas Department of Agriculture, Austin

Lunch
Sponsored by our Allied Industry Partners

ANNUAL MEETING OF THE COTTON AND GRAIN PRODUCERS OF THE LOWER RIO GRANDE VALLEY	**Sam Simmons, President** **Special Guest Speaker: John Maguire** **National Cotton Council, Washington, D.C.**

Cotton Fertility	Leo Espinosa Extension Associate, Weslaco
Emergency Exemptions . . . . and Their Importance to RGV Cotton Production	Charlie Thomas Director of Pesticide Regulation Program Texas Department of Agriculture, Austin
Cotton Aphids	Dr. Stormy Sparks Extension Entomologist, Weslaco
New Developments from Industry	Allied Industry Representatives

Sponsored by Extension Crops Committees in Cameron, Hidalgo and Willacy Counties

TDA CEU'S TO BE OFFERED

Fourth Annual
National
Conservation Tillage

Also Featuring
Corn • Sorghum • Peanuts • Precision Ag

January 30-31, 2001
Houston, Texas
Radisson Hotel Astrodome Convention Center
8686 Kirby Drive, Houston, Texas, 77054

KEYNOTE SPEAKERS

DR. TOMMY VALCO
Conference Moderator
Director of Research
Cotton Incorporated

DENNIS R. DeLAUGHTER
Professional Farm Manager
Investment Advisor
Commodity Broker

BARRY KNIGHT
Environmental Affair Manager, Southern Region
Monsanto Co.

CONFERENCE PRESENTATIONS

COTTON Researchers

- **Weed Management Considerations for Central Texas Conservation Tillage Cotton Production**

Presented by Dr. Paul Baumann
Professor, Extension Weed Specialist, Texas A&M University

Presented by Dr. Robert Lemon
Associate Professor and Extension Agronomist - Cotton and Peanuts, Texas A&M University

- **A Comparison of Three Tillage Systems: for Cotton and Grain Sorghum in South Texas:** *Test Plot Results & Whole Farm Projections 1998 thru 2000*

Presented by Harvey L. Buehring
County Extension Agent, Agricultural Nueces County, Texas A&M University

- **Economics of Conservation Tillage in Central Texas**

Presented by Dr. Cloyce G. Coffman
Professor and Extension Agronomist, Dept. of Soil and Crop Sciences, Texas A&M University

- **Sustainable Weed Control in Con-Till Roundup Ready Cotton**

Presented by Steve Crawford
Professor Ementus, Louisiana State Agricultural Center

- **Efficient Nitrogen and Phosphorus Fertilization in Cotton**

Presented by Dr. Leonel Espinoza
Extension Associate of Water Quality, Texas A&M University Extension Service

- **Improving the Crop Water Supply:** *A Key to Increasing Dryland Cotton Yields*

Presented by Dr. Tom Gerik
Professor of Crop Production and Physiology, Texas A&M University

- **Comparison of Weed Management Strategies in Roundup Ready (Glyphosate-Tolerant) Cotton Cropping Systems**

Presented by Dr. Wayne Keeling
Professor and System Agronomist, Texas A&M University

- **Problems & Progress Associated with IPM Strategies in Conservation Tillage Systems for Cotton**

Presented by Dr. Roger Leonard
Professor of Entomology, Louisiana State Agricultural Center

- **Effect of Conservation Tillage on Soil Phosphorus Availability**

Presented by Dr. John E. Matocha
Professor, Soils and Plant Nutrition, Agricultural Research and Extension Center

- **No-Tillage Cotton Seed Placement with Coulters and Residue Managers**

Presented by Dr. James Smart
Research Agronomist, USDA-ARS Texas

- **Con-Till:** *Making It Work in South Texas*

Presented by Charles Stichler
Extension Agronomist, Texas A&M University

- **The Influence of Conservation Tillage on Cotton Seedling Disease and Root-Knot Nematode**

Presented by Dr. Terry Wheeler
Plant Pathologist, Texas A&M University

- **Combining No-Till and Cover Crops Benefits Soil Biology and Fertility**

Presented by Dr. Larry Zibilshi
... ARS, Weslaco, Texas

Texas Agricultural Extension Service
THE TEXAS A&M UNIVERSITY SYSTEM

RECERTIFICATION TRAINING

5 HOURS of Continuing Education Units (CEU's) for TDA Licenseholders

Thursday, February 22, 2001
Registration at 8:00 a.m., Training begins at 8:30 a.m. Concludes at 3:00 p.m.
Hoblitzelle Auditorium, A&M Research & Extension Center, Weslaco
Registration Fee:$5.00 per hour
Lunch on your own

Pre-registration is not required.

This training will meet the annual requirements of commercial/non-commercial license holders for continuing education. It will include one hour each on laws and regulations and Integrated Pest Management.

Topics	Speakers
Rules and Regulations	Carlos Rivas Texas Department of Agriculture, San Juan
Digital Diagnostics	Brad Cowan County Extension Agent-Agriculture Hidalgo County
Non Point Source Pollution	Dr. Leo Espinosa, Extension Associate- Water Quality
Integrate Pest Management	Dr. Stormy Sparks, Extension Entomologist
Benificial Insects and Scouting for Cottons' Six Most Wanted	Enrique Perez County Extension Agent-Agriculture Cameron County

This training will be conducted by the Texas Agricultural Extension Service. If you have any questions, contact your local County Extension office at:

Enrique Perez	Cameron County Extension Office	399-7757
Brad Cowan	Hidalgo County Extension Office	383-1026 or 1-800-638-8239

CONSERVATION TILLAGE CONFERENCE

Breakout Session I
9:30 A.M. - 10:10 A.M. -WEDNESDAY

TOPIC	SPEAKER	ROOM
System Approach Consideration for Con-Till on Cotton Production	Dr. Jim Smart John Bradley	Lounge
Getting Started/Personal Experience with Con-Till on Cotton Production	Ray Gray Guillermo Jimenez	Pecan
Fertility Considerations for Reduced Tillage	Dr. Leo Espinoza Mike Hudsonpillar	Blue Bonnet
Sorghum & Corn Weed Management with Con-Till	Dr. John Bremer	Texas
Effects of Con-Till on Reniform Nematodes on Con-Till and Conventional Tillage	Dr. Andreas Westphal	Topaz
Personal Experience with Nematodes on Con-Till and Conventional Tillage	John Christian	Topaz

Breakout Session II
10:15 A.M. - 10:55 A.M. -WEDNESDAY

TOPIC	SPEAKER	ROOM
Chemical Use on Cotton Stalk Destruction	Charlie Thomas	Lounge
Laws and Regulations Related to Con-Till	Ed Gage	Lounge
Cotton Stalk and Residue Management with Con-Till	Charles Stichler Charles Eubanks	Texas
Insect Comparison with No-Till vs Conventional Tillage	Sasha Greenberg	Topaz
General Integrated Pest Management and Con-Till	John Norman	Topaz
Cotton Weed Management with Con-Till	Dr. Paul Baumann	Blue Bo
Production & Economics across the Cotton Belt	Dr. Tommy Valco	Pecan
Lenders View on Con-Till	Travis Richards	Pecan

Breakout Session III
11:00 A.M. - 11:40 A.M. -WEDNESDAY

TOPIC	SPEAKER	ROO
Sorghum & Corn Weed Management with Con-Till	Dr. John Bremer	Texas
Getting Started/Personal Experience with Conservation-Tillage	Ray Gray Guillermo Jimenez	Pecan
Soil Quality and Microbial Population in Con-Till	Dr. Al Knoff Dr. Larry Zidilske	Blue B
Chemical Use on Cotton Stalk Destruction	Charlie Thomas	Lou
Laws and Regulations Related to Con-Till	Ed Gage	Lou

REC 2001 Planning Committee

Catherine Allen	*Texas A&M University - Kingsville*
Dr. William Berg	*University of Texas at Brownsville*
Dr. Charles R. Bevers	*University of Texas at Brownsville*
Mary Lou Campbell	*Frontera Audubon Society*
Rafael De Castro	*Air Consulting and Engineering Services, LLC*
Sandra De Leon	*City of Brownsville*
Dr. Andrew Ernest	*Texas A&M University - Kingsville*
Leonel Espinoza	*Texas Agricultural Extension Service*
Carol Evans	*United States Fish and Wildlife Service*
Rolando Gallegos	*Texas Natural Resource Conservation Commission*
Javier Guerrero	*City of McAllen*
Ileana Hinojosa	*Texas Agriculture Extension Service*
Jose Hinojosa	*City of Brownsville*
Dr. Kuruvilla John	*Texas A&M University - Kingsville*
Ken Jones	*Lower Rio Grande Valley Development Council*
Dr. Kim Jones	*Texas A&M University - Kingsville*
Steve Labuda	*USFWS Laguna Atacosa NWR*
Elaine Lockhardt	*Harlingen Proud*
Brenda Lukefahr	*Texas A&M University - Kingsville*
Dr. Al Martinez	*Texas A&M University - Kingsville*
Pat Patrick	*Air Consulting and Engineering Solutions, LLC*
Ernesto Reyes	*US Fish and Wildlife Service*
Zaragosa Rodrigues	*Soil Conservation Service*
Dr. Ronald Rosati	*Texas A&M University - Kingsville*
Dr. David R. Tilley	*Texas A&M University - Kingsville*

Conference Objective: To provide an international forum for the discussion and dissemination of information and significant technical findings pertaining to environmental issues relevant to the Rio Bravo/Rio Grande Region.

Conference Format – The conference will include:

- **Welcoming Speakers:**
  The Honorable Eugene Braught, Mayor of Weslaco, Texas
  Frank Castellanos, Weslaco City Manager
  The Honorable Eloy Pulido, Hidalgo County Judge
- **Luncheon Keynote Speaker:** A luncheon will be held Friday April 27th with a Keynote Speaker (TBA). The keynote speaker will be a distinguished guest, like a State Senator or Federal Agency Head that is involved with the region's environmental issues.
- **Technical Papers:** featuring both research topics and practical environmental and regulatory topics of concern to business and industry (see agenda).
- **Technical Posters & Competition:** posters and displays that highlight innovations in environmental engineering and science. The posters will be judged and prizes awarded for first through third places.
- **Vendor Exhibits:** the latest in environmental solutions from equipment suppliers, environmental consulting, and environmental laboratories.
- **Workshops:** offered by regulatory agencies and vendors to give hands-on experience in compiling with new regulations and in operations of new technologies.
- **Field Trip:** an afternoon field trip to the Santa Ana and Lower Rio Grande Valley National Wildlife Refuge is planned for Saturday, April 28th. Participants will be taken on a tram ride through the Refuge, and then will be free to walk the refuge trails and see the visitor center.
- **Ice Breaker Social** - A reception will be held Thursday, April 26th, from 6:30 PM – 9:30 PM for all conference participants, at the Palm Aire Best Western in Weslaco.

Conference Location and Hotel

Hotel rooms are available at the BEST WESTERN PALM AIRE HOTEL AND SUITES in Weslaco, Texas, at a Special State Rate Program of **$50.60** per room for Thursday, April 26th through Saturday, April 28th, 2001 for the **Rio Bravo/Rio Grande Environmental Conference** in Weslaco. This is based on single occupancy and includes a Full Breakfast Buffet in their Courtyard Restaurant. Additional persons in a room are **$6.00** each person per night. **Please make sure you have the necessary documentation to present to the Hotel for Occupancy Tax exemption at arrival, if you qualify for exemption.**

To reserve your rooms, call **1-800-248-6511** and ask for **reservations**. Then you must identify yourself as being with the **RIO BRAVO/RIO GRANDE ENVIRONMENTAL CONFERENCE** in order to be set up with the group. **Please make these reservations by Thursday, April 12th, 2001 or after that time all rooms will be subject to availability.** You will need to guarantee your reservations for late arrival with a Credit Card. Rooms must be **cancelled** within 24 hours of arrival or you will be liable for First Nights Room Charge and Tax.

Texas Agricultural Experiment Station

The Texas A&M University System
Agricultural Research and Extension Center
Weslaco

2415 E. Hwy. 83
Weslaco, TX 78596-8399
956/968-5585
Fax: 956/968-0641
Web: primera.tamu.edu

MEMO

Date: 21 December 1999

To: Dr. Srormy Sparks
Leo Espinoza
Brian Rigsby

Subject: University Outreach Program

Thank you very much for your presentation to the University Outreach group that visited the Weslaco Center this morning. The students were very attentive and I know they got a lot out of the presentations that were made. Ms. Esmerelda Sanchez, the coordinator for the visit, was very grateful for the program that was presented.

Sincerely,

Bob Wiedenfeld
Professor

cc: Dr. José Amador

The Agriculture Program
The Texas A&M University System

Nitrogen and Crop Production

Leonel A. Espinoza, Mark L. McFarland and Charles R. Stichler
Department of Soil and Crop Sciences

Introduction

Nitrogen (N), together with phosphorus and potassium, constitute the three macro-nutrients needed for optimal crop growth. Nitrogen is an important part of amino acids and proteins, which are the basic building blocks of all living matter- both plant and animal. Nitrogen is the nutrient used in the largest amount by a plant, with the productivity of most ecosystems and thus the ability to produce food being limited more by nitrogen than by any other nutrient.

Soil organic matter, chemical fertilizers and animal manures are all good sources of nitrogen for plants. Nitrogen in excess of the amount required for plant growth tends to accumulate as nitrate (NO_3^-), which is very mobile in soils. As water leaches through the soil profile, it may carry this excess nitrate to the groundwater, especially in sandy soils. Nitrate also can be lost in agricultural runoff and affect the quality of surface waters. High nitrate levels in drinking water may harm humans and create livestock health problems.

An understanding and practical application of the nitrogen cycle is of utmost importance for efficient fertilizer use. Finding the best timing, placement and rate of fertilizer application under current price scenarios and environmental scrutiny, is a constant challenge facing farmers and agricultural scientists.

Plant Requirements

Nitrogen is a structural part of chlorophyll, the green pigment in plants responsible for photosynthesis. The energy of light is combined with water and carbon dioxide through the process of photosynthesis to form simple carbohydrates, which are essential for plant growth.

Leonel A. Espinoza, Extension Associate-Water Quality, Weslaco; Mark L. McFarland, Associate Professor and Soil Fertility Specialist, College Station; Charles R. Stichler, Professor, Uvalde; Texas Agricultural Extension Service.

The amount of nitrogen required for optimal plant growth varies among species. Depending on the plant species and age, the nitrogen required for optimal growth ranges from 2 to 5% expressed as plant dry weight. Nitrogen promotes vegetative growth, with healthy plants showing a deep green color. A plentiful supply of nitrogen during the head-filling stage also will ensure a higher protein content in grains such as corn, grain sorghum and wheat.

N-deficient plants normally show a pale-yellowish color (***chlorosis***), which results from a shortage of chlorophyll, "the plant's solar collection cells." Under deficient conditions, nitrogen is translocated to younger leaves causing ***senescence*** (premature leaf drop) of older leaves. Other deficiency symptoms include poor growth rate, small leaves, stems which have a spindly appearance, early plant maturity, and poor tillering in cereals.

Supplying a plant with excessive amounts of nitrogen may be as detrimental as a deficiency. In cereals, high N rates increase the risks of lodging which can reduce yields considerably. In cotton, excess N may promote rank growth, furthermore, excess N may increase the incidence of various fungal diseases in other crops and has been correlated with increased insect attack. The sugar content of sugarcane and sugar beets, and fruit appearance, also can be affected by excessive applications of N fertilizers. Finally, because nitrate N is very soluble and mobile in the soil, it can increase the potential for both surface and ground water contamination.

The Nitrogen Cycle

Nitrogen exists in soils in many forms and changes from one form to another constantly. The paths that the different forms of nitrogen follow in and out of the ecosystem are collectively called the ***Nitrogen Cycle*** (Figure 1). Understanding how the different pools of nitrogen interact among each other, and the processes by which these forms enter and leave the cycle, is the subject of continuing study.

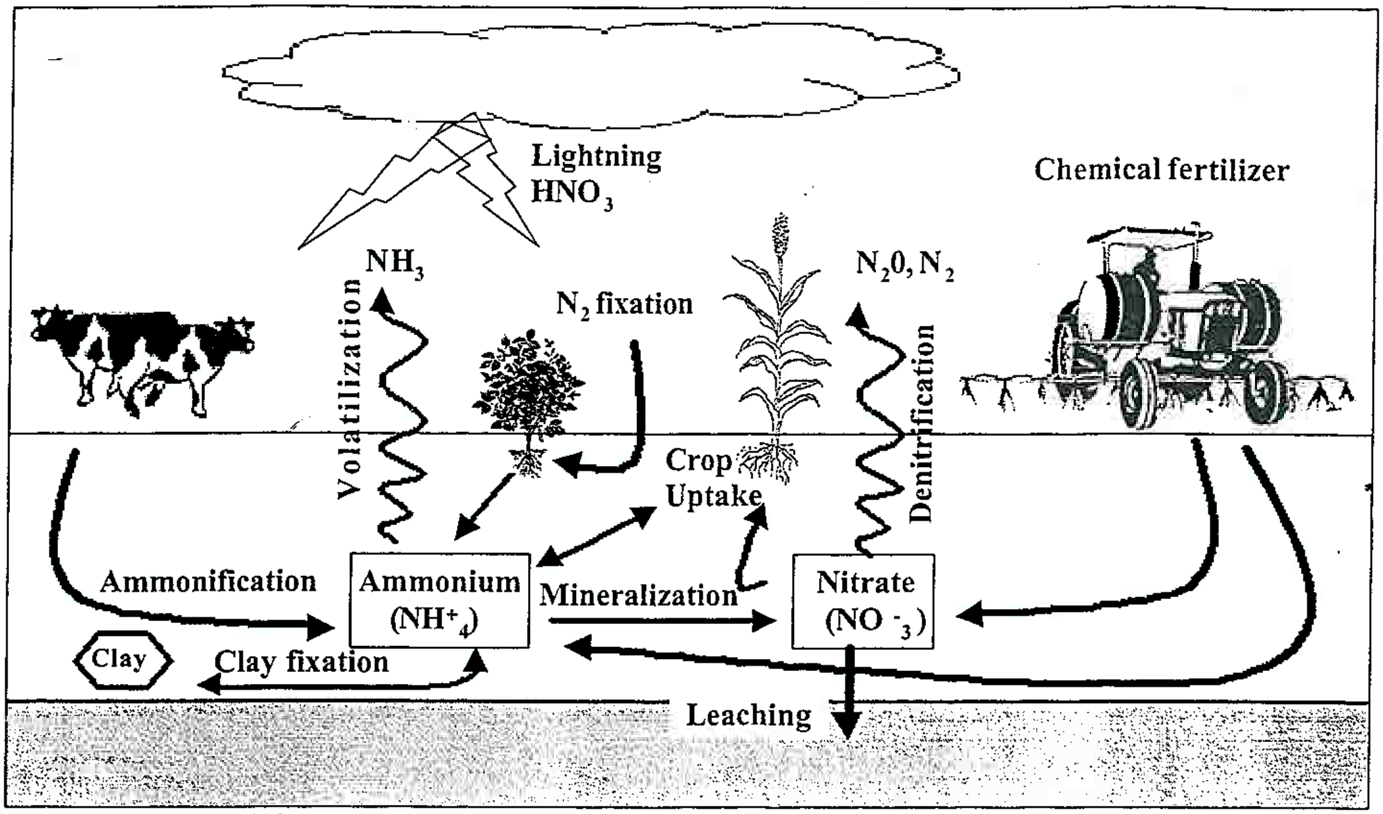


Figure 1. Simplified soil-nitrogen cycle

Nitrogen is found in both inorganic and organic forms. The organic form which is associated with the soil organic matter, is primarily in the form of amides (NH_2) and accounts for more than 90% of the total nitrogen present in most environments. In general, nitrogen is not found associated with soil minerals as is the case with phosphorus. Some clay minerals may tie up small amounts of nitrogen in the ammonium form, but this form typically contributes little to the pool of available N.

Organic Nitrogen

Soil organic matter is the major storehouse of many plant nutrients in soils including nitrogen, phosphorus, sulphur, calcium, and magnesium. Soil organic matter is composed of a stable material called ***humus***, an easily decomposed material (litter), soil microbes, and some other organic molecules. Typically, humus will contain 45 to 55% carbon and about 5% nitrogen. In other words, soil humus typically has a carbon to nitrogen ratio (C:N ratio) of approximately 10:1.

Organic matter improves soil structure, water infiltration, soil aeration, and water storage capacity, which is of extreme importance for Texas agriculture. One benefit of reduced tillage systems is the increase in the levels of soil organic matter, which enables these soils to hold more water for plant use as compared to conventional tillage systems.

Mineralization

Nitrogen that is present in soil organic matter, crop residues and manures is converted to the inorganic form by the process of ***mineralization*** (Figure 2). Mineralization is a two-step process which includes many reactions. Initially, larger organic matter molecules are broken down into smaller ones, with soil microorganisms attacking these remaining materials by producing specific enzymes. The first step, the transformation of organic nitrogen to the ammonium (NH_4^-) form is referred to as ***ammonification***. The second step, the transformation of ammonium to the nitrate form (NO_3^-) is called ***nitrification***. Since the decomposition process is carried out by living organisms, the process will be affected by several environmental variables,

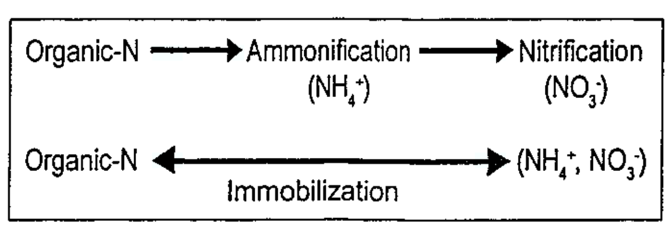


Figure 2. Nitrogen mineralization/immobilization process

including soil moisture, soil temperature, soil pH, and the C:N ratio, type and age of organic materials in the residue.

Cotton burs, sorghum stalks and small grain residues are relatively high in carbon and low in nitrogen (having C:N ratios greater than 30:1). Soil organisms may need additional nitrogen to decompose these residues. When the nitrogen supply is limited, soil microbes compete with plants for this nutrient via a process referred as ***immobilization***. Eventually, the nitrogen that was tied up in the decomposition process again becomes available for crop use.

Biological Nitrogen Fixation

Atmospheric nitrogen (N_2) is basically an endless source of N, but this nitrogen cannot be used by most plants. Legumes such as alfalfa, soybeans and clovers form a ***symbiotic association*** (mutually beneficial) with bacteria to convert atmospheric N_2 to a form plants can use. The plant provides nutrients and other compounds to the N_2-fixing bacteria and in return the plant benefits from the N fixed by the microorganism (Table 1). The symbiotic association is highly specific, thus the bacteria species that fixes N_2 with soybeans is not effective for fixing N_2 with alfalfa. The site of the N_2-fixing process is a root nodule, which forms on the root system, and has a pink coloration if actively fixing N_2.

The biological nitrogen fixation process is catalyzed (accelerated) by the nitrogenase enzyme, which is affected by a number of soil and weather factors. The association does not work well in soils that are too acid, or when high levels of available mineral nitrogen are present. The absence of the right type of inoculum (bacteria) in the soil also will limit nodulation and N_2 fixation.

Some other soil organisms are capable of fixing N_2 via ***non-symbiotic*** associations. This process is of little significance in most agricultural systems, with the exception of blue-green algae which live in paddy rice systems. Some nitrogen also is fixed by lightning, but in considerably smaller amounts than biologically fixed N_2.

Crop Uptake

The amount of nitrogen removed by harvest varies among crops. Table 2 lists nitrogen removal for several crop species based on yield. Nitrogen *is not* readily available for plant uptake in the organic form; this nitrogen first must be converted to the inorganic form, mainly ammonium (NH_4^+), and nitrate (NO_3^-).

Table 1. Typical amount of nitrogen fixed by selected crops

Crop	(lbs./A)
Soybeans	40 - 160
Peanuts	30 - 190
Clover	100 - 160
Alfalfa	160 - 275

Table 2. Nitrogen removed by selected crops

Crop	Yield	Nitrogen Content (lbs.)
Cotton *(seed and lint)*	2,600 lbs.	63
Cotton (stalks, leaves)	3,000 lbs.	57
Corn (grain)	180 bu.	170
Corn (stover)	8,000 lbs.	70
Sorghum (grain)	7,500 lbs.	107
Sorghum (stover)	5,280 lbs.	78
Soybeans (beans)	50 bu.	188
Soybeans (leaves, stems, and pods)	6,000 lbs.	89
Sugarcane	40 tons	40
Coastal Bermudagrass	8 tons	400

Losses of Nitrogen

Nitrogen can be lost or removed from cropped fields by one or more of the following processes:

- ✓ Leaching and surface runoff
- ✓ Volatilization as NH_3
- ✓ Denitrification

Leaching and runoff

Nitrogen in the nitrate form is very mobile and highly soluble in water. Rainfall moving through the root zone may wash this nitrate downward, reaching tiles or drainage channels and potentially polluting groundwater or surface waters. Leaching is a more serious problem in sandy soils than in clays, due to the high permeability of sandy soils. The magnitude of nitrate loss through leaching will obviously depend on the intensity of the rainfall or the amount of irrigation water, and the amount of nitrate present in the soil. In some areas of Texas, leaching may not be a serious problem since rainfall is not adequate and/or soils have a low permeability..

The loss of nitrate by leaching is of concern for two important reasons. Nitrate beyond the root zone is no longer available for plant use, representing an important loss of resources. In addition, water quality problems caused by excess nitrogen leaving fields may result in the deterioration of drinking water sources and wildlife habitat.

Volatilization as NH_3

Texas farmers can potentially lose a high percentage of applied nitrogen fertilizers through the process of volatilization, unless best management practices (BMPs) are followed. Most commercially available fertilizers contain ammonium, or convert readily to ammonium such as in the case of urea. Under high soil pH conditions, typical of many regions of Texas, a percentage of the ammonium will convert to ammonia gas (NH_3) and eventually escape to the atmosphere (Figure 3). The amount of nitrogen loss can be as high as 50% of the applied fertilizer, if the fertilizer is left on the soil surface. In addition to high soil pH, high soil temperatures and strong winds will contribute to such loss. For this reason, rapid incorporation of nitrogen fertilizer is very important.

Ammonia volatilization also can occur under neutral and acidic soil pH conditions. During the transformation of urea to ammonium (NH_4^-), the pH of the soil adjacent to the fertilizer can increase to levels that will promote ammonia. formation. This effect will be more pronounced in sandy soils, which lack the ability to resist pH changes (i.e., low pH buffering capacity).

Denitrification

The process of denitrification is a form of respiration carried out by microorganisms under low oxygen conditions. Specific microorganisms, primarily bacteria, have the ability to use nitrate instead of oxygen to carry out their metabolic functions. In this process, nitrate (NO_3^-) is reduced to NO_2^- and then to various N gas forms including N_2O and N_2.

Temperatures between 75 and 95 °F, low oxygen levels for several days, soil pH > 6, and the presence of a source of carbon (to provide a source of energy) are ideal conditions causing denitrification to proceed at a high rate. The magnitude of N loss due to denitrification varies widely among locations, and with time of the year, but it normally represents only a small percentage of the potential losses from agricultural fields. Denitrification plays an important role in rice production, where losses can account for two thirds of the fertilizer applied. Such losses can be lowered by placing the N fertilizer several inches deep in the soil.

The process of denitrification is detrimental for agriculture, since a source of plant-available nitrogen is being lost to the atmosphere. However, denitrification also can be used as a means to prevent the buildup of nitrates in groundwater wells, manure storage lagoons, and in wastewater treatment plants.

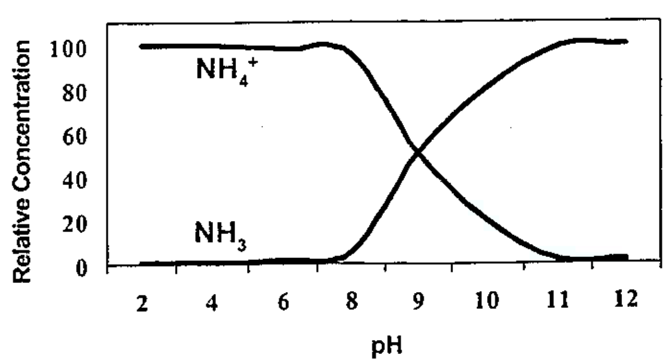


Figure 3. Relative NH_4^+ and NH_3 concentration (%) according to soil pH

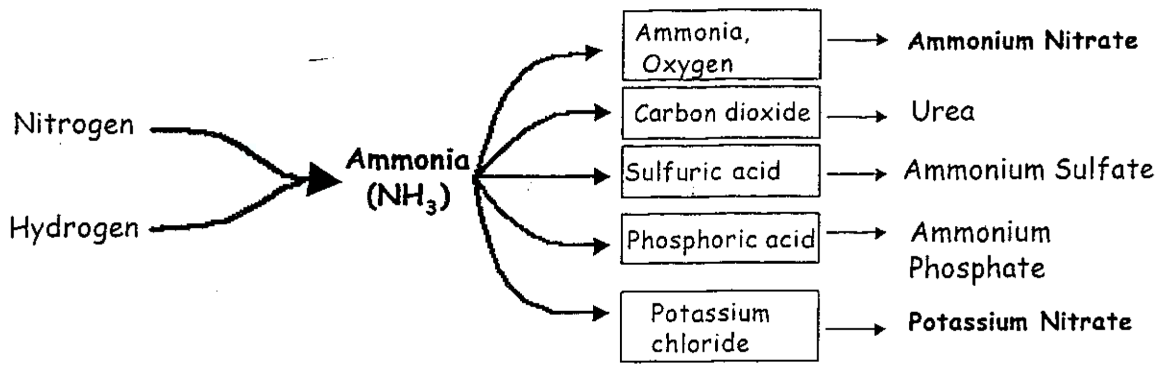


Figure 4. The manufacturing of most nitrogen containing fertilizers involves the use of ammonia

Denitrification plays an important role in atmospheric chemistry. Nitrous oxide (N_2O) contributes to the formation of acid rain, especially near industrial regions of the country. It also plays a small role as a greenhouse gas. Other greenhouse gases include CO_2 and methane, which form an impermeable roof for re-radiation from the earth's surface (just like the glass in a greenhouse), keeping the planet warm. Nitrous oxide also may react with other compounds in the atmosphere and thereby damage the ozone layer. The ozone layer protects us from the damaging effects of infrared radiation from the sun.

Types of Nitrogen Fertilizer and Their Behavior

Nitrogen can be supplied as dry, liquid or gas formulations. It also can be added through manure, crop residues and other organic sources. Chemical N fertilizers are the most important sources of nitrogen in today's agriculture, with anhydrous ammonia (NH_3) being the basis for most of the synthetic fertilizers (Figure 4). In essence, no N-fertilizer source is better than another if applied according to recommendations. In fact, once N is in the inorganic form it is basically impossible to identify the original source.

Ammonium Nitrogen (NH_4^+)

The ammonium form of nitrogen is composed of nitrogen and hydrogen in a ratio of 1:4. It is the form used in the largest amounts by plants after nitrate, with most ammonium converting fairly rapidly to nitrate under Texas conditions. Ammonium has a positive charge which is attracted to the negatively-charged surfaces of clay and humus particles. As a result, the ammonium ion is not as mobile as nitrate, and it is less likely to be lost by leaching or denitrification. However, under alkaline conditions it may be lost via ammonia volatilization.

Nitrate Nitrogen (NO_3^-)

Nitrate is the form used in the largest proportion by plants. Nitrate is a combination of nitrogen and oxygen and has a negative charge. Nitrate ions are repelled by the negative charge of soil clays and tend to remain in the soil solution. As a result, the nitrate ion is highly soluble and readily mobile in soils, which increases the chances of loss by leaching and denitrification.

Urea Nitrogen $CO(NH_2)_2$

Urea is basically an ammonium-type nitrogen, containing nitrogen, hydrogen, carbon, and oxygen. Plant roots do not absorb urea from the soil solution; it must first be converted to an inorganic form (NH_4^+ or NO_3^-). This conversion is promoted by the enzyme urease, which exists in all types of soils. In cold, wet soils urea may be considered a slow-release fertilizer, since conversion to the inorganic forms may take longer than under the warm conditions characteristic of most regions in Texas. However, urea itself is highly mobile in soils, and thus the urea-N also can be leached beyond the crop rootzone if heavy rainfall or irrigation occurs.

Urea is a naturally occurring compound found in animals and some plants. Urea was the first organic substance to be synthesized from inorganic substances, more than a century ago. Urea is made by combining ammonia and carbon dioxide (CO_2), both of which are gases at normal atmospheric pressure.

Organic Amendments

Manures, sewage sludge, municipal compost, N_2-fixing crops, cover crops, and irrigation water all contribute to the nitrogen pool of soils. Land application of organic materials has been a common cultural practice by farmers around the world for centuries. However, as recently as the early 1970s, a considerable amount of research was initiated to study crop and soil responses to applications of organic materials.

Organic wastes (animal manures, sewage sludge, municipal compost) contain most of the essential elements for optimal plant growth, in addition to some heavy metals and other organic compounds. The chemical composition of these materials depends basically on the source and the way the materials were handled or processed. Land application rates are typically based on the concentration of nitrogen or phosphorus and the estimated rate of organic-N mineralization, soil type, pH, crop nutrient requirement, and levels of salts in the material. For more specific information, the reader is encouraged to obtain related TAEX publications:

> *"Feedyard Manure Management Handbook "* (SCS-1999-19)
>
> *"Poultry Waste Management Handbook"* (SCS-1999-18)
>
> *"Benefits of Applying Sewage Sludge on Agricultural Land"* (E-16).

The terms ***cover crops*** and ***green manuring*** also are commonly used in the literature. A cover crop is normally planted for erosion control, soil tilth improvement, fertility improvement (if legumes are grown as part of such a program) and also for weed or insect control. Seeding costs, ease of killing the crop, and soil moisture are all factors which producers should consider before planting cover crops.

Green manuring refers to the incorporation of the crop while green, the crop being basically grown to be plowed under. Gradual mineralization of the residues provides a source of nutrients for the new crop in its early stages of growth.

Nitrogen Behavior in Flooded Soils

In upland soils, the process of mineralization gradually increases the nitrate content of soils, with organic nitrogen being converted to ammonium and then to nitrate. Under flooded conditions, however, due to the low oxygen concentration, the end product of the mineralization process is ammonium (Figure 5).

Under flooded conditions, such as in rice paddies, two layers are clearly defined-an ***oxidative layer*** at the soil/water interface which is normally less than one inch thick, and a ***reductive layer*** beginning immediately beneath. If nitrate-containing fertilizers are added to flooded soils, bacteria will convert them to nitrogen gas by the denitrification process, with this nitrogen eventually being lost to the atmosphere. Ammonium forms of nitrogen in the oxidative layer also may be converted to nitrates just like in an upland soil. If this nitrate then moves downward to the reduced layer, it also could be lost by the denitrification process.

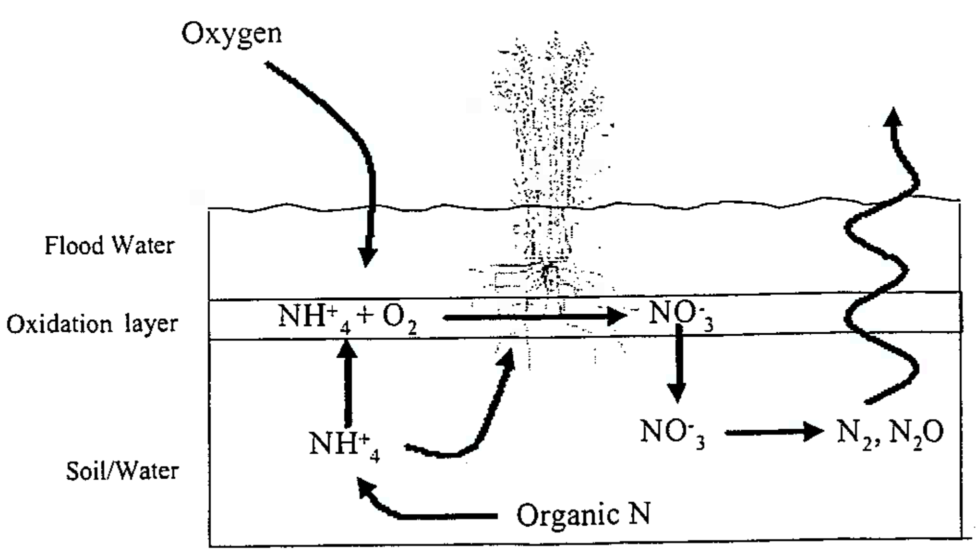


Figure 5. Nitrogen cycle in flooded soils

The practical significance of the distinct oxidation and reduction layers is apparent. Field results show the poor efficiency of nitrate nitrogen fertilizer sources on flooded soils and the need to properly place ammonium fertilizers. The nitrogen must remain in the ammonium form and not be oxidized to the nitrate form. Nitrate nitrogen, if applied as a fertilizer or as a result of oxidation, is largely lost through downward leaching and subsequent denitrification. Placing the fertilizer, in the ammonium form, several inches deep into the soil before seeding or flooding provides good nitrogen retention and availability for the rice plant.

Nitrogen and Water Quality

The growth of algae in surface waters is normally limited by the concentration of phosphorus or nitrogen. Excess nitrogen enriching surface waters contributes to the occurrence of algal blooms. As algae decompose, oxygen in water is depleted, often resulting in fish kills.

The source of the nitrogen is generally excess fertilizers lost by leaching or runoff from agricultural and urban settings and direct sewage effluent discharges. Runoff waters from livestock operations are a major concern, especially under situations where the maintenance of wastewater lagoons, and the design and operation of associated storage facilities, is inadequate. Over-application of manure to croplands also can contribute to water quality problems in some regions. The U.S. Environmental Protection Agency has revised the current Clean Water Act requirements and associated effluent guidelines for close to 40,000 concentrated animal feeding operations or CAFOs. The proposed changes include the distinction between "animal feeding operations" (AFO) and "concentrated animal feeding operations" (CAFOs), and new guidelines and permitting requirements for the land application of manure.

Unlike phosphorus, nitrogen in the nitrate form can be detrimental to human and animal health. The United States Public Health Service has established a limit of 10 mg/L NO_3^--N (10 ppm) as the maximum concentration considered safe for human consumption. High levels of nitrates in drinking water are a concern especially for families with infants under 6 months of age. Infants and young animals have certain bacteria in their digestive tracts that change nitrate into the toxic nitrite form (NO_2^-). This form of nitrogen impairs the ability of the blood to carry oxygen and can cause a condition known as "blue-baby" disease, which may be life-threatening if not treated immediately.

Striving for Maximum Nitrogen Use Efficiency

Fertilizers should be applied to obtain a yield response that results in a monetary return larger than the cost associated with the application. Application rates beyond the amount needed for optimal crop production are not only a bad monetary investment, but also increase environmental and health risks.

Finding the most efficient rate, placement and timing of fertilizer application under constantly changing environmental and marketing scenarios is an important effort. Selecting the best available management practices for fertilizer use is the key to maximize the efficiency of fertilization.

Soil testing is one of the most important *best management practices* for fertilizer use. A soil test measures the amount of plant available nutrients, and can be used in conjunction with information from specific fields to plan an effective fertilizer management program.

Some points to consider when applying nitrogen fertilizers:

- ✓ Test the soil for the amount of plant-available nutrients, modifying rates accordingly.
- ✓ Incorporate, as soon as possible, any urea or ammonium-containing fertilizers.
- ✓ Ensure rapid and complete closure of the placement knife or chisel furrow.
- ✓ Nitrate is a very mobile ion in soils, subject to leaching under conditions of heavy rainfall or irrigation, especially in sandy soils.
- ✓ Excessive fertilizer rates can be as detrimental to crop yields as inadequate rates of application.
- ✓ Legumes develop symbiotic associations with bacteria capable of fixing atmospheric nitrogen, with the amount of nitrogen fixed ranging between 30 and 400 pounds per acre, depending on soil and weather conditions, and crop species.
- ✓ Nitrogen fertilizers should be applied before the period of rapid growth in cereals and before peak bloom in cotton. Supplying a cotton plant with nitrogen after peak bloom may promote rank growth, particularly under optimum soil moisture conditions.

- ✓ All fertilizer sources work equally well, if applied as recommended.
- ✓ Animal manures should be analyzed for nutrient content, prior to land spreading.
- ✓ Plant material with a wide carbon to nitrogen ratio (>30:1) may tie up plant-available nitrate.
- ✓ Additional applications of nitrogen will not compensate for deficiencies of other nutrients or drought.
- ✓ Under flooded conditions (i.e. rice paddies), nitrogen in the nitrate form may be lost through the denitrification process.
- ✓ There is no substitute for careful observation, accurate record keeping and experience.

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The Agriculture Program
The Texas A&M University System

Phosphorus and Crop Production

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Department of Soil and Crop Sciences

Phosphorus (P) is an essential element for plant and animals. It has been called the "key of life," because it plays a very important role in the storage and transfer of energy within the cell as part of the adenosine triphosphate (ATP) molecule. This is the energy source that activates and regulates many processes in plants and animals.

Plants take up P from the soil solution. With continued production, the ability of the soil to provide adequate levels of plant available P declines, and P fertilization is generally needed for optimal crop production.

Excess phosphorus in agricultural runoff has been associated with water pollution, particularly in areas dominated by intensive animal production. High levels of P in waters are not directly harmful to living organisms. However, excessive P can trigger the degradation process in most surface fresh waters.

Role of Phosphorus in Plants

Phosphorus is second only to nitrogen in its frequency of application as a fertilizer. However, its concentration in plant tissue (0.1 - 0.4% P) is only one tenth that of nitrogen (1 - 5% N). Phosphorus is involved in several key plant processes including nutrient uptake and transport within the plant, root growth and development, disease resistance as well as drought and cold tolerance, seed formation and early maturity.

Symptoms of phosphorus deficiency are not as easily recognized as those of nitrogen and some micronutrients, which may show dramatic foliar symptoms. A typical P-deficient plant is stunted and often has thin stems. Deficiencies are first observed on older leaves (they turn deep-purple) since the plant relocates P from older tissues to supply younger growing parts.

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Plants differ in their P requirements for optimal crop growth. Table 1 shows typical amounts of P removed by several crop species.

Table 1. Phosphorus removed by several crops

Crop	Yield (acre)	Amount removed (lbs./P_2O_5/acre)
Corn (grain)	150 bu.	50
Cotton	2 bales	60
Sorghum (grain)	5,600 lbs.	42
Peanuts	4,000 lbs.	25
Soybean	50 bu.	44
Sugarcane	40 tons	36
Rice	100 bu.	30
Wheat	70 bu.	38

Forms of P in the Soil

Phosphorus occurs in soils as both organic and inorganic forms (Figure 1). It can be found dissolved in the soil solution or associated with soil minerals or organic materials. The relative amounts of each form of phosphorus vary greatly among soils, with the total amount of P in a heavy (clay) soil being up to ten times that in a sandy soil.

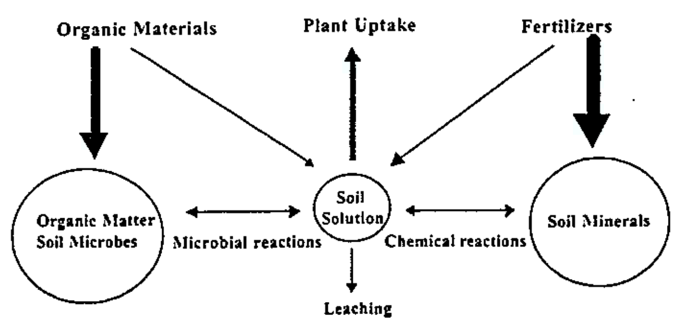

Figure 1. Phosphorus cycle in an agricultural soil. The width of the arrows represents the relative importance of each process.

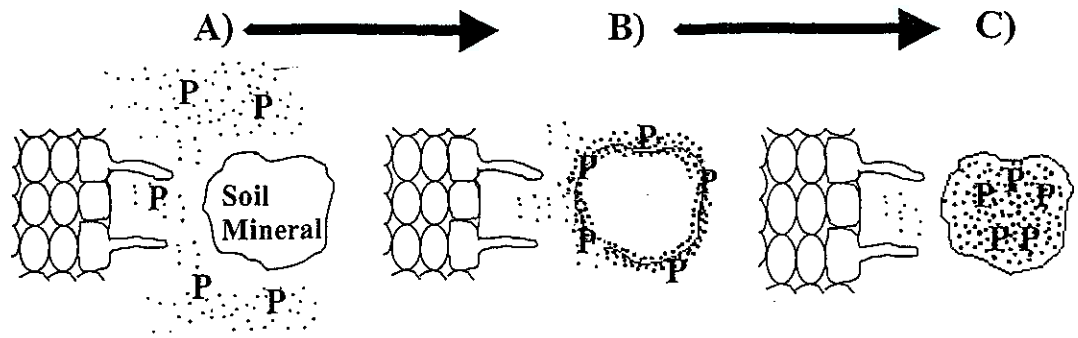

Figure 2. How phosphates are tied up by soil minerals. A) A large percentage of the P is available for root uptake immediately after fertilizer application. B) P in the solution binds rapidly to the surface of soil minerals. Roots may still use this P. C) Eventually, bound P becomes part of the structure of the mineral, with its plant availability being significantly decreased.

Organic-P in soils. A large number of compounds make up the organic P in soils, with the majority being of microbial origin. Organic P is held very tightly, and generally is not available for plant uptake until the organic materials are decomposed and the phosphorus released via the ***mineralization*** process. This process is carried out by microbes, with the rate of P release being affected by factors such as soil moisture, composition of the organic material, oxygen concentration and pH.

The reverse process, ***immobilization***, refers to the tie up of plant-available P by microbes for their own nutritional needs. Microbes may compete with plants for P, if the organic materials they are decomposing are high in carbon and low in nitrogen and phosphorus (i.e., wheat straw). *Mineralization and immobilization* occur simultaneously in soil. If the P content of the organic material is high enough to fulfill the requirements of the microbial population, then mineralization will be the dominant process.

Inorganic-P in soils. The concentration of inorganic P in the soil solution at any given time is very small, amounting to only 2-3 lb/A. Phosphorus in the inorganic form occurs mostly as combined compounds of aluminum, iron or carbonate.

Phosphorus Behavior in Soils

The chemistry of soil P is very complex, with more than 200 forms of P minerals being affected by a variety of physical, chemical, and biological factors. Soluble P resulting from commercial fertilizer applications or from mineralization reacts with soil constituents to form P compounds of very low solubility (low plant availability). This series of reactions is commonly referred as *sorption* or fixation (Figure 2). Iron and aluminum compounds will fix (tie up) P under acidic conditions (soil pH less than 6), while under alkaline conditions (soil pH greater than 7) phosphorus is tied up by calcium and magnesium compounds.

Phosphorus availability to plants in most soils is at a maximum in the pH range 6 to 7. Application of liming materials is a common production practice to raise the pH in acidic soils. However, lowering the pH of calcareous soils to increase the solubility of P is not an economically viable option since large amounts of acidifying material must be applied and mixed into the soil.

Mobile ions such as nitrate move toward plant roots by a process called ***mass flow***, while relatively immobile ions such as phosphorus move by a process called ***diffusion***. Mass flow refers to the movement of a nutrient with the flow of water toward plant roots. In other words, mobile ions such as a nitrate move toward roots as plants absorb water from the soil. Consequently, nitrate uptake is mostly affected by the moisture level of the soil, with nitrogen usage by a crop following basically the same pattern as water usage. Diffusion is a much slower process and refers to the movement of phosphorus from zones of high concentrations to zones of low concentration. It results in very short travel distances for phosphorus, perhaps only 1-2 inches per cropping season.

Because P is so immobile, surface applications of fertilizer P tend to result in nutrient stratification. This is where P accumulates in the upper 2-3 inches of soil and may be positionally unavailable to plants. Periodic cultivation or deep banding of P fertilizers may be necessary to improve nutrient availability and uptake.

If phosphorus does not move much in soil, why is it associated with water quality problems? Phosphorus can contribute to water quality problems because: (1) small amounts of dissolved P and the P attached to soil particles can move with runoff, and (2) phosphorus is often the limiting nutrient for eutrophication and even small concentrations (0.001 mg total P per liter of water or 10 to 100 ppb P) may trigger the degradation of fresh waters.

Soil Testing for P

Soil testing is the best way to determine the amount or concentration of plant available nutrient in the soil solution. Texas soils cover a wide range in chemical, biological and physical properties, which must be considered when determining if a soil is very low, low, medium, high or very high in available phosphorus. The soil test, together with experimental trials involving different crops, under different soil and climatic conditions, provide the basis for fertilizer recommendations.

In addition to the Soil Testing Laboratory at Texas A&M University, several commercial labs provide analytical services to farmers. These labs may use different approaches for soil testing and fertilizer recommendations. Farmers should always employ the concept of maximum economic yield (MEY). MEY is a sound practice that aims at obtaining the yield which results in the maximum economic return to the grower.

Collecting a soil sample that accurately represents the area of interest is of utmost importance to obtain appropriate fertilizer recommendations based on soil testing (Figure 3). Traditionally, a sample is collected from the top 6 inches of soil, with pre-plant preparation involving tillage operations 8 to 12 inches deep. However, with an increasing number of acres being converted into reduced tillage, the potential

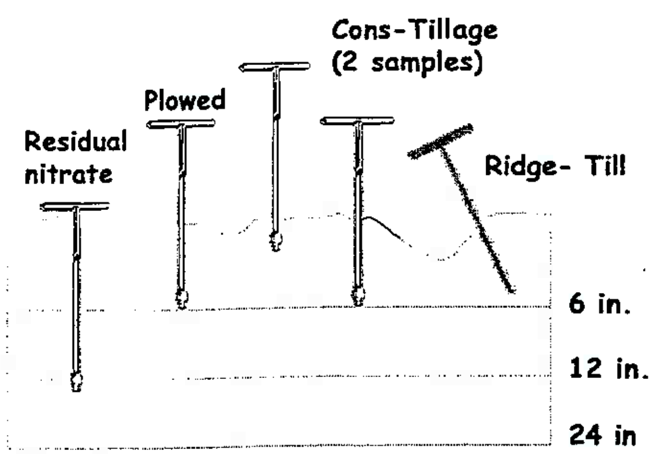

Figure 3. Proper soil sampling is the most critical step in soil testing. Soil samples must be representative of the given area and most be taken from the appropriate depth and location based on management.

for nutrients to accumulate in the top soil layers increases significantly. In a study conducted at seven locations in Texas, soil cores were collected at 3-inch increments to a depth of 24 inches. The concentration of available P decreased considerably below the top 3 to 6 inches. Based on available P concentrations in the top 6 inches alone, no fertilizer P would have been recommended for such soils. However, when the soil test values for the 6 to12- inch increments were included, a recommendation for fertilizer P was obtained. Deep soil sampling should be done periodically to evaluate the degree of nutrient stratification and to modify, if necessary, management and/or fertilization practices.

During the last decade, there has been increased interest in using standard soil testing for environmental monitoring purposes. However, identification of the critical levels above which there may be potential for pollution of water resources will require additional research. Soil tests for agronomic purposes have been developed based on the crop response to P, with the relationship to environmental pollution not yet well defined. There is considerable evidence indicating that application of phosphorus fertilizer when soil test indicates little or no potential for crop response is not only a waste of resources and capital, but also can increase the potential for water pollution.

Phosphorus Fertilization

As mentioned before, there is little soil phosphorus available for plant uptake at any given time. Phosphorus in the soil solution must be replenished quickly to ensure a constant supply of this nutrient. The ability of a soil to replenish and maintain an adequate level of P in the soil solution is a measure of its ***buffering capacity*** with respect to P.

Organic matter content, type of soil clay and soil minerals are some of the factors which influence the buffering capacity of a soil. Soils with a high buffer capacity are able to maintain a relatively constant supply of P, but also need larger quantities of fertilizer to change the soil test level. Studies have shown that between 10 to 20 lb per acre of P fertilizer may be required to increase the soil-P solution level by 1 lb per acre.

Sources of Fertilizer Phosphorus

Although there is no actual P_2O_5 in fertilizer materials, phosphorus fertilizer recommendations are made in, and fertilizer materials are sold as, P_2O_5. There are occasions where elemental P is used instead, however, and understanding which units are used is very important. For instance, diammonium phosphate (18-46-0) contains 46% P_2O_5 (46 lbs. P_2O_5 per 100 lbs of material). To find out how much elemental P there is in 100 lbs. of 18-46-0 material, simply multiply by 0.44. In this case, 100 lbs. 18-46-0 material is equal to 20 lbs. elemental P. To convert from P_2O_5 to elemental P, multiply the amount of P_2O_5 by 2.29, or divide by 0.44 instead.

Rock phosphate is the primary source for P used in the manufacturing of phosphorus fertilizer, with the U.S. being the largest producer in the world. Major production operations occur in Florida and North Carolina. The phosphorus in rock phosphate is found mainly as the apatite mineral, which is subjected to heat and/or acid treatment to produce commercially available P fertilizers.

Some of the most common fertilizer materials include triple superphosphate (TSP), monoammonium phosphate (MAP), and diammonium phosphate (DAP), which are normally sold in a dry formulation; and ammonium polyphosphate (11-37-0 or 10-34-0) sold as a liquid material (Table 2). Each of these materials causes a different pH reaction once they dissolve in soil: pH 1.5 in the immediate vicinity of the fertilizer granules for TSP; 3.5 for MAP and 8.0 for DAP, with Ammonium Polyphosphate producing a neutral pH instead. Although the use of any of these products may cause an initial soil reaction in calcareous soils, especially the materials with acidic pH, very large quantities of fertilizer would be needed to cause a significant drop in the pH of the soil solution. Each of these materials will follow the same dissolution steps, with the decision about which one to use (liquid vs. dry; TSP vs. MAP) being dependent more on material price and availability than on any added agronomic effect. The addition of a small amount of sulfur to "keep the P more available for a longer period" in high-pH soils is often attempted but in fact does not result in a significant increase in plant-available P.

Table 2. Phosphorus concentration of several fertilizer materials.

Material	P Concentration (P_2O_5)
Triple superphosphate	46%
Diammonium phosphate	46-48%
Monammonium phpsphate	48-55%
Broiler litter	50 lbs./ton
Dairy manure	5 lbs./1,000 gals.
Phospate rock	27-41%

Plant Uptake

Phosphorus enters the plant mainly through root hairs and root tips. Plant roots are able to absorb P from the soil solution as HPO_4^{-2} and $H_2PO_4^{-1}$ (orthophosphates), with the ratio of these two ions depending on the soil pH. The $H_2PO_4^{-1}$ ion predominates at lower pH values, while HPO_4^{-2} is the more abundant form in alkaline soils. Although both forms are taken up by plant roots, uptake of HPO_4^{-2} occurs at a slower rate than that of $H_2PO_4^{-1}$. Some organic P compounds also may be absorbed by plants, but in smaller amounts. Once inside the plant, phosphorus is stored in root compartments or transported to leaves where it is converted into enzymes, proteins and other organic compounds.

Phosphorus uptake normally occurs against a concentration gradient since the concentration inside root cells is normally higher than in the soil solution. This is called active uptake, since plants use energy derived from carbohydrates for such purposes. This energy requirement is one of the reasons why phosphorus uptake is affected by cold temperatures and dry and wet periods. The plant metabolism under those conditions slows down, generating less energy for nutrient uptake.

Placement of Fertilizer

Once P fertilizer is applied to the soil, it undergoes a series of reactions that may reduce its solubility and leave less than 40% of the applied nutrient available for immediate crop use. It is for this reason that the placement of phosphorus fertilizers has been the subject of considerable research, especially for high P-fixing soils.

Phosphorus fertilizers can be applied broadcast on the soil surface, subsurface banded at 6 to 8 inches, or injected using a spoked wheel applicator that places the fertilizer at points about 8 inches apart, 4 to 6 inches deep. The choice of application method will depend on factors such as the soil fertility level, the pH of the soil, soil temperature, available moisture, and root distribution.

Banding the fertilizer two inches to the side of the seed row and two inches deep is the recommended application method under most conditions, especially in soils with high fixing capacity, low fertility levels, high runoff potential, and/or in situations where emergence could be affected by wet and cool soils. Placing the fertilizer in a ***deep band***, typically 4-8 inches below surface has proven effective under low soil moisture levels since roots will tend to explore deeper soil layers. By placing the fertilizer deep in the soil, the chances of roots intercepting the fertilizer also are increased. Placing P-fertilizers in a band not only reduces the potential for tied up by soil minerals, but also develops zones of high concentration which should allow uptake to proceed with reduced use of carbohydrate energy.

Broadcast application has been the method of choice in soils, with low P-fixation capacity, where fertility levels are uniform throughout the soil, where moisture levels during the growing season are adequate, and where the risk of excess P being lost by runoff is low. Crops that develop an aggressive root system tend to respond equally well to band and broadcast P applications.

Starter fertilizer or ***pop-up*** refers to the placement of P fertilizer beneath the seed row or with the seed to provide additional energy to the emerging seed, especially under cooler temperatures. High application rates should be avoided to prevent toxicity problems, especially if P is applied together with N-containing fertilizer materials.

Choosing the correct method of placement is important to obtain maximum benefits from applied fertilizer, but applying the fertilizer at the appropriate time is equally important. The demand for phosphorus varies among plant species, growth stage, and specific part of the plant (Figure 4). Although phosphorus provides additional energy to the emerging seed, most plants need very little P in the first weeks after planting, amounting to less than 5% of their total P uptake. A sorghum plant will use only 3% of its seasonal P during the first three weeks, but close to 55% of the total uptake occurs during the following six weeks. A corn plant has its highest demand during the silking stage, with nearly one third of the total P demand occurring during that critical growth stage. The fact that cotton is a perennial plant and sets fruit throughout its growth cycle, explains why the demand for P is highest during later stages of crop development.

Phosphorus Interactions with Other Nutrients

Phosphorus uptake can be directly influenced by the soil concentration of other nutrients, and vice versa. Some of these interactions are crop and site specific. For example phosphorus tends to increases the uptake efficiency of ni-

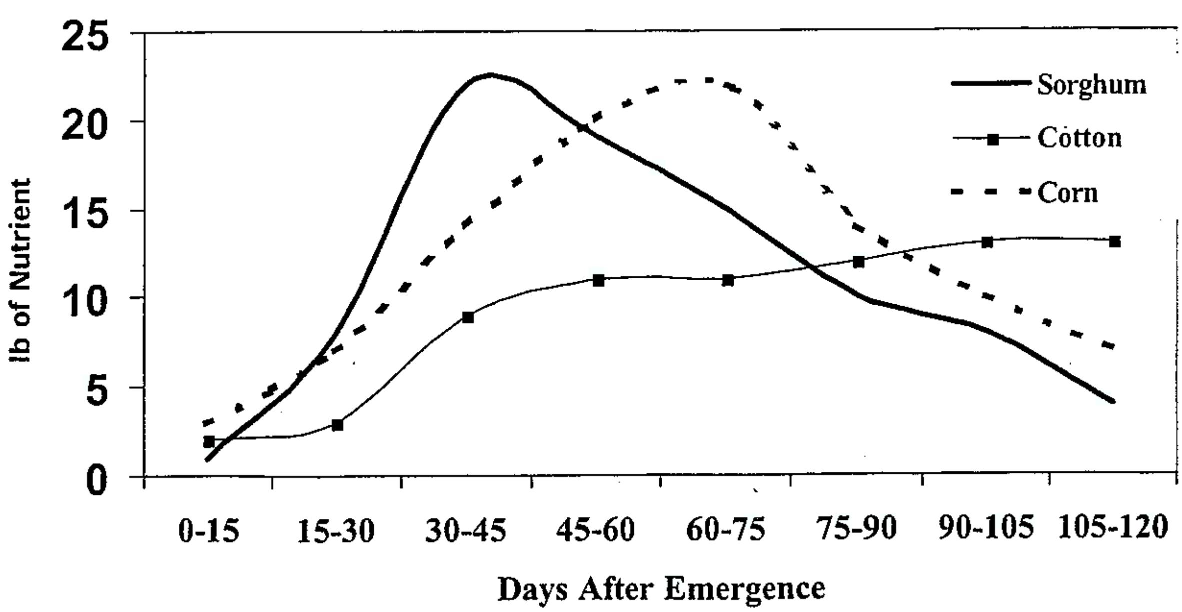

Figure 4. Phosphorus needs for several plants according to plant age.

trogen. In a fertility trial with coastal bermudagrass in Texas, higher yields were obtained when phosphorus and potassium were added together. Similar observations have been reported for a soybean trial in Virginia and a grain sorghum field trial in Kansas.

Negative interactions result when high rates of P reduce the uptake of some micronutrients. For example P-induced Zn deficiencies have been reported in some regions in Texas. It is important to emphasize that induced deficiencies often can be prevented simply by applying fertilizers at the correct rates. It is not a good practice to compensate for excess P fertilization with Zn or other micronutrient applications.

Other known interactions are those of phosphorus with boron, copper, iron, and molybdenum. Negative interactions with molybdenum are important in alkaline soils, where legumes are grown, since molybdenum is an essential component of two very important enzymes involved in the fixation of atmospheric nitrogen. Plants have the ability to form ***symbiotic*** (beneficial) associations with soil microorganisms such as bacteria and fungi. ***Mycorrhizae*** represent a beneficial association between plants and fungi that colonize the plant roots. These fungi grow long filaments called hyphae, which are structures smaller in diameter than plant roots capable of absorbing nutrients and water from the soil solution. These filaments not only help the plant by absorbing phosphorus from the soil solution, but also can explore a larger soil volume since mycorrhizal hyphae may be over 100 times longer than the length of the host plant roots.

Mycorrhizae also increase absorption of other nutrients that behave similarly to phosphorus, such as zinc and copper. These fungi excrete organic chemicals that can dissolve P-containing minerals and enhance uptake and translocation. In calcareous soils, mycorrhizae are believed to release carbon dioxide that dissolves P which would otherwise be unavailable for plant uptake. Mycorrhizal fungi are more active under reduced tillage conditions, since the vast network of filaments (hyphae) remains relatively intact from one cropping season to the next.

Phosphorus and Environmental Quality

Average crop yields in the U.S. have increased by 30-40% during the last three decades, and proper nutrient management is one key reason for the improvement. Considerable efforts and resources were allocated to understand and improve the agronomic effectiveness of P, and it is still the subject of research in most regions of the United States. However, the fact that excess P has contributed to, and continues being a factor in the degradation of surface waters, has shifted the research focus toward understanding and controlling the mechanisms by which phosphorus is removed and transported off lands, and its contribution to the ***eutrophication*** of surface waters.

Eutrophication is the term used to describe the nutrient enrichment of surface waters and the resulting increase in growth of algae and other unwanted organisms. This condition can result in depletion of oxygen and the production of chemicals that are detrimental to fish, native underwater vegetation, and use of water for drinking and recreation purposes. Although several factors contribute to the degradation of surface waters, phosphorus is generally the limiting factor in this process. Phosphorus can contribute to the eutrophication of surface waters by direct discharges or ***point sources***, such as those represented by wastewater treatment plants and industrial facilities, or by indirect means or ***non-point source*** discharges such as agricultural and urban runoff.

Livestock production and associated generation of manure also is a contributing factor to the phosphorus problem. Manure application rates based solely on the nitrogen requirement of a crop can result in P loading rates above those required by the crop. As result, P can accumulate in the soil to levels well above those needed for optimal crop growth.

To reduce the potential for pollution, a series of BMPs or ***Best Management Practices*** for phosphorus fertilization has been developed for a wide variety of soil and climatic conditions. Such practices include the use of soil testing, proper fertilizer rates, placement and timing of application, constant monitoring of the nutrient content of organic amendments, land leveling, and the establishment of buffer zones, among many possible considerations.

A group of scientists from across the nation developed a P assessment tool (***P Index***) that integrates a series of chemical and physical properties and land management practices with the potential for P losses by runoff. This approach ranks individual fields on their potential for pollution using a numerical index and a ranking system: Low; Medium; High; and Very High. The index provides planners and land managers with a practical tool for evaluating potential phosphorus runoff and identifying appropriate BMPs to minimize losses.

When P is applied beyond the level of a possible crop response, it increases the risk of water pollution. In fact, this is one of the most critical challenges facing agriculture today, especially in those regions where the potential for P runoff is high. The implementation of a soil testing program, combined with appropriate calibration data and realistic yield goals is the best approach to reduce the potential for water pollution, increase fertilizer use efficiency and to increase economic returns.

Summary

- ✓ Phosphorus, together with nitrogen and potassium, constitute the macronutrients needed for profitable crop production, with the demand for P varying among plant species.
- ✓ Phosphorus is a very immobile nutrient, generally moving less than 2 inches from the area where the fertilizer is placed.
- ✓ The concentration of phosphorus in the soil solution, at any one time, is very small (equivalent to less than 1-2 lb/A).
- ✓ Phosphorus reacts rapidly with soil constituents that reduce the availability of this nutrient to plant roots. Its highest availability occurs at neutral pH. At pH < 6, P reacts with iron and aluminum minerals, while above pH 7 P reacts with calcium minerals.
- ✓ Phosphorus is absorbed by roots as orthophosphates (HPO_4^{-2} and $H_2PO_4^{-1}$). The HPO_4^{-2} ion predominates at alkaline pH, while the $H_2PO_4^{-1}$ predominates under acidic conditions.
- ✓ Phosphorus interacts positively with nitrogen and potassium, while high soil P levels may reduce uptake of some micronutrients, such as zinc, copper and molybdenum.
- ✓ Because P is very immobile, placement in the root zone by banding/injection of fertilizers may be important to improve uptake efficiency.
- ✓ The *P-index* is a planning tool used by planners and land managers to assess the potential for P loss by surface runoff.

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