Approved _____
Date

MINUTES OF THE Senate COMMITTEE ON Agriculture.

The meeting was called to order by Senator Allen at
Chairperson

10:08 a.m./~~p.m.~~ on March 29, 1988 in room 423-S of the Capitol.

All members were present ~~except~~

Committee staff present: Raney Gilliland, Legislative Research Department
Jill Wolters, Revisor of Statutes Department

Conferees appearing before the committee: DeVern Phillips, State Sealer, State Board of Agriculture
Francis Kastner, Kansas Food Dealers Association
Representative Eugene Shore
Dale Lambley, State Board of Agriculture
Charlene Stinard, Kansas Natural Resource Council
Kansas Audubon Council
Kansas Chapter - Sierra Club
Kansas Rural Center
Kansas Wildlife Federation
Bill Fuller, Kansas Farm Bureau
Rich McKee, Kansas Livestock Association
Chris Wilson, Kansas Fertilizer and Chemical Association
Dan Manwarren, Iuka, Kansas
Lee Eisenhauer, Executive Vice-President, Kansas LP-Gas Association

The Chairman called the committee to order and attention to HB 2964; he called on the following to testify.

DeVern Phillips gave copies of his testimony to the committee (attachment 1).

Francis Kastner testified in support of HB 2964 and furnished the committee with copies of her testimony (attachment 2).

The Chairman declared the hearing closed for HB 2964 and called attention to HB 3022 and the following to testify.

Representative Eugene Shore expressed opposition to HB 3022. Representative Shore stated that the present chemigation law is working. He stated that the state does not need a seperate chemigation law that the pesticide law is sufficient and that other states are copying their pesticide law after the Kansas law.

Dale Lambley gave copies of his testimony to the committee (attachment 3).

Charlene Stinard gave copies of her testimony to the committee (attachment 4) and requested passage of HB 3022.

Bill Fuller furnished the committee with copies of his testimony (attachment 5) and expressed some support for the bill but opposition to any increase of penalties.

Rich McKee gave copies of his testimony to the committee (attachment 6) and spoke in opposition to HB 3022.

Chris Wilson gave copies of her testimony and information to the committee (attachment 7) and testified in opposition to HB 3022.

MINUTES OF THE Senate COMMITTEE ON Agriculture,

room 423-S, Statehouse, at 10:08 a.m./~~p.m.~~ on March 29, 1988.

Dan Manwarren testified that he thought HB 3022 was a cleanup bill. Mr. Manwarren stated that HB 3022 with amendments is a workable bill. He stressed the need to know if chemicals are getting into the water of Kansas. Mr. Manwarren, when asked if the bill really needs to be passed, stated he felt the bill did need to be passed that especially the changes in lines 112 through 117 and lines 118 through 123 are needed.

The Chairman declared the hearing closed for HB 3022 and turned committee attention to HB 2965; and called on the following to testify.

DeVern Phillips gave the committee copies of his testimony (attachment 8).

The Chairman called attention to written testimony given the committee by Lee Eisenhauer (attachment 9) who could not be present for the hearing. Her testimony expressed support for HB 2965.

The Chairman declared the hearing for HB 2965 closed and asked Senator Norvell, Chairman, of the subcommittee for a report on HB 2966.

Senator Norvell gave copies of a compromise amendment for HB 2966 (attachment 10) and reported that the amendment was worked out and agreeable with Jim Maag, Kansas Bankers Association, Ron Wilson, Farm Credit Council and with Penny Geis, Kansas Farmer Creditor Mediation.

Senator Norvell made a motion the committee accept the proposed amendment. Senator Arasmith seconded the motion. Motion carried.

Senator Norvell made a motion the committee recommend HB 2966 favorable for passage as amended. Senator Montgomery seconded the motion. Motion carried.

The Chairman called for action on committee minutes.

Senator Arasmith made a motion the committee minutes of March 28 be approved. Senator Gordon seconded the motion. Motion carried.

The Chairman reminded the committee that the committee would meet at 8:00 a.m. the following day for action on bills; he then adjourned the committee at 11:00 a.m.

GUEST LIST

COMMITTEE: Senate Agriculture DATE: March 29, 1988

NAME	ADDRESS	ORGANIZATION
FRANges KASTNER	Topeka	KS Food Dealers
Dolvern Phillips	Topeka	KS Bd of Ag
LARRY D. WOODSON	Topeka	KBOA
DAN MANWARREN	IUKA	SELF
Alan Steppat	TopeKA	Pete McGill & Assoc.
Bill Fuller	Manhattan	Kansas Farm Bureau
JOHN D. TORBERT	TOPEKA	Ks. Assoc. of COUNTIES
Dick McKee	Topeka	K.L.A.
Chuck Stones	"	Ks Bankers Assn.

PRESENTATION TO THE SENATE COMMITTEE ON AGRICULTURE

March 29, 1988

By

DeVern H. Phillips, State Sealer

Good morning Mr. Chairman, and Members of the Senate Agriculture Committee. My name is DeVern H. Phillips. I am the State Sealer and responsible for the Weights and Measures Program for the State of Kansas. The Agency is here to address our position on Senate Bill 2964.

Senate Bill 2964 changes the existing act that deals only with commercial large capacity scales. The existing law requires the testing by licensed service companies of all commercial large capacity scales (those whose capacities exceed 5,000 pounds) annually. Since 1985, when the existing law became effective, the accuracy of these devices has, as monitored by Kansas Weights and Measures, risen from 70% to 87%. This is directly attributable to the requirement of annual testing by licensed service companies. Kansas Weights and Measures at this time was also able to reduce equipment requirements and manpower.

Service companies who test and repair large capacity scales are required to be licensed by Kansas Weights and Measures. Their work is monitored by this agency and they must maintain standards of performance set by Kansas Weights and Measures. This is done to assure the industries serviced by the scale testing and repair companies that only competent service technicians are permitted to work on their equipment. These service companies pay an annual fee of $50.00 to operate in the State of Kansas and must meet other criteria to maintain their licenses in Kansas.

attachment 1
3-29-88

Commercially used small capacity scales (less than 5,000 pound capacity) used to weigh and buy or sell commodities in grocery stores, jewelry stores, salvage yards, etc., are not required by Kansas law to be tested, yet commodities of equal or greater value bought and sold over large capacity scales are bought and sold daily across these small scales.

Service companies that work on small capacity scales are not required to be licensed by Kansas Weights and Measures. Their work is not monitored and no method exists of licensing or assurance of quality workmanship to industries serviced by these companies.

The proposed modification of the existing scale law would bring about an equality of enforcement to both device owners (large and small capacity scales) and equality of treatment of service companies. There are presently more than twice as many companies testing only small scales (38) as are testing large scales (16).

The majority of the grocery stores in Kansas (the entity utilizing the majority of the known small scales in Kansas) have service contracts with scale testing/service companies, therefore minimal financial impact will be felt by these device owners.

40% of Weights and Measures inspectors' time is spent testing devices which are found to be correct 97% of the time. However, these same inspectors when testing packages in stores, find only 66% of packages weighed in the stores to be correct.

By shifting responsibility for the accuracy of the device from Kansas Weights and Measures to the device owner, more time can be spent by Kansas

Weights and Measures on package checking and education of the store operators to correct the weighing/labeling problems. One package in three picked up in stores in Kansas is overpriced or shortweight.

We ask for assistance in realigning our limited resources to allow us to correct this problem. Let us "hoe where the weeds are".

Kansas Food Dealers' Association, Inc.

2809 WEST 47th STREET SHAWNEE MISSION, KANSAS 66205

PHONE: (913) 384-3838

March 29, 1988

SENATE AGRICULTURE COMM.

EXECUTIVE DIRECTOR
JIM SHEEHAN
Shawnee Mission

SUPPORTING HB 2964

Jim Sheehan, the Executive Director of the Kansas Food Dealers, and I recently visited with the State Sealer about the slight inaccuracies found when their inspectors checked weights listed on pre-packaged items and scales in some grocery stores. We agreed that it was equally important to our members and to the consumer to assure that the scale testing, or repair, is done by qualified personnel.

Our associations commends the inspectors and the State Sealer for their fairness and impartiality. We see their function as vital in assuring that the retailer and the consumer receive proper weights, whether that item is weighed by the retailer or by the processor.

We support HB 2964 and ask for your favorable consideration of this bill. If you have any questions I will be happy to answer them.

attachment 2
3-29-88

TESTIMONY

HOUSE BILL NO. 3022

PRESENTED TO

SENATE COMMITTEE ON AGRICULTURE

by

Dale Lambley, Director
Plant Health Division
Kansas State Board of Agriculture

March 1988

attachment 3
3-29-88

TESTIMONY

HOUSE BILL NO. 3022

House Bill No. 3022 is an amendment of the Chemigation Safety Law. The bill was developed and introduced after some debate by the House Committee on Energy and Natural Resources. The bill would affect the current law in four principal ways:

1. Amend language describing anti-pollution devices which are to be used in the chemigation process;
2. Increase fees from the current $50 per permit to $50 per permit plus $20 for each additional well or point of diversion;
3. Impose an exam requirement similar to the private applicator certification exam in order for a person to obtain a chemigation user permit; and
4. Increase penalties from the current maximum $500 fine for violation to a Class B misdemeanor plus a civil penalty for application of pesticides or fertilizers in violation of the act. Civil penalties are set in amounts not to exceed $2,500 per day for fertilizer and $5,000 per day for pesticide use.

Quite frankly, there are some aspects of this bill which I find difficult to address. Normally we implement a program, gain a couple of years experience and then return for any change in the statute which is found to be necessary. However, we are still in the implementation stage on the chemigation program and not yet to the point where we can advise you on changes which may or may not be needed. I would like, however, to provide you with some basic information and comments about the proposed amendments.

New Section 3 (lines 0104-0136) were changes recommended by the Plant Health Division. This is basically a clean-up of language dealing with the types and locations of anti-pollution devices which are to be installed and remedies some problems farmers are having in coming into compliance with the law. When the agency learned that this bill was to be introduced, we asked

that this language be included. After HB 3022 passed out of committee, the language in New Section 3 was adopted by amendment on the floor of the House. There is no doubt that language changes in this area are needed.

The House Committee on Energy and Natural Resources also approved an increase in fees. Fees generated were to provide the Kansas State Board of Agriculture with additional manpower to conduct field inspections and take water quality samples. Only one field position was provided to the agency when the law was passed in 1985.

The Kansas State Board of Agriculture believes that adequate education and testing is an important element of our pesticide program and believe the same is true relative to the chemigation program. As a matter of fact, examination requirements were a part of the initial bill introduced by the agency in cooperation with the various agricultural industry representatives which led to passage of the Chemigation Safety Law.

The division really does not feel that we are in much position to make substantial comments about the penalties provisions. As you all know, we feel civil penalty authority to be an important tool for enforcement of the pesticide programs. However, our primary problem with this program to date has been one of getting into contact with all individual chemigators and making them aware of the specific requirements of the law.

Once the contact has been made, chemigators have either come into compliance or they are in the process. Therefore, I cannot come to you with a history of violations nor indicate that we have a substantial enforcement problem.

The civil penalties imposed for pesticides by this bill do equate with those currently imposed by the U. S. Environmental Protection Agency for misuse of pesticides. To my knowledge, EPA has no statutory authority covering fertilizer use.

Kansas Natural Resource Council

Testimony before the Senate Agriculture Committee

HB 3022: Chemigation

March 29, 1988

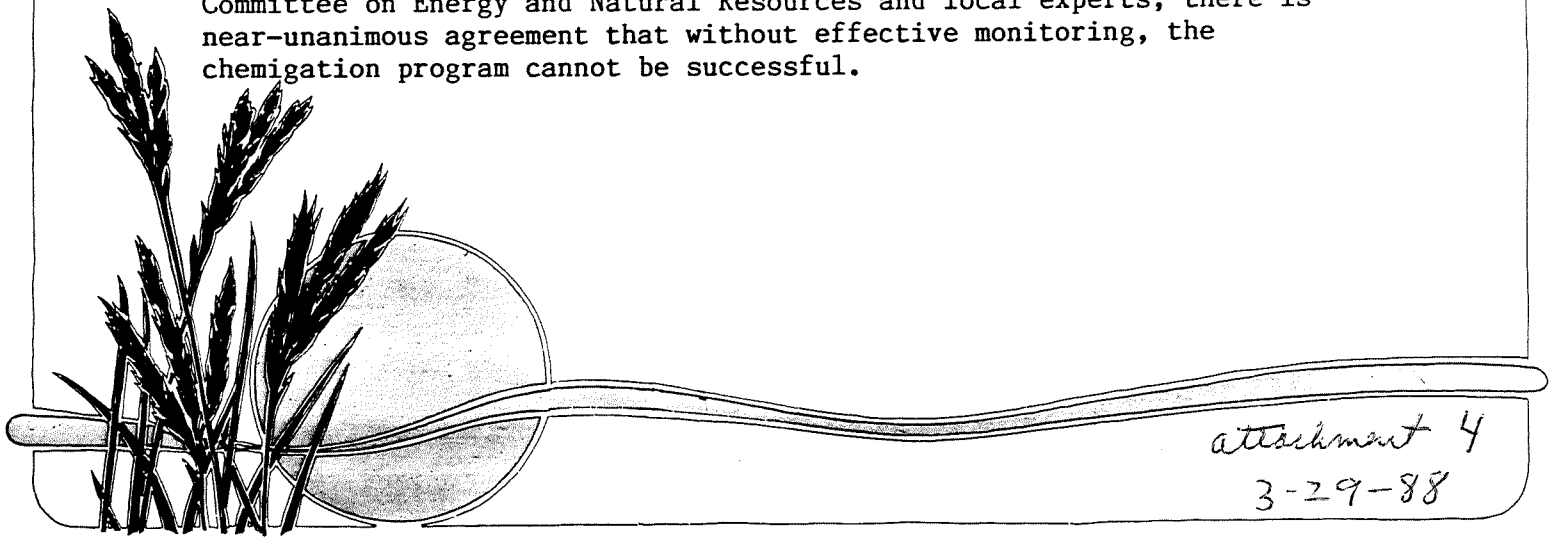
My name is Charlene A. Stinard and I represent the Kansas Natural Resource Council, a private, nonprofit organization of 800 members. In addition, I appear today on behalf of the following groups:

Kansas Audubon Council	5,000 members
Kansas Chapter - Sierra Club	2,000 members
Kansas Rural Center	2,500 members
Kansas Wildlife Federation	8,000 members

Our long-term goals center on promoting sustainable natural resource policies. The protection of Kansas groundwater supplies is a priority issue.

The protection of groundwater from contamination by agricultural chemicals is part of the intent of Kansas Chemigation statutes. Monitoring data and water quality analyses to date are insufficient to assure that the chemigation process does not adversely affect surface and groundwater supplies. While initial sampling data are encouraging, the importance of continued monitoring of the program cannot be overstated.

HB 3022 does not adequately address the issues of monitoring and sampling. Nor does the bill include provisions for other state agencies and organizations to assist in the implementation and oversight of the chemigation program. (In Nebraska, implementation at the local level, through the Natural Resource Districts, has been very successful.) Local implementation improves the possibility for identifying users, investigating violations, issuing notices, and obtaining injunctions against those not in compliance. Among conferees before the House Committee on Energy and Natural Resources and local experts, there is near-unanimous agreement that without effective monitoring, the chemigation program cannot be successful.



attachment 4
3-29-88

1516 Topeka Avenue • Topeka, Kansas 66612 • (913) 233-6707

HB 3022 does address well three crucial issues: enforcement, funding, and user testing.

(1) ENFORCEMENT: Provisions for enforcing the chemigation statutes have been expanded; the state Attorney General is now authorized to intervene in cases of non-compliance. Penalties have been increased substantially as well, providing added incentives for voluntary compliance.

(2) FUNDING: A new fee structure (per wellhead charge in addition to application fees) provides the possibility for additional resources to fund more extensive field work. Success of the chemigation program is largely dependent on inspection and monitoring capabilities.

(3) TESTING: New requirements covering content and frequency of examinations may help insure more informed use of this potentially dangerous process.

We strongly support the Legislature's efforts to improve regulation of the chemigation process and urge favorable passage of HB 3022.

Kansas Farm Bureau

PUBLIC POLICY STATEMENT

SENATE COMMITTEE ON AGRICULTURE

RE: H.B. 3022 - Amending the Kansas Chemigation Safety Act

March 29, 1988
Topeka, Kansas

Presented by:
Bill R. Fuller, Assistant Director
Public Affairs Division
Kansas Farm Bureau

Mr. Chairman and Members of the Committee:

My name is Bill Fuller. I am the Assistant Director of the Public Affairs Division of Kansas Farm Bureau. We appreciate this opportunity to comment on H.B. 3022.

Agriculture must be responsible in its actions to protect our environment and natural resources. Farmers and ranchers have been good stewards of our natural resources. We want to assist in addressing potential problems. In fact, the agricultural community recommended and supported S.B. 330 which created the "Kansas Chemigation Safety Law" during the 1985 Legislative Session.

H.B. 3022 was introduced by the House Committee on Energy and Natural Resources after conducting several days of groundwater hearings. We believe review of any new program is appropriate. However, we question the need for this legislation at this time. No chemigation accidents have been reported. Monitoring of irrigation wells by the State Board of Agriculture has not

attachment 5
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revealed any significant groundwater contamination. We believe the Act has been administered according to the Legislative intent as expressed in 1985. In fact, we believe with the limited resources ... both funds and personnel ... the Kansas State Board of Agriculture has done well in administering this new program. The leveraging of their resources with the cooperation and assistance from other water agencies and organizations is commendable.

If more funds are needed, the amendment to add a fee for each well to the current $50 users permit requires a chemigator with several wells to pay higher fees than a chemigator with only one well. We believe that is fair.

We believe providing chemigators with adequate information is the key to a successful regulatory program. **We support an examination procedure for chemigators if it is a part of the Private Applicators Certification Program.** We want to do our part in assisting farmers in preventing pollution from farming activities. For that reason, Farm Bureau has developed and the KFB Board of Directors has authorized the printing and distribution of **"Self-Help ... POLLUTION CHECKLIST."** In that document we point out that the Kansas Chemigation Safety Law requires a permit and anti-pollution devices.

The proposed changes in the "penalty" section are causing many of our members concern. The original bill added a civil not to exceed to $10,000 for each violation ($10,000 per day for continuing violations) and Class A misdemeanor criminal penalty,

rather than the current $500 fine is a significant change. The House Committee amended the bill to reduce the penalty to $2,500 when applying fertilizer and $5,000 when applying pesticides. Will this threat of a substantial penalty improve compliance with the law? The $5,000/$2,500 civil penalty may adversely affect the cooperation we generally have between chemigators and the regulatory agency. Is the State prepared to fund additional personnel to find chemigation wells and administer the law? We do not condone the misuse or overuse of agricultural chemicals. **We do oppose increasing the penalties.**

Thank you for allowing us to express our views on H.B. 3022. We will attempt to respond to any questions you may have.

Self-Help...

POLLUTION CHECKLIST

....to assist farmers in reducing or preventing pollution from farming activities

- ✓ **Fill out this Checklist**
- ✓ **Review it once a year**
- ✓ **Protect our groundwater and environment**

IS YOUR DRINKING WATER SAFE?

Kansas Farm Bureau and Affiliated Services
2321 Anderson Avenue, Manhattan, Kansas 66502 / (913) 537-2261

I. BAS NFO ON YOUR WATER SUPPLY & TI NG, CLIMATE AND SOILS:

Which system provides drinking water for your family and/or livestock?

____ **PUBLIC** (EPA defines it as any system with 15 or more connections or serving 25 or more people, including most rural water districts.) Water testing and treatment required by federal Safe Drinking Water Act.

____ **PRIVATE** (includes your own system; bottled water; and systems with 14 or fewer connections or systems serving 24 or less people). Water tests generally not required except for dairies and for new wells.

Check ✓ the source/s from which your system draws its water:

GROUNDWATER

____ Shallow well, 0 to 50 ft.
____ Medium well, 50 to 150 ft.
____ Well deeper than 150 ft.
____ Artesian well
____ Spring

SURFACE WATER

____ Stream
____ River
____ Farm pond
____ Lake
____ Cistern

____ Don't know, but I intend to find out.

Is your water treated to kill bacteria? ____ Yes ____ No

If you have a well, is it dug, drilled, or sandpoint? _____

In what year was your well constructed? _____

Is your well properly grouted to prevent contamination from rainfall and animal contamination from seeping down along the well's casing? ____ Yes ____ No ____ Don't Know

Does your well's casing extend above ground level? (It should.)
____ Yes ____ No

Does your well have a water tight cover or seal? _____ Yes ____ No

WATER TE NG

Have you had your water tested within the last year?
____Yes ____ No
If No, what year did you last test it? _____

Did the test include any of the following? Check those that apply.

____ pH
____ Nitrate
____ Total Coliform Bacteria
____ Total Dissolved Solids

Done by many state health labs for a small fee. Should be done annually even if no obvious problems exist.

____ Pesticide Scan
____ Heavy Metals (lead, arsenic, etc.)
____ Purgable Organic Carbons (fuels, dry cleaning solvents, etc.)

CLIMATE and SOILS

What is the average rainfall for your area? _____ inches.
(Leaching potential increases as annual rainfall increases.)

Is the bedrock limestone? ____ Yes ____ No

Are your topsoils shallow to bedrock (less than 3 ft.)
____ Yes ____ No
(Thicker top soils may still be a problem depending on soil type.)

Are your soils generally:
____ Sandy (most likely to allow leaching into groundwater)
____ Loams (medium leaching potential)
____ Clays (least likely to allow leaching)
____ High organic matter (peat or muck)
____ Loam or some combination of those listed above?

How are any ponds or impoundments on your farm recharged?
____ rainfall/runoff
____ groundwater/spring
____ stream
____ pumped well

II. CHE YOUR FARM'S POTENTIAL TO PC UTE GROUNDWATER AND YOUR DRINKING WA ER SUPPLY

DO YOU:	YES*	NO
• Have limestone bedrock fairly close to the surface? *(Cracks and sinkholes provide fast movement of runoff and pollutants to groundwater and wells many miles away.)*	____	____
• Have sandy soils? *(Fertilizers and chemicals can move rapidly to groundwater.)*	____	____
• Have groundwater tables within 30 ft. of the surface?	____	____
• Have a dug or sandpoint well less than 50 feet deep? *(These are generally old, not properly cased or grouted. Easily contaminated by bacteria, rodents and surface runoff.)*	____	____
• Have a well pit? *(Easily contaminated by surface runoff, flooding and rodents.)*	____	____
• Have an older submersible well pump? *(Many older pumps contain lubricating oil with highly toxic PCBs which could contaminate your whole water supply system.)*	____	____
• Have lead water pipes or pipe joints soldered with lead? *(Lead is highly poisonous and could leach into drinking water, especially if the water is acidic.)*	____	____
• Use your well for both livestock and household use? *(Potential for cross contamination exists.)*	____	____
• Have livestock or poultry within 200 feet of a well? *(Bacteria, nitrates and disease may reach the weli water.)*	____	____
• Have a feedlot, manure lagoon or manure holding facility?	____	____
• Have a septic tank or soil absorption field within 200 feet of a well? *(Bacteria and nitrate contamination is possible.)*	____	____
• Have a surface water drainage well? *(Runoff carries chemicals and manure directly into groundwater.)*	____	____

DO YOU: **YES*** **NO**

- Have a farm dump? . . . . . ____ ____
  (Improperly disposed household and farm chemicals and animals.)
- Have an underground fuel tank? . . . . . ____ ____
  (Average life of steel tanks is 40 years or less.)
- Put chemicals or fertilizers into your irrigation system? . . . . . ____ ____
  ("Kansas Chemigation Safety Law" requires a permit and anti-pollution devices to prevent backflows into wells.)
- Use chemicals which are on EPA's Priority Leachers List? . . . . . ____ ____
  (If you do use them, try to find a substitute chemical which is equally effective but less likely to leach to groundwater. See list below)
- Apply sewage sludge? . . . . . ____ ____
  (Possible problems with heavy metal buildup, disease and nitrates if not monitored carefully.)
- Dump or spread used oil to control road dust? . . . . . ____ ____
  (EPA considers this hazardous waste, better recycle it.)

IF YOU CHECKED "YES" FOR ONE OR MORE OF THE QUESTIONS ON PAGE 3 AND 4 YOU SHOULD DEFINITELY BEGIN A PROGRAM OF ANNUAL WELL WATER TESTING!

*Also, if you checked the "YES" column you should try to reduce your system's pollution potential and/or reduce your production costs.

EPA PRIORITY LEACHERS *(Current as of October 21, 1987 but could change)*

acifluorfen
alachlor
aldicarb
aldicarb sulfone
aldicarb sulfoxide
ametryn
atrazine
atrazine, dealkylated
baygon
bromacil
butylate
carbaryl
carbofuran
carbofuran-30H
carboxin
carboxin sulfoxide
chloramben
alpha-chlordane
gamma-chlordane
chlorothalonil
cyanazine
cycloate
2,4-D
dalapon
dibromochloropropane
DCPA
DCPA acid metabolites
diazinon
dicamba
5-hydroxy dicamba
3,5-dichlorobenzoic acid
1,2 dichloropropane
dieldrin
diphenamid
dinoseb
disulfoton
disulfoton sulfone
diuron
endrin
ethylene dibromide
ETU
fenamiphos sulfone
fenamiphos sulfoxide
fluormeturon
heptachlor
heptachlor epoxide
hexachlorobenzene
hexazinone
methomyl
methoxychlor
methyl paraoxon
metolachlor
metribuzin
metribuzin DA
metribuzin DADK
metribuzin DK
nitrates
oxamyl
pentachlorophenol
pichloram
pronamide metabolite, RH 24,580
propachlor
propazine
propham
simazine
2,4,5-T
2,4,5-TP
tebuthiuron
terbacil
trifluralin

III. OFF ,TE ASSESSMENT

(i.e., are other people's actions affecting your water supply?)

What is the approximate distance to the nearest neighbor's well? (Express in feet or miles) _____.

Is that well: ____ shallow (less than 50 feet); ____ deeper than 50 ft.?

From a map or by observation, in what direction does the groundwater flow through your property? From the _____

_____ to the _____. (Check with local Soil Conservation Service or State Geological Survey if you don't know the answer.) Often times groundwater moves toward the nearest creek or river.

Place a check mark ✓ next to all **POLLUTANT SOURCES** within a 1-mile radius of your property where the groundwater seems to be coming from. (If your farm's water supply is surface water you may have to think in terms of many miles upstream.)

Pollutant Source	Potential Pollution or Problem	If You Suspect/ observe these Problems, Request These Tests
____ Ag Areas	All problems listed in Part II	TC, NO_3, pH, TDS, Pesticide Scan.
____ Wetlands	Polluted recharge water.	Bacteria, NO_3.
____ Forests	Pesticide use.	Pesticide scan.
____ Highways	Road salt, lead petroleum.	TDS, chlorides, sodium.
____ Housing	Septic, house and lawn chemicals.	NO_3, surfactants, Fecal Coliform & Streptococcus.
____ Fuel Tank	Gasoline, diesel.	Hydrocarbon scan.
____ City	Street runoff, fuels.	TDS, pH, Hydrocarbon scan.
____ Abandoned Wells	Contaminant runoff or seepage.	NO_3, Fecal Coliform & Pesticide scan

Pollutant Source	Potential Pollution or Problem	If You Suspect/ observe these Problems, Request These Tests
____ Industry	Metals, fuels, solvents, acids.	TDS, pH, Hydrocarbon scan.
____ Food Ind.	Rinse water, cleaning solvents.	Bacteria, TDS, pH, Surfactants.
____ Injection Well	Brine, chemicals, & acids.	TDS, pH, acidity, Hydrocarbon Scan, Corrosion Index.
____ Mining	Acid, salts, minerals.	TDS, Fe, SO_4, pH, Mn, Al, acidity Corrosion Index.
____ Oil & Gas	Brine, sulfur & minerals	TDS, Na, Cl, Ba, Pb, pH, Strontium, Corrosion Index.
____ Golf Club	Pesticide and Fertilizer use.	NO_3, pH, Pesticide Scan.
____ Landfills	Chemicals of all sorts.	TDS, pH, COD, Volatile organics.
____ Sludge	Heavy metals, bacteria.	Bacteria, nitrate, metals.
____ Utilities	Seepage from storage ponds.	TDS, pH
____ Other		

TDS = Total Dissolved Solids, TC = Total Coliform Bacteria, NO_3 = Nitrates, Al = Aluminum, Fe = Iron, Cl = Chlorides, Mn = Manganese, Ba = Barium, SO_4 = Sulfates, COD = Chemical Oxygen Demand, Pb = Lead, Na = Sodium.

If there is any question in your mind about how any of the pollutant sources you checked above may be affecting your water supply then you should have your water tested. This gives you a baseline against which to compare water test results in future years.

Work closely with local government to deal with off-farm problems.

IV. FERT ER CHECKLIST

DO YOU:	Yes	No	Can Improve* Investigate	Does Not Apply
• Soil test every year, including 2 to 3 feet deep? . . . . . *(Deep testing is important in drier climates to determine how much of last year's nitrogen fertilizer remains within the plant's reach.)*	____	____	____	____
• Have a nutrient "BUDGET" for your cropland?	____	____	____	____
• Split nitrogen applications by plant growth stages?	____	____	____	____
• Give fertilizer credits to manure or sewage sludge?	____	____	____	____
• Give nitrogen credits for previous crops such as alfalfa, soybeans, clover, vetch and other legumes? . .	____	____	____	____
• Band fertilizers where possible? . . *(Banding reduces the amount of rainfall that contacts the fertilizer as the rainfall percolates down through the soil. Banding also reduces the chances of weeds using the fertilizer before your crop does.)*	____	____	____	____
• Use goggles and rubber gloves around anhydrous ammonia?	____	____	____	____
• Reduce use of nitrogen fertilizers in the fall? . . . . . *(Spring use increases yield and reduces NO_3 leaching.)*	____	____	____	____
• Use N-inhibitors, such as N-Serve?	____	____	____	____
• Set "Realistic" yield goals? . . . . . *(10 percent higher than the average yield for the last 3 years is reasonable.)*	____	____	____	____

**Even if you checked the YES or the NO column you also should check the "Can Improve" if you think there's the slightest chance you could reduce your system's pollution potential and/or your production costs.*

V. STORAGE OF AG CHEMICALS

DO YOU:	Yes	No	Can Improve* Investigate	Does Not Apply
• Know whether your fire department would let a building burn if it contained ag chemicals, rather than risk having their water carry chemicals to groundwater or nearby streams?	____	____	____	____
• Padlock chemical storage areas?	____	____	____	____
• Keep duplicate records of amounts and types of chemicals in storage and keep one set someplace else other then your chemical storage building? *(The extra record is useful in case of fire.)*	____	____	____	____
• Know which chemicals must be stored in a heated area to prevent lose of effectiveness due to freezing?	____	____	____	____
• Have any chemical containers with missing or unreadable labels?	____	____	____	____

VI. HANDLING & APPLICATION OF AG CHEMICALS

DO YOU:

• Know that different parts of your body absorb pesticides at different rates?	____	____	____	____

Anatomy	% Parathion Absorption
scalp	32.1
ear canal	46.5
forehead	36.3
forearm	8.6
palm	11.8
abdomen	18.4
scrotum	100.0
ball of foot	13.5

(Researchers in California measured the percent absorption of parathion by different parts of the anatomy:) Most other pesticides have not been checked for body absorption rate.

DO YOU:	Yes	No	Can Improve* Investigate	Does Not Apply
• Know that symptoms of low-level organophosphate insecticide poisoning closely mimic the symptoms of exhaustion or flu? ..... *(Symptons include headaches, loss of appetite, nausea, dizziness, weakness and sweating.)*	____	____	_____	_____
• Know that a product with higher water solubility, longer persistence, and low soil absorption has a greater potential of reaching groundwater?	____	____	_____	_____
• Use integrated Pest Management (IPM) to determine whether the $ loss to the pest is great enough to warrant spraying, rather than spraying by schedule?	____	____	_____	_____
• Use one of the five specifically defined types of conservation tillage (reduced till, mulch till, slot till, ridge till, or no-till? ..... *(They reduce the amount of soil, chemicals & fertilizer that is eroded to surface waters.)*	____	____	_____	_____
• Band herbicides, insecticides, and other chemicals, rather than broadcasting them, to cut your costs and reduce their potential for pollution?	____	____	_____	_____
• Read the label before applying any chemical, and follow it?	____	____	_____	_____
• Calibrate spray nozzles before use?	____	____	_____	_____

**Even if you checked the YES or the No column you also should check the "Can Improve" if you think there's the slightest chance you could reduce your system's pollution potential and/or your production costs.*

DO YOU:	Yes	No	Comprove* Investigate	Does Not Apply
• Mix and load chemicals and fertilizers at least 100 feet away from your well? ..... *(The closer you are, the easier it is for spilled chemicals to get into well.)*	____	____	____	____
• Use rubber gloves and boots when handling chemicals? ..... *Leather absorbs chemicals and keeps it in contact with your skin for days.)*	____	____	____	____
• Measure concentrates and dilutions accurately before adding to tank?	____	____	____	____
• Drain the container into the spray tank by holding it in the vertical position for 30 seconds?	____	____	____	____
• Rinse containers as soon as they are emptied before the residue dries?	____	____	____	____
• Empty rinsate into your spray tank?	____	____	____	____
• Have an air gap between the water supply hose and the top of your spray tank to prevent back-siphoning?	____	____	____	____
• Have check valve and proper safety equipment on irrigation wells?	____	____	____	____
• Pump tailwater pits often and reuse the water for irrigation to prevent chemical residue from leaching into groundwater?	____	____	____	____
• Use irrigation scheduling? ..... *(If soil is at field capacity, excess water and chemicals will likely move down past root zone.)*	____	____	____	____

DO YOU:	Yes	No	Com-promise* Investigate	Does Not Apply
• Delay application to prevent wash-off or surface runoff if heavy rain is forecast?	___	___	___	___
• Drive tractor into wind or at right angles to the wind whenever possible when spraying to prevent drift from getting on you?	___	___	___	___
• Refrain from draining rinse water from equipment near or into ditches, streams, ponds, lakes or other water sources? *(Rinse waters containing any quantity of certain pesticides are classified as hazardous wastes according to state and federal laws.)*	___	___	___	___
• Wear one of the new types of disposable coveralls when mixing or applying chemicals? *(It's not very expensive and they do a good job of protecting you.)*	___	___	___	___
• Wash spray clothes separately?	___	___	___	___
• Use crop rotation to avoid buildup of pest populations and maintain or improve soil conditions?	___	___	___	___
• Alternate pest control products and use crop varieties that are pest resistant?	___	___	___	___
• Have general groundwater pollution liability insurance?	___	___	___	___
KEEP COMPLETE APPLICATION RECORDS? *i.e. which chemical, how much, application rate, date, time, temperature, wind conditions, which field, and reason for spraying.)*	___	___	___	___

VII. CON NER DISPOSAL

DO YOU:	Yes	No	Can Improve* Investigate	Does Not Apply
• Return unopened chemicals for a refund?	___	___	___	___
• Check the product label for specific container disposal instructions from the manufacturer?	___	___	___	___
• Triple rinse and puncture metal pesticide containers and recycle or dispose of them in approved landfills?	___	___	___	___
• Follow local and state laws on disposal of plastic and paper pesticide containers?	___	___	___	___
• Live in an area that sponsors voluntary container collection programs? *(If not, you might want to help start one.)*	___	___	___	___
• Burn plastic, paper, and other combustible materials after each day's use per application site?	___	___	___	___
• Burn only in daylight hours and have one person responsible to be in attendance for the entire period of the burn?	___	___	___	___
• Dispose of used motor oil at recycling centers?	___	___	___	___

**Even if you checked the YES or the NO column you also should check the "Can Improve" if you think there's the slightest chance you could reduce your system's pollution potential and/or your production costs.*

VIII. HO\ O TAKE A WATER SAMPLE

Always contact the lab where you plan to have the water tested, and ask them for sampling methods, containers, and packaging and delivery instructions.

Your method and timing of taking a sample will vary slightly depending on which point in the system you are concerned about:

1. Actual quality of the main source of water, (groundwater, stream, river, or main distribution lines of a public water system). Remove the faucet's aerator, sterilize the faucet opening by flaming and let the water run for 10 minutes before taking the sample.
2. Condition of your water pipes or storage tanks. Remove the aerator from your faucet, sterilize the faucet opening with flame, and take the sample within 3 or 4 seconds after you turn the water on.

TYPE OF SAMPLING CONTAINER. For some tests, water samples can be submitted in a plastic bag or bottle. Other tests require special dark-colored glass bottles. ASK THE LAB!

TIMELINESS. Usually, it's best to test the sample as soon as possible. Some tests must be done on site, others can wait a day or two, and others can be analyzed several weeks later (and often are).

HANDLING OF SAMPLE CONTAINERS.

- Do not touch the inside of the container or inside of the lid.
- Refrigerate or pack in ice and deliver to lab as quickly as possible if lab so instructs. (Don't throw the sample in the back seat and run all your errands before you stop at the lab.)
- Don't pump gasoline before taking the sample; ethylene dibromide (EDB) in the gasoline will evaporate off your hands into the sample.

For most accurate results, water samples should always be collected by a disinterested third party trained in proper sample collection procedures, and samples should be tested at an Environmental Protection Agency certified laboratory.

IX. RECOMMENDED INDIVIDUAL ACTIONS

1. Even if no obvious water problems exist, **household water supplies should be tested ANNUALLY** by your county or state Health Department for: pH, nitrates, total coliform bacteria, and total dissolved solids.

   Testing water for every contaminant is possible, but very expensive and not necessary. **It is more important to test on a regular basis for a few indicators of contamination and to maintain a record of water quality.** This helps to identify changes in the supply, contamination of the water source or deterioration of the water system.

2. Test livestock and poultry water supplies ANNUALLY for pH, total dissolved solids, sulfate, flouride, calcium, magnesium, iron, copper, arsenic, cadmium, lead, nitrate, barium, total coliform, fecal coliform bacteria, and total plate count.

3. **Review this Checklist at the end of each calendar year** and jot down which potential problem areas you improved on, and which ones you can work on in the coming year.

Record of Household Water Tests

Year	Date	pH 6.8 to 7.5*	Nitrates NO_3-N 10ppm*	Total Coliform Bacteria 0/100ml*	Total Dissolved Solids 500ppm*	Other
1987						
1988						
1989						
1990						
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						

ppm = parts per million ml = milliliters
*ACCEPTABLE LIMITS WITHOUT TREATMENT

4. Test your water. Many contaminants are not detectable by taste, odor or appearance. To help assure that your private water supply is safe, have your water analyzed by:

- State Certified Water Testing Lab...for a list contact:

Laboratory Certification Officer
Office of Laboratories
Ks. Dept. of Health & Environment
Topeka, Kansas
(913/296-1639)

or

Kansas Farm Bureau
2321 Anderson Ave.
Manhattan, Kansas
(913/537/2261)

- An Alternative...Testing is available at

Kansas Department of Health and Environment
Environmental Laboratories
Forbes Field, Bldg. 740
Topeka, Kansas 66620
(913/296-1657)

X. SUGGESTED LOCAL FARM BUREAU ACTIVITIES

- **Distribute Checklists**

- **Set up a booth and promote water testing**...at county fair, farm show, field day.

- **Conduct Safe Drinking Water Clinic**...in cooperation with Extension Service, county Health Department, local well driller, and local water conditioning and testing companies.

- **Seek information and assistance:**

County & Kansas Farm Bureau
County Extension Agent
Soil Conservation Service
Local Water Testing Lab
Regional U.S. EPA Office
Kansas Board of Agriculture
Kansas Dept. of Health and Environment

Kansas Livestock Association

2044 Fillmore • Topeka, Kansas 66604 • Telephone: 913/232-9358

Owns and Publishes The Kansas STOCKMAN magazine and KLA News & Market Report newsletter.

STATEMENT

OF THE

KANSAS LIVESTOCK ASSOCIATION

TO THE

COMMITTEE ON

AGRICULTURE

SENATOR JIM ALLEN, CHAIRMAN

SENATOR DON MONTGOMERY, VICE CHAIRMAN

WITH RESPECT TO HB 3022

CHEMIGATION

PRESENTED BY

RICH MCKEE

EXECUTIVE SECRETARY, FEEDLOT DIVISION

MARCH 29, 1988

Mr. Chairman and members of the committee, I am Rich McKee representing the Kansas Livestock Association. KLA represents a broad range of over 9,000 livestock producers who reside in virtually every geographic corner of the state.

The Kansas Livestock Association opposed HB 3022 in its original form.

First, KLA members would **support** increased staffing within the Board of Agriculture to help enforce the chemigation law. We would approve some increase in the chemigation permit fee to accomplish this increase. The $20

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per well charge may be more than necessary.

KLA **supports** the provision requiring examination of individuals who seek a permit for chemigation.

The Kansas Livestock Association, as every other group, supports the protection of groundwater quality. A large portion of our membership not only uses water for irrigation and stock watering...but that same water is used for their families. These people have a vested interest in how chemigation may affect their water supply. These same people have expressed concern that HB 3022 may be going a little overboard.

Thank you for your consideration of our position.

KANSAS FERTILIZER AND CHEMICAL ASSOCIATION, INC.
816 S.W. Tyler St. P.O. Box 1517 A/C 913-234-0463 Topeka, Kansas 66601-1517

STATEMENT OF THE

KANSAS FERTILIZER AND CHEMICAL ASSOCIATION

TO THE SENATE AGRICULTURE COMMITTEE

SENATOR JIM ALLEN, CHAIRMAN

REGARDING H.B. 3022

MARCH 29, 1988

Mr. Chairman and Members of the Committee, I am Chris Wilson, Director of Governmental Relations of the Kansas Fertilizer and Chemical Association (KFCA). KFCA is a professional and trade association of over 450 members, representing the state's manufacturing, wholesale and retail agricultural fertilizer and chemical industry. Our Association requested the Chemigation Safety Law during the 1985 Session of the Legislature, so we have a particular interest in H.B. 3022, which would amend this act.

The two major amendments of this bill would require chemigation users to successfully complete an examination prior to receiving a permit and would increase penalties for violations of the act. While we do not oppose those objectives, we have reservations about the ways this particular bill seeks to accomplish them. The examination requirement in Sec. 4 (b), lines 0143 through 0148, would refuse a permit to anyone who had not already passed the exam. We assume that this means the Board of Agriculture would have to offer the exam on an individual basis. There are questions to be answered concerning this requirement. For instance, would the individual have to come to Topeka to take the exam, or could it be offered periodically or through county Extension offices?

The penalty amendment Sec. 6 (e), lines 0215 through 0222, applies a penalty of $2,500 for violations associated with fertilizers and $5,000 for violations associated with pesticides. We question why this difference in violations was established since fertilizers have documented potential

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health effects, while any potential for detrimental health effects from pesticide consumption is not established.

Mr. Chairman and Members of the Committee, our Association is in full support of the Chemigation Safety Law and of improving it through the better education and training of chemigation users. However, we believe that this bill was offered on the basis of two misconceptions. First, there was a misconception that chemigation is a dangerous practice. Anyone who understands this practice can tell you that it is designed to protect groundwater, rather than contaminate it. Chemigation allows users to "spoon feed" the crop, using smaller amounts of chemicals than would normally be required for adequate treatment. Secondly, there was a mistaken idea that the current law is not being adequately enforced. The State Board of Agriculture should be commended for the job they have done in implementing the law. Contrary to what some think, there has been very good compliance with the law. Beyond that, the Board's tests to date clearly illustrate that there is not a problem of well contamination from chemigation.

In short, this law has been in effect for just over a year. It appears to be working well. Some changes may be merited in the future; but our Association is of the opinion that this bill to amend the law was entered into hastily and is based on incomplete and incorrect information. We do not believe that this is the time or the way in which to modify our Chemigation Safety Law.

I would be happy to respond to any questions you may have.

STATEMENT OF THE

KANSAS FERTILIZER AND CHEMICAL ASSOCIATION

and the

KANSAS GRAIN AND FEED ASSOCIATION

to the

HOUSE ENERGY AND NATURAL RESOURCES COMMITTEE

REP. DENNIS SPANIOL, CHAIRMAN

REGARDING GROUNDWATER PROTECTION

FEBRUARY 10, 1988

Mr. Chairman and Members of the Committee, I am Chris Wilson, Director of Governmental Relations of the Kansas Fertilizer and Chemical Association (KFCA) and the Kansas Grain and Feed Association (KGFA). KFCA's 450 members represent the agricultural fertilizer and chemical industry and KGFA's over 1,100 member firms constitute the state's grain storage and handling industry. KFCA members are distributors or retailers of agricultural chemicals or others associated with the industry. Many KGFA member firms who are country elevators also market ag chemicals.

Both Associations appreciate the opportunity to offer some thoughts for your consideration in regard to groundwater protection and the impact of ag fertilizers and chemicals on groundwater quality. Our objectives today are to 1) provide you with additional information on the impact of agriculture fertilizer and chemicals on groundwater quality; 2) inform you as to what our industry is doing to protect groundwater; and 3) offer some action options for your consideration.

Before doing that, I would emphasize that the issue of groundwater protection is of the highest priority to us. Since most of us in Kansas, particularly in rural areas, rely upon groundwater as our source of drinking water, its quality is of critical importance to us and our families. For those of us in agriculture, both our lives and our livelihoods depend on the safe

and wise use of ag chemicals, in such a way as to pose no adverse effect on our environment. Groundwater is the lifeblood of agriculture. Ag chemical retailers are acutely aware that--while they always like to sell more product--it is far better to have precise applications with no adverse environmental impact than to have too much product applied, resulting in groundwater contamination. Farmers, too, have learned that more is not necessarily better as environmental concerns and sound economics have dictated that fertilizers and chemicals be properly applied. A great deal remains to be done, but we in agriculture have been very diligently working to do what is necessary to protect groundwater. I believe there is reason for us to be very optimistic about the future in terms of agriculture's effect on groundwater.

1. Agriculture's Impact on Groundwater Quality - One of the reasons this is such a challenging area is that developing technologies are continually allowing us to learn more about the movement of fertilizers and chemicals in soil, their degradation and their potential for reaching groundwater. Much research has been done, and is going on, yet much more is needed. Chemical manufacturers conduct extensive leachability studies, required before EPA approves a chemical for use, to determine that chemical's potential for reaching groundwater. We have gone from being able to test for parts per million (ppm) several years ago to being able to test for parts per quadrillion (ppq) today. To put that into perspective, a ppm is the size of a postage stamp in the infield of a major league baseball field. A ppq is equal to one postage stamp in an area the size of the land area of Michigan, Ohio, Indiana, Illinois and Wisconsin. While advances in analytical chemistry have allowed us to detect the presence of a chemical in groundwater, we still need to know more about whether that presence poses a health risk and if so, at what level.

When we speak about fertilizers, the one with documented health risks

is nitrogen. High levels of nitrates in drinking water can result in illness or death to infants, particularly within the first three months of life. This is know as methemoglobinemia or "blue baby", and cases of it are very rare. After 3-6 months, infants produce acidity in their stomachs and intestinal tracts, so that intake of nitrates no longer results in the reactions which produce methemoglobin.

When we speak of agricultural chemicals, we mean pesticides. Pesticides include herbicides, insecticides, fungicides and nematacides. According to an October 1987 report from the U.S. Department of Agriculture, "The Magnitude and Costs of Groundwater Contamination from Agricultural Chemicals", the relationship between pesticides, groundwater contamination and cancer is unknown. Based on a National Academy of Sciences (NAS) study done last year, the Council on Agricultural Science and Technology (CAST) and scientists at the University of California determined the possible lifetime cancer hazard from ingesting a list of 52 pesticides which EPA suspects as being carcinogens. They found that the possible total carcinogenic hazard associated with daily consumption of all 52 pesticides is equal to the hazard from consuming about 1.6 quarts of chlorinated tap water per day. This cancer hazard would be at 1.48 on an index system, zero being no risk. By comparison, eating one peanut butter sandwich per day is a 30 on the index and eating one half-ounce mushroom per day is 100. Further information from the CAST study is included in your packet. According to the same USDA report mentioned above, "While the actual risks from low-level exposure to agricultural pollutants are uncertain, the public perception appears to be that they are significant".

While in no way do we want to underestimate agriculture's potential impact on groundwater, it is important to understand the problem potential as much as possible before we can best determine what actions are needed. The USDA report further helps put potential groundwater contamination

from agriculture in perspective by identifying all counties where potential for groundwater contamination from pesticide and nitrate use exists. There's good news and bad news for Kansas, as the following maps from the report illustrate. For our state, only one county is indicated as having contamination potential from pesticide use. This data was based on hydrogeologic characteristics and pesticide use. As you can see from the map, the greatest potential for groundwater contamination from pesticides is along the Eastern seaboard and the northern cornbelt. A second map shows numbers of pesticides found in groundwater caused by agricultural practices in 1986. That is the good news--and now for the not-so-good. The third map shows the potential for groundwater contamination from nitrogen fertilizers. No state has more potential for nitrate contamination than Kansas. A look at the fourth map helps explain why this is the case. This map shows nitrate-nitrogen distribution in groundwater in agricultural areas. Kansas has high levels of nitrates naturally occuring in the groundwater. In addition to natural causes, septic tanks and municipal sewage contribute to excess nitrate in groundwater. The fifth map combines data for hydrogeologic characteristics and nitrogen fertilizer use and shows only two counties in southwest Kansas which are high in both categories.

We should also keep in mind that fertilizers and chemicals are much more likely to end up in surface water, due to runoff, than in groundwater. According to Kansas State University, non-point source pollution has had a much greater effect on surface waters, while groundwater quality is more directly tied to point source contamination. In many cases, where pesticides are found in groundwater, they can be tied to sinkholes, abandoned wells or some other direct conduit from the ground surface to the water below. Soil type and conditions have a tremendous amount to do with whether chemicals will reach groundwater.

I believe that the research data to date indicates no cause for alarm,

but certainly reason to be doing all possible to prevent fertilizers and chemicals from ending up in groundwater.

2. What Agriculture is Doing to Protect Groundwater - Producer and agribusiness groups work at the federal, state and local levels with research institutions, the Cooperative Extension Service and the departments of agriculture to protect the groundwater. A number of publications have been provided to you with this statement for your review, which have been distributed to help producers in protecting groundwater. "Best management practices" (BMPs) have been designed to reduce erosion, control runoff and protect groundwater.

As you have seen, it is important for Kansas producers to accurately assess the amount of nitrogen their crops will need. K-State publishes optimum nitrogen rates, which are used by retailers to advise producers. We emphasize the importance of having soil tests taken to help determine how much nitrogen is needed and to be sure to include other sources of nitrogen besides commercial fertilizer in determining amounts to apply. Only 39% of available nitrogen is from commercial fertilizer. The rest comes from sources such as crops alfalfa, which fix nitrogen, or manure applied to the field. The table below gives an example of the diminishing crop production yields of additional nitrogen.

Table 2

The increase in corn yield due to added N and the cost of N for the extra bushels. Eight-year average for a central-Illinois experiment.

N, lb/A	Corn, bu/A	For each 30 lb/A of N	
		Extra corn, bu/A	Cost of N per extra bushel of corn
0	79	-	-
30	100	21	$0.29
60	117	17	$0.35
90	131	14	$0.43
120	142	11	$0.55
150	150	8	$0.75
180	154	4	$1.50
210	155	1	$6.00
240	155	0	—

We also emphasize integrated pest management (IPM), combining chemical use with other production practices to control pests.

Education is extremely important and there are innumerable seminars and schools for dealers and farmers which continually emphasize BMPs. Of course, educational programs are largely voluntary. However, certification and training is required for anyone buying or applying restricted use pesticides.

In a sense, the conservation provisions of the 1985 Farm Bill (Food Security Act) constitute a mandatory nonpoint source pollution control program. In order to be eligible for farm program benefits, which has been critical in recent years, farmers will have to comply with conservation regulations. Conservation compliance and the Conservation Reserve Program (CRP), which is expected to take four million acres out of production in Kansas and devote them to conservation use, will have major effects on controlling nonpoint source pollution from agriculture.

While the Committee is focusing on nonpoint sources, I believe it is important to mention point source contamination from agricultural fertilizers and chemicals again here. Our industry has developed BMPs for fertilizer and chemical plants for groundwater protection, and some information is included in that regard. Insurance companies and chemical manufacturers have also set requirements for groundwater protection measures at plants.

Further, our two Associations have established a joint Groundwater Task Force, which is in the process of establishing a set of standards/guidelines for plants in Kansas. The Task Force is being assisted by personnel from KSU, the Board of Agriculture, Kansas Department of Health and Environment, and Environmental Protection Agency in designing the standards.

KFCA is committed to appropriate regulation of our industry and in fact was responsible for initiating the Chemigation Act. In that spirit, we

decided to establish groundwater protection guidelines, knowing that it would mean additional costs to members in upgrading facilities. They may not be able to afford to make the changes, but they really can't afford not to.

Now for what I consider to be the most exciting part of my report to you. Both government scientists and scientists at every major chemical manufacturing company in the country are hard at work on the development of a new generation of chemicals, which are made from natural sources and are totally biodegradable and environmentally safe. A USDA news release which explains a little about these chemicals is included in your packet. These chemicals will be very specific and require only a few grams as opposed to pounds per acre to do the job. Dr. Hank Cutler of the Agricultural Research Service predicts that these chemicals will be on the market in five to seven years. Some of these environmentally safe chemicals are already being used in Japan, where their small land area, large population and topography magnify anything in the environment.

3. Action Options - Groundwater contamination from agriculture results not so much, if at all, from proper field application of pesticides and fertilizer. Causes of contamination include:

- spills & leaks
- discharge through sinkholes or abandoned wells
- improper field application

These problems could be addressed in a variety of ways:

- KFCA's state guidelines for plants will minimize spills and leaks at points of concentration of agricultural fertilizers and chemicals.
- We commend the Kansas Water Well Association for their efforts to improve well quality. Today's well technology is vastly improved from 40-50 years ago when many now abandoned wells were installed. We understand they will be requesting legislation for more education for pump installers as well as drillers.
- Continued education for dealers and producers is important. A special

emphasis program could be carried out by the Cooperative Extension Service.

- There are many research needs. A list identified by CAST is attached. More resources could be provided to KSU for research on nitrogen, and is particularly needed for nitrogen mineralization and leaching research.
- The Committee could consider legislation to provide for action when a chemical is detected in groundwater. The Iowa law focuses on research and education, but does not set standards or provide for action. Enclosed in your packet is information on groundwater laws in Wisconsin, California, Nebraska, Florida, and Arizona. Another law, passed last year in Mississippi, is being considered in Montana, Minnesota, Oregon and Ohio. That law requires the state authority to determine which chemicals are most likely to leach to groundwater and then set standards for those. If the chemicals are detected in groundwater, then the state can restrict their use, for instance, on certain soil types or under certain conditions, which have contributed to their leaching to groundwater. This is a concept which EPA has promoted.

One last item in your packet is some information on the importance of pesticides and fertilizers. Whatever their shortcomings, they have enabled agriculture to produce a more abundant, safer, and more wholesome food supply and to make dramatic contributions to the total economy. Over 20% of all U.S. jobs depend on agriculture.

Thank you for this opportunity to offer input to you on this important topic. I'd be happy to try to answer any question you may have.

###

Figure 4

Potential Groundwater Contamination from Pesticide Use

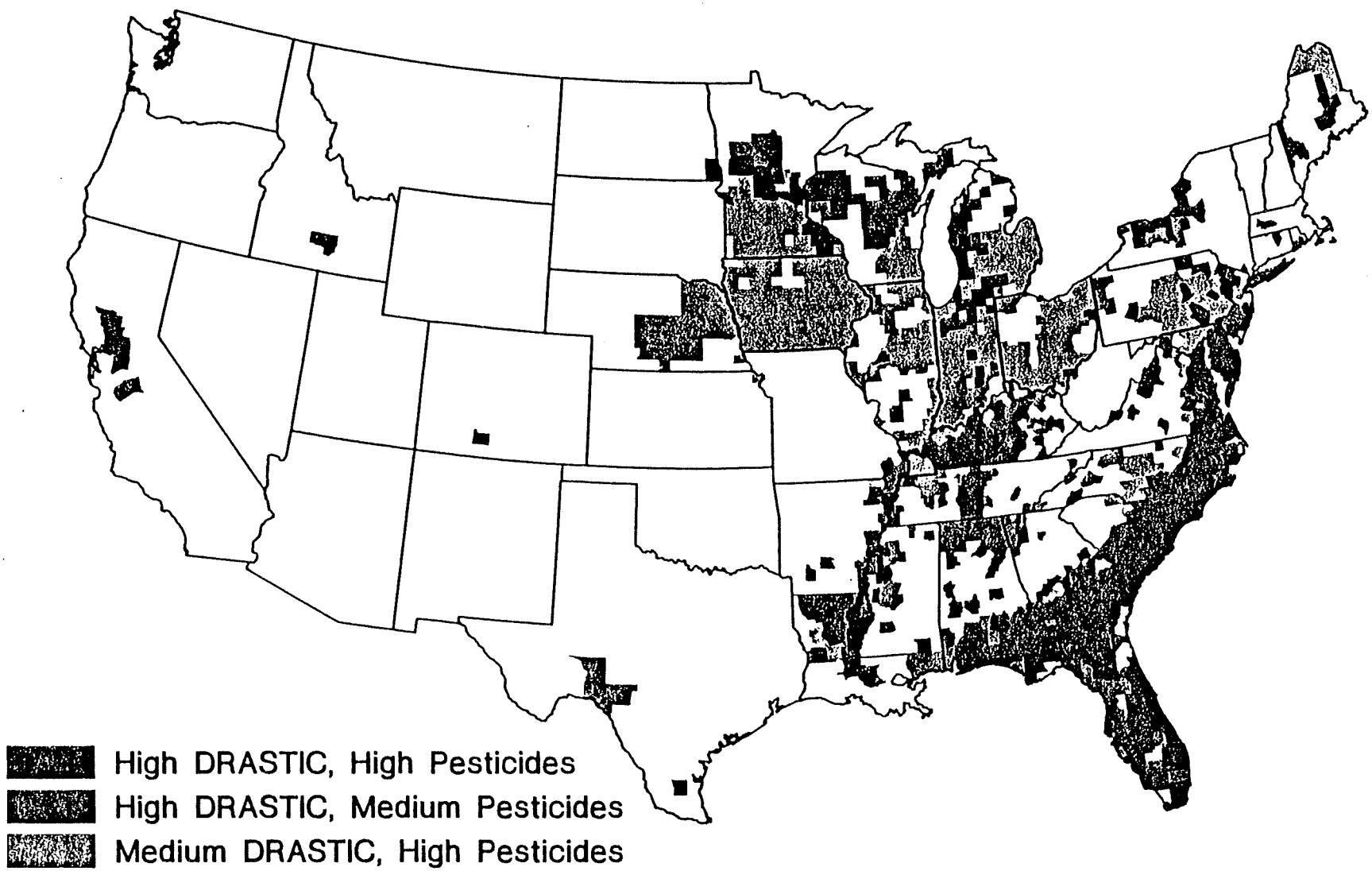
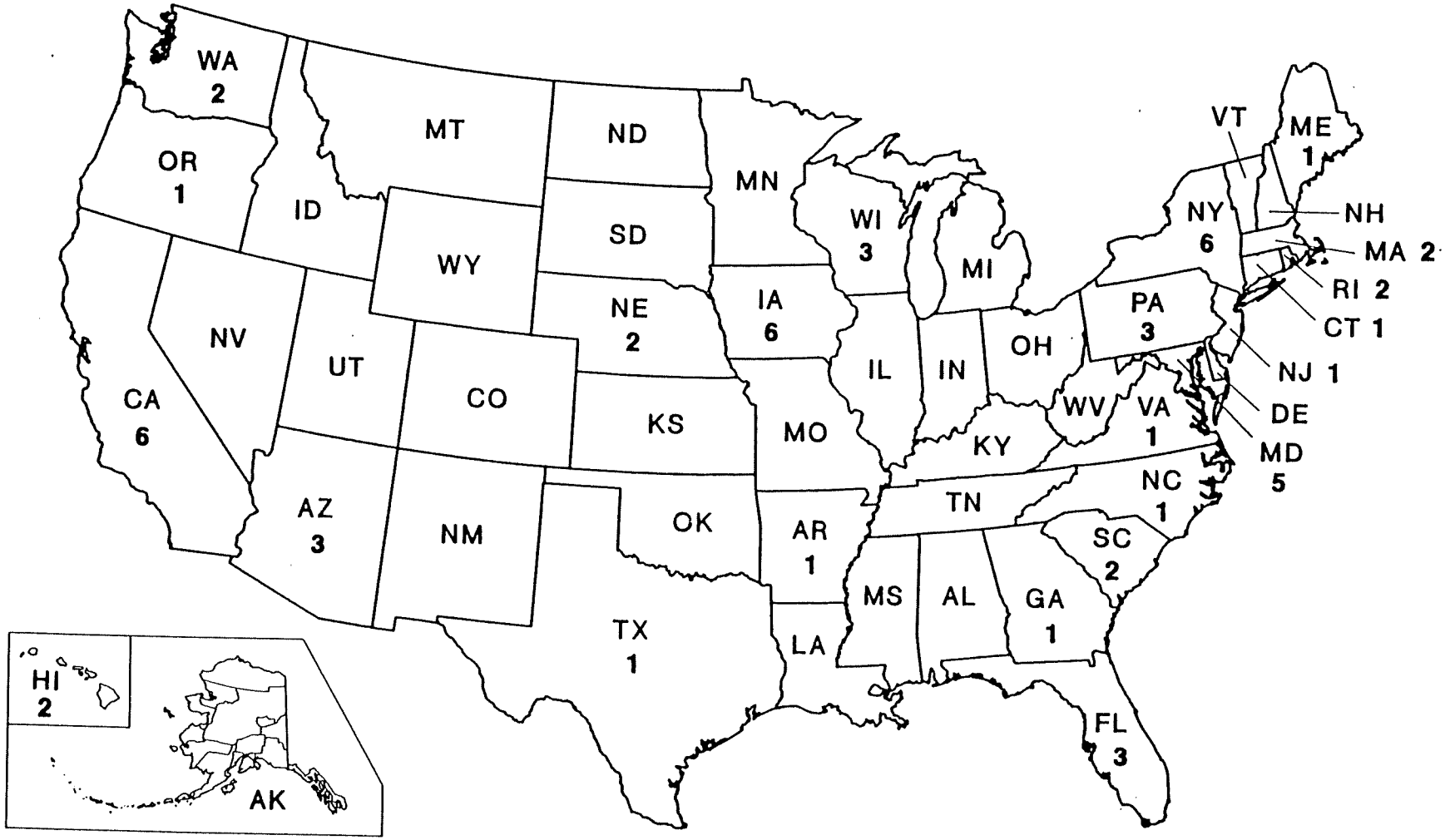


Figure 5

Numbers of Pesticides Found in Groundwater Caused by Agricultural Practices, 1986



Source: *(14)*

Figure 8

Potential Groundwater Contamination from Nitrogen Fertilizers

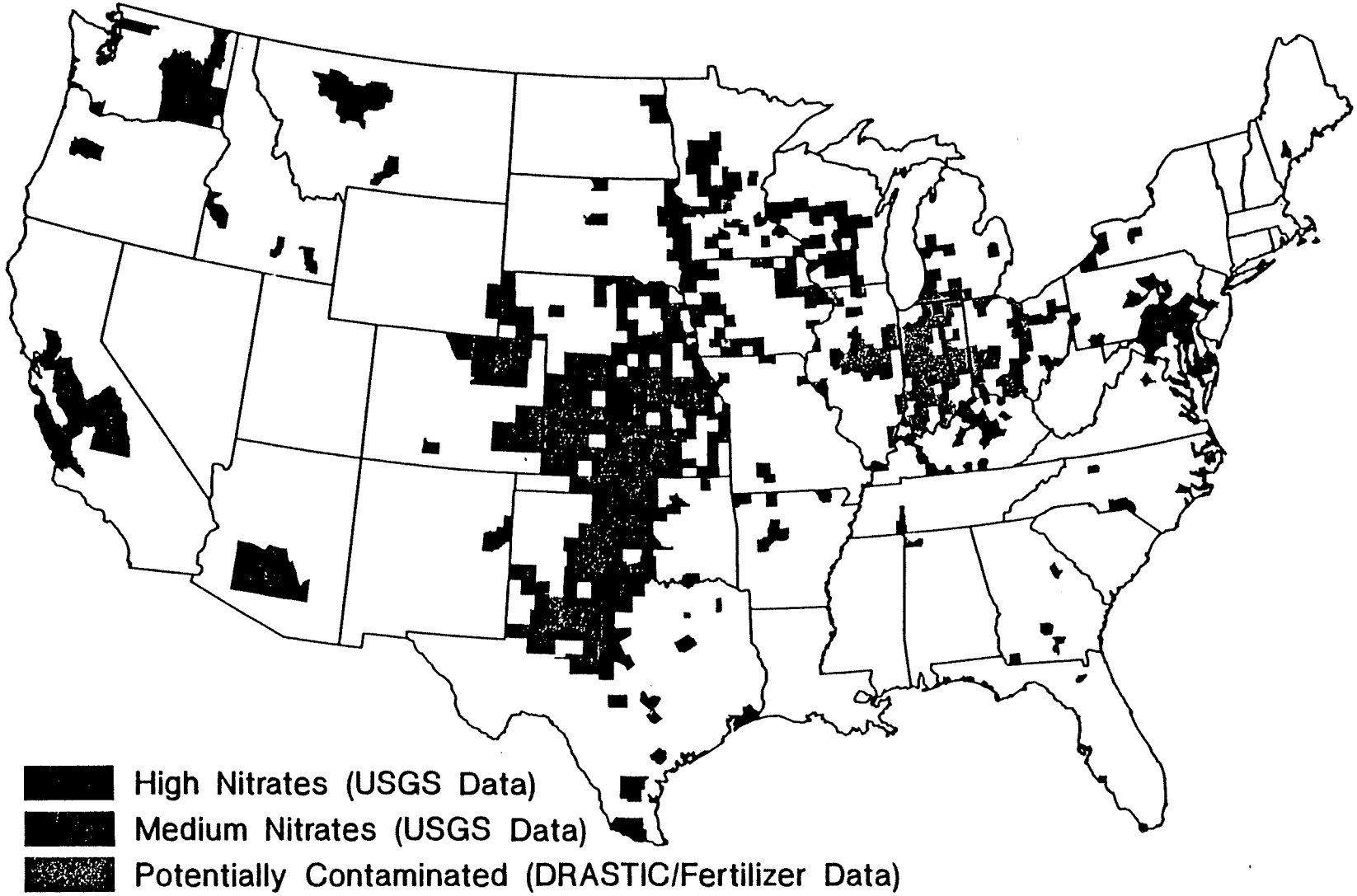


Figure 6

Nitrate-Nitrogen Distribution in Groundwater in Agricultural Areas

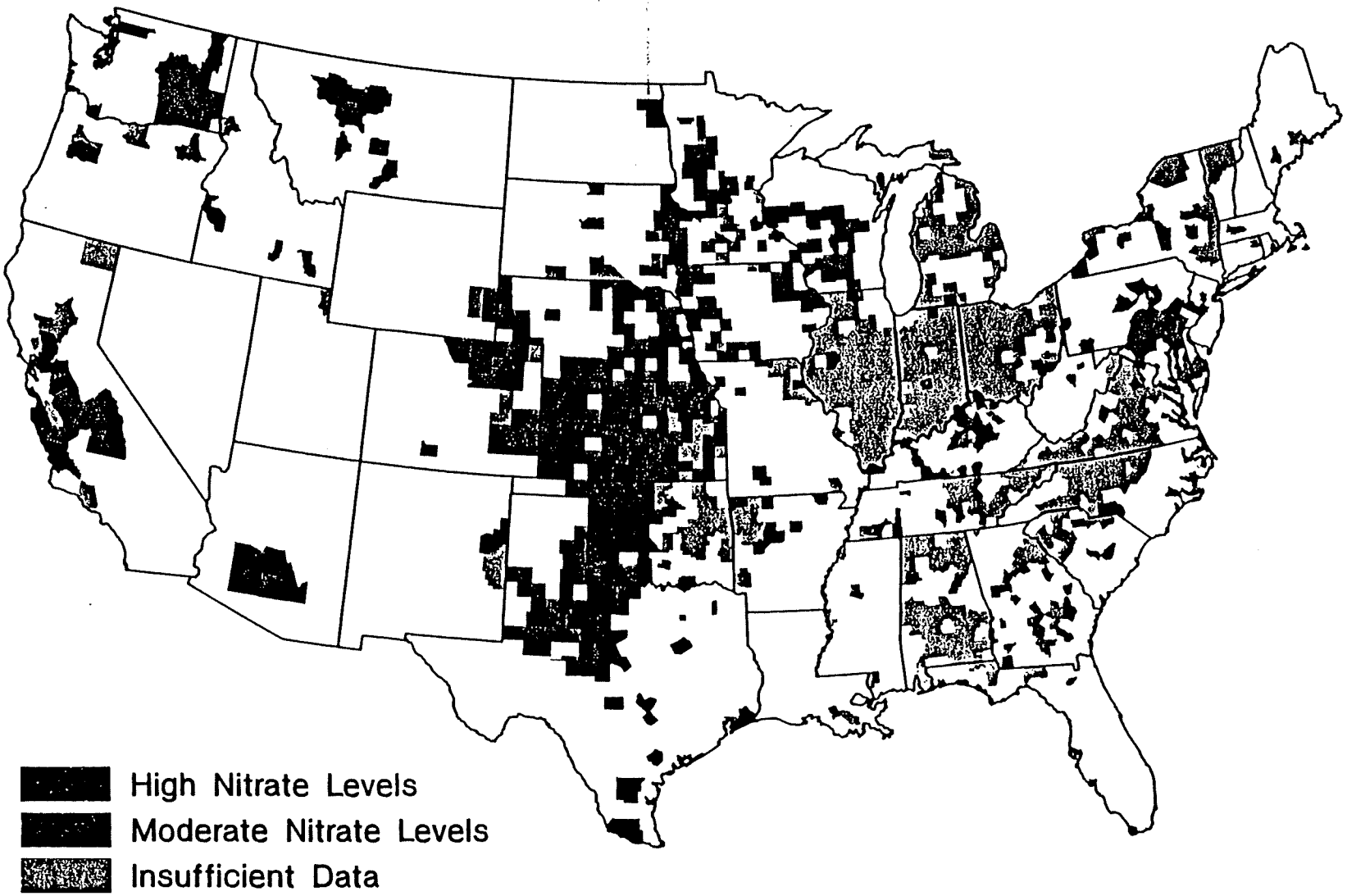
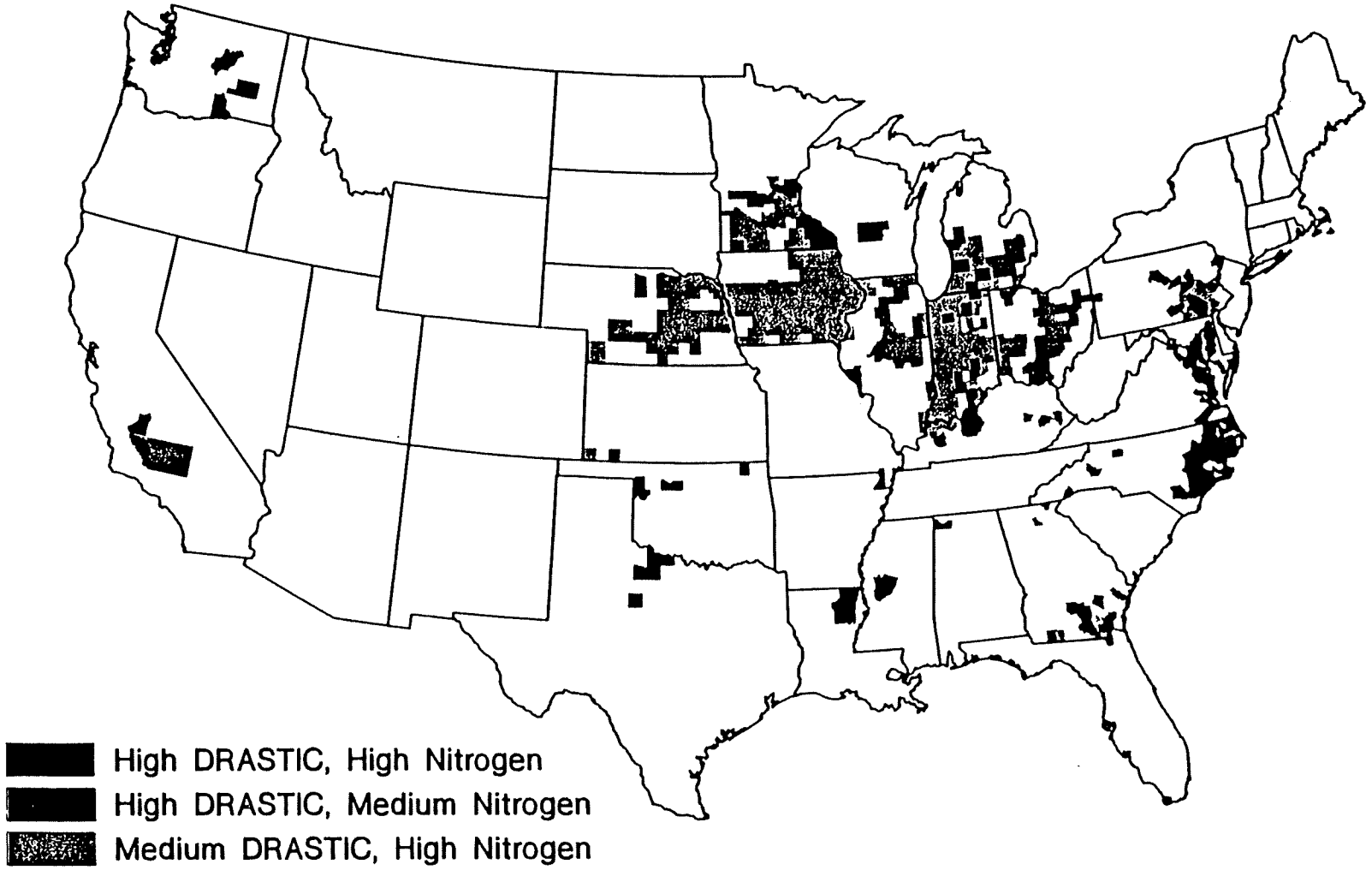


Figure 7

Combinations of Nitrogen Fertilizer Use and DRASTIC Ratings[1]



1/ Fertilizer use data include five crops: corn, wheat, soybeans, cotton, and sorghum.

Table 1. Intake, Acceptable Intake, and Safety Factors for Pesticidal Chemicals in Food in the United States (Gartrell et al., 1986)

Chemical	Micrograms of Chemical per Kilogram of Body Weight per Day		Safety Factor for Actual Intake Relative to Acceptable Intake[b]
	Intake in Food 1981-1982	Acceptable Daily Intake[a]	
Captan	0.015	10	667
Carbaryl	0.012	10	833
Chlordane	0.004	1	250
Chlorbenzilate	0.002	20	10,000
Chlorpyrifos	0.003	10	3,333
DDT	0.034	5	147
Diazinon	0.007	2	286
Dichloran	0.047	30	638
Dicofol	0.006	25	4,167
Dieldrin	0.016	0.1	6
Dimethoate	0.003	20	6,667
Endosulfan	0.044	8	182
Endrin	Not Detected	0.2	-
Ethion	0.005	1	200
Fenitrothion	0.002	1	500
Fenthion	Not Detected	1	-
Heptachlor	0.006	0.5	83
Lindane	0.002	10	5,000
Malathion	0.243	20	82
Methidathion	Not Detected	5	-
Parathion	0.002	5	2,500
Parathion-methyl	0.001	1	1,000
o-Phenylphenol	0.047	20	426
Phorate	0.003	0.2	67
Phosalone	0.024	6	250
Quintozene	0.007	7	1,000
Tecnazene	0.004	10	2,500

[a] Values established jointly by the Food and Agriculture Organization of the United Nations and the World Health Organization.

[b] The acceptable daily intake divided by the daily intake in food. This safety factor is in addition to the safety factor used in calculating the acceptable daily intake. The overall safety factor is the product of the two.

Table 2. Ranking of Possible Carcinogenic Hazards (Ames et al., 1987)

Daily Human Exposure per 70 kg (154 lb) Person[a]	Index of Possible Human Hazard[b]
PCBs: daily dietary intake, 0.2 µg of PCBs	0.0002
DDE/DDT: daily dietary intake, 2.2 µg of DDE derived metabolically from the insecticide DDT	0.0003
EDB: daily dietary intake from grains and grain products, 0.42 µg of ethylene dibromide	0.0004
Tap water, 1 liter, 83 µg of chloroform from chlorination	0.001
Bacon, cooked, 100 g (3.5 ounces), 0.3 µg of dimethylnitrosamine	0.003
Swimming pool, 1 hour for child, 250 µg of chloroform from chlorination	0.008
Peanut butter, 32 g (one sandwich), 64 ng of aflatoxin	0.03
Mushroom, one 15 g (0.5 ounce) raw Agaricus bisporus, mixture of hydrazines and other compounds	0.1
Conventional home air, 14 hours per day, 598 µg of formaldehyde	0.6
Beer, 354 ml (12 ounces), 18 ml of ethyl alcohol	2.8
Wine, 250 ml (9 ounces), 30 ml of ethyl alcohol	4.7

[a] A microgram (µg) is one millionth of a gram (g). A nanogram (ng) is one billionth of a gram. There are 453.6 grams in a pound and 1,000 grams in a kilogram. A milliliter is one thousandth of a liter. A liter contains 1.06 quarts.

[b] Daily lifetime human exposure in milligrams per kilogram of body weight as a percentage of the daily dose rate in milligrams per kilogram of body weight to halve the percentage of tumor-free test animals (rodents) by the end of a standard lifetime.

MANAGEMENT PRACTICE	NUTRIENTS CONTROLLED: Insolut (phospho. potassium)	Soluble (nitrogen)
Subsurface drain — a conduit, such as tile, pipe, or tubing, installed beneath the soil surface and which collects and/or conveys drainage water.	☑	☐
Terrace — an earth embankment, channel, or a combination ridge and channel constructed across a slope to control runoff.	☑	☐
Critical area planning — planting and managing vegetation on highly erodible or severely eroded areas where traditional crops are difficult to establish.	☑	☐
Pond — water impoundment made by constructing a dam or embankment, or by excavating a pit or "dugout."	☑	☐
Pond sealing or lining — installing a fixed lining of impervious material or treating the soil in a pond to reduce or prevent excessive water loss.	☑	☐
Water supply, dispersal — a well, constructed or improved, to provide water for irrigation and livestock in order to enhance natural distribution of grazing or improved vegetative cover.	☐	☑
Irrigation water management — determining and controlling the rate, amount and timing of water applications to supply crop needs in a planned and efficient manner.	☑	☑

MANAGEMENT PRACTICE	NUTRIENTS CONTROLLED: Insoluble (phosphorus/ potassium)	Soluble (nitrogen)
Proper fertilizer application — selecting the proper time and method of fertilizer application to reduce losses through leaching and soil erosion, and ensure adequate crop nutrition.	☐	☑
Slow release fertilizers — use of fertilizers which release nutrients over an extended period of time. Discourages leaching of soluble plant nutrients from the root zone and lessens the likelihood of entry into groundwater.	☐	☑
Soil testing and plant analysis — analysis of soil crop plants to assess the amount of fertilizer and lime that are required for optimum crop growth.	☐	☑
Land absorption areas — vegetated areas used to absorb nutrient-laden liquids from animal production operations. This is one of the least preferred pollution abatement practices because the nutrient resource is wasted rather than utilized.	☐	☑

*Source: An adaptation of "Best Management Practices Handbook, Agriculture," Planning Bulletin 316, Virginia State Water Control Board, 1979.

Table 1. AGRICULTURAL BEST MANAGEMENT PRACTICES GLOSSARY OF TERMS

Section 208 of the Federal Water Pollution Control Act requires the development and implementation of "best management practices" (BMPs) for reducing erosion and runoff from agricultural land. BMPs include both crop and land management practices which help to reduce or prevent nonpoint pollution. Following is a general summary of BMPs, their definitions, and an indication of their effectiveness in preventing the loss of nitrogen, phosphorus and potassium. Actual applicability of these practices depends on the site's soil type, topography, and existing moisture and crop conditions.

MANAGEMENT PRACTICE	NUTRIENTS CONTROLLED: Insoluble (phosphorus/potassium)	NUTRIENTS CONTROLLED: Soluble (nitrogen)
Conservation tillage — any crop tillage method which controls or reduces the amount of runoff and erosion from crop fields.	☑	☑
Chiseling and subsoiling — loosening the soil, without inverting and with a minimum of mixing of the surface soil. Shatters restrictive layers below normal plow depth.	☑	
Listing — plowing and planting are done in the same operation. Plowed soil is pushed into ridges between rows, and seeds are planted in the furrows between the ridges.	☑	☑
No-till or zero tillage — utilizes a fluted coiter or double-disk openers to cut through untilled residues of the previous crop, ahead of the planter shoe.	☑	☑
Plow-plant — crop is planted directly into plowed ground with no secondary tillage. This system increases infiltration and water storage.	☑	☑
Ridge plant — produces a row configuration similar to listing, but planting is done on the ridges year after year, with no seedbed preparation preceding planting.	☑	☑
Strip tillage — narrow strip is tilled with a rototiller gang or other implement. Seed is planted in the same operation.	☑	☑
Sweep tillage — used on small-grain stubble to kill early fall weeds. System shatters and lifts the soil, thus enhancing infiltration while leaving residue in place.	☑	☑
Wheel-track plant — similar to plow-plant, but isn't restricted to freshly plowed ground. Planting is done on wheel tracks of the tractor or planter.	☑	☑
Conservation cropping — stress planting crops in combination with recommended cultural and management practices. Systems should include rotations that contain grasses and legumes, as well as rotations in which the desired benefits are achieved without the use of such crops.	☑	☑
Contour farming — manage sloping, cultivated land in such a way that seedbed preparation, planting, and cultivation are done on the contour.	☑	☑
Cover and green manure crops — use of close-growing grasses, legumes, or small grain for seasonal protection and soil improvement.	☑	☑
Crop residue use — plant residues left after harvest to protect cultivated fields during critical erosion periods when ground would otherwise be bare.	☑	☑
Debris basin — a barrier or dam constructed across a waterway or at other suitable locations to form a silt or sediment basin.	☑	☑
Diversion — a channel with a supporting ridge on the lower side constructed across a slope. Diverts water from areas of excess to sites where it can be used or disposed of safely.	☑	☑
Filter strips — a barrier of perennial vegetation, established or left undisturbed, to filter out sediment from water flowing through vegetation.	☑	☑
Grade stabilization structure — stabilizes a sharp grade or controls head cutting in natural or artificial channels.	☑	☑
Mulching — applying plant residues or other materials, not produced on the site, to the soil surface. Usually done in conjunction with a seeding practice.	☑	☑
Row arrangement — establishing crop rows on planned grades and lengths to provide drainage and erosion control.	☑	☑
Streambank protection — stabilizing and protecting stream banks, excavated channels, and shorelines against erosion, by vegetative or structural means.	☑	☑
Stripcropping — growing crops in a systematic arrangement of strips or bands across a general slope. Crops are arranged so that a strip of grass or close-growing crop is alternated with a clean-tilled crop or fallow.	☑	☑

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Reducing erosion, controlling nutrient runoff, and preserving the soil.

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Factors in Choosing Proper BMPs

There is no such thing as a "universal" best management practice to address all potential nutrient loss situations. This message was emphasized by participants in a research colloquium sponsored by the National Academy of Sciences, on "Agricultural Management to Protect Water Quality." BMPs include management of nutrient use as well as cropping and tillage practices. Choosing the "right" BMP for your farm customer depends on a number of factors.

How to Choose A BMP

There are several key questions to ask before choosing BMPs to reduce water quality concerns. First, what is the nutrient of concern? Nitrate, ammonia, phosphorus? Second, where is the nutrient of concern being transported? A river? A lake? Groundwater? What is the relationship between agriculture's impact on ground and surface water quality? What are major factors that affect nutrient loss from local agricultural land? Soils, geology, rainfall, water conservation, cropping practices and tillage practices? After answering these questions, you can then select the most appropriate BMPs that reduce agriculture's impact on water quality while maintaining the farmer's goal of maximizing economic yield.

Types of BMPs

Nutrient Management Techniques rely on use of soil testing and accounting for all sources of plant nutrients, including contributions from previous crops (such as legumes), and application of manures. In addition, this set of BMPs includes timing applications to coincide with periods of maximum plant uptake and reduced losses from leaching, runoff or volatilization. Placement of nutrients by injection or banding improves plant uptake and reduces the potential for losses to the environment. Other specialized techniques are foliar application, use of nitrification inhibitors and addition of carbon to soils to immobilize residual nitrogen.

The goal of nitrogen management practices is to leave as little residual nitrogen as possible in the soil during the non-cropping period.

Water Conservation aids in reducing loss of nutrients from the plant root zone and, used in conjunction with nutrient application such as chemigation, can help increase plant uptake efficiency. Paying close attention to irrigation scheduling can dramatically reduce nitrate leaching.

Changes in Cropping Practices such as use of cover crops can help reduce soil erosions and, in the case of deep-rooted crops, increase uptake of nitrogen found below the root zone of the predominant crop.

Cropping and Tillage Practices aim to reduce soil erosion and associated nutrient losses as well as to maximize the uptake of nutrients in the soil. Practices include proper timing of crop planting and use of optimum crop variety for the local conditions. Soil erosion control can be accomplished by use of no-till or reduced tillage, terracing, strip cropping, cover crops to reduce rain drop impact, filter strips and set-aside of highly erodible lands.

Clearly, not all BMPs are appropriate to all situations encountered by fertilizer dealers throughout the country. However, careful selection of the proper combination of BMPs will help ensure that you and your farm customer reduce the effect of agriculture on ground and surface water quality through the judicious use of plant nutrients. ■

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Reducing erosion, controlling nutrient runoff, and preserving the soil.

Refocus on Soil Testing — Is It Up to Speed for Today's Needs?

There's a need seen by some soil scientists for a megatrend in agriculture — a re-emphasis on soil testing. Why? Farmers are more concerned than ever about profitability in their crop production programs. Practices involving minimum tillage are growing in popularity. And, in addition, farmers are being made increasingly aware of the public's concern about nutrient contributions from agriculture to surface and groundwater.

Robert A. Bohannon, program leader for soils in USDA's Extension Service, says testing is the first choice as a best management practice to provide guidance in managing both economic and environmental concerns of crop farmers, yet current records suggest that this tool is not being utilized adequately — and technology and education on soil testing may not be keeping up with changing needs.

Bohannon notes that farmers are undertaking major changes in tillage practices which involve management of greater amounts of crop residues for erosion control. "Such a program of residue management and reduced tillage requires a re-examination of many soil fertility considerations," he says. Bohannon adds that crop residues on the surface of the soil, concentration of lime and fertilizer materials at or near the surface, and fertility changes associated with germinating seeds in cold soil are some of the new considerations that face many growers. Soil sampling techniques are undergoing review, he says, because of the changing chemical characteristics of the surface 1 inch to 2 inches of soil in conservation tillage fields.

As in the past, Bohannon says, accurate soil sampling — coupled with a reliable laboratory soil test — is the starting point for fine-tuning a soil fertility and herbicide program. Farmers must continue to place reliance on a sound soil testing plan, he adds, as the basis for fertilizer programs in order to ensure crop profitability.

Sampling Not Widespread

Soil testing is given primary credit for the dramatic growth in fertilizer use over the past century by many in the agricultural sciences. Yet, J. Benton Jones Jr., horticulture professor, University of Georgia, and long-time promoter of improvements in soil testing, estimates that only about one U.S. farmer in 10 regularly tests soil, and fewer than one in 1,000 collects plant tissue for crop nutrient analysis. Both scientists say the numbers of soil samples tested in the United States have stabilized at 3 million to 3.5 million annually over the past several years. Interestingly, the Soviet Union records more than 27 million soil samples tested each year through its state-owned laboratories, according to Bohannon.

Jones also notes a drop in the number of U.S. commercial soil testing laboratories from more than 400 to about 300 in recent years, with one-third located in Illinois — the state with the highest number of soil tests — and California, which has the most tissue tests.

Some farmers still evidence a lack of understanding, Jones says, as to how to use test results for other than nutrient deficiency identification and, to some extent, a lack of total confidence in test results. This means, he says, that there is a continued need for increased attention to uniformity of laboratory procedures and standardization of results, coupled with more effective educational programs for farmers.

Systems Approach Needed

Many farmers have found soil tests to be invaluable guides. They test soils regularly, utilize the same laboratory each time, and keep records so test results and crop yields can be calibrated to their crop production plans. Retailers are playing an expanded role, in many areas, in assisting farmers with such good management practices.

The experience of these farmers can be the commonplace occurrence rather than exceptional success stories, Jones emphasizes, if a complete "system" approach becomes the norm for crop farmers.

"It is the systems approach that makes soil testing and plant analysis results work, based on frequent sampling, identical analysis procedures and tracking of results," Jones emphasizes. "It's the ability of the farmer to customize the analytical result to his own soil-crop management system that makes these tests work."

A Valuable BMP

Both Jones and Bohannon agree that soil testing has yet to realize its full potential in most crop programs. "It's obvious," says Jones, "that there needs to be a significant change and improvement in testing procedures in the laboratory if soil test results and, to some degree, plant analyses are going to be used to their fullest by farmers." The current state of the system provides information on nutrients needed for crop production, Jones says, but is offering little to farmers on how best to use plant nutrients.

Bohannon suggests that soil testing can be utilized as a best management practice and will be increasingly used as such by farmers. "As a BMP, soil testing leads the way to use of the best fertilizer grade, the best fertilization rate, and the best timing for nutrient uptake and use," he concludes. ■

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Minimizing Nitrogen Losses Under Irrigation

by James S. Schepers

Nitrogen fertilizer management and irrigation scheduling practices have been implicated as major factors in nitrate-nitrogen concentrations in streams, rivers and groundwater. These charges are not totally unfounded. Soil percolation of water is a natural process, and some leaching of nitrates probably is inevitable. Research has shown, however, that these losses can be minimized with good N fertilizer and irrigation management.

Excess irrigation or precipitation can carry nitrate deeper into the soil profile. Irrigation scheduling can minimize this percolation during the summer; but precipitation in fall and spring, when plant water demand is low, can result in large amounts of percolation. Therefore, it is critical to manage the amount of nitrates in the root zone. Before soil N can be managed, one must characterize the sources of N and understand how biological, chemical and physical processes interact to supply the plant with nitrate.

Common sources include residual nitrate, N from decomposition of organic residues (mineralization), nitrates in irrigation water and precipitation, and fertilizer N. Fertilizer recommendations typically are based on crop removal, and adjusted downward to account for residual N found in the surface foot. However, subsoil residual N, mineralized N, or nitrate in irrigation water seldom are considered in the recommendations.

Soil Sampling Provides Answers

Residual N can be determined by soil testing. Sampling depth depends on the rooting depth and uniformity of soil texture. Colorado and Nebraska studies indicate that a sampling depth of 2 feet is adequate.

Nitrates in irrigation water may represent a minimal source of plant N, or a substantial one. The amount in pounds of N per acre can be evaluated by multiplying the depth of irrigation water in inches by the nitrate-nitrogen concentration in the water (ppm or mg/L) times 0.227. Use of nitrates by transpiring corn plants in irrigation water or applied through fertigation is probably 50- to 75-percent efficient, similar to that of sidedress N applications. In contrast, preplant N is only 30- to 60-percent efficient.

Evaluating N Management

Mineralization of N functions as a slow release form, and is at optimum levels when soil water content is approximately at field capacity, and soil temperature is about 95 degrees. Mineralization occurs mainly in the surface foot of soil and often is thought to contribute between 2 and 3 percent of the total N found in the organic matter.

Of the various N sources, fertilizer is the only one over which the producer has much control. The key is to use fertilizer to supplement other sources of N while maintaining an adequate supply for the crop.

Each producer must evaluate N management practices in terms of time constraints, what is physically feasible, and the economics of various N fertilizers. For example: An irrigated corn producer in Nebraska wishes to produce 150 bushels per acre. Soil test results show he has 45 pounds per acre of residual N. The "rule-of-thumb" recommendation of 1.2 pounds N to produce one bushel of corn suggests that an additional 135 pounds N per acre is needed. Studies indicate there is likely at least 90 pounds residual N per acre, to a depth of 4 feet, for his soil. Further, mineralization is known to contribute about 135 pounds N per acre over the growing season. In addition, it is estimated that he will need to apply about 10 inches of irrigation water (20 mg/L nitrate-nitrogen) for a total contribution of 45 pounds N per acre. By harvest, the crop has taken up 180 pounds N per acre and produced a 150-bushel yield.

Balancing Plant Needs

Could he attain the same yield with less fertilizer? Summing all the N sources available to the crop in May and June would suggest excess N at that time. Reducing the fertilizer N application to 67 pounds per acre would reduce the supply of plant-available N and also the potential for nitrate leaching. The rapid rate of N uptake during late June, July and early August should not be hindered. This conclusion has been substantiated by studies that seldom show any yield response above the rate of 45 pounds N per acre for this silt loam soil.

The potential for nitrate leaching can be reduced by applying N when crop demand is greatest. This approach usually is restricted where sidedressing is feasible or fertigation can be practiced. Where delayed N application is not possible, the use of nitrification inhibitors can slow the rate of N conversion.

One final consideration for producers whose soils have poor drainage is that of denitrification. This microbial process can be especially important in the spring and fall when soils are very wet.

The potential for N losses may be similar for many soils, but denitrification losses do not threaten the quality of the groundwater; however, both leaching and denitrification represent an economic loss to the producer that can be minimized by good N management. ■

Dr. Schepers, soil scientist, Agricultural Research Service, U.S. Department of Agriculture, is stationed at the University of Nebraska, Lincoln.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Handling Wastewater from Washing Fertilizer Applicators

Wastewater from washing fertilizer applicators is often identified as a potential avoidable source of environmental contamination. Unlike most best management practices, controlling wastewater is *your* responsibility.

Wastewater from washing applicators may contain corrosive chemicals (mineral acids or fluorides), nutrients (nitrogen or phosphorus), or crop protection chemicals. Depending on local laws and regulations, wastewater containing such materials may be classified as hazardous and be subject to regulatory programs to protect the environment.

Increased awareness over the potential hazards of such wastewater has led to new regulatory programs to control these wastes, acccelerating the development of more sophisticated catchment systems for equipment washdown operations. These systems usually incorporate an impervious pad with a central collection system. The collection system consists of a lined impoundment, underground tank(s), or a sump with piping to above-ground tank(s). If not handled in accordance with applicable regulations, the collected wastewater must be discarded because it cannot be reused in the on-site processes or products. As a discarded material, the wastewater may be subject to a substantial number of restrictions with respect to its treatment, storage and handling, as well as disposal. The costs associated with handling or disposing of wastewater increase dramatically under the regulatory programs.

Alternatives to Collecting Wastewater for Disposal

Fertilizer distributors are developing both methods of reducing the volume of wastewater from equipment washing, and enabling systems to recycle water from equipment washing. Minimizing waste generation allows fertilizer dealers to avoid the difficulty of finding environmentally acceptable, cost-effective methods of handling the wastewater.

Four wastewater volume reduction techniques can be applied to most fertilizer operations. First, planning applications of fertilizers to increase the uniformity in applications. Emphasis is placed on applying materials to a single crop before switching to a second crop. This reduces the number of times that an applicator must be washed. Secondly, reducing "haul-back" of unused materials. Less material remaining in the applicator requires less water to clean up *and* results in fewer pounds of contaminants in the wastewater. Third, reducing volume of wash water used to routinely clean applicators. Fourth, performing "in-field" washing of the applicator, and disposing of the wash water onto the crop.

For facilities that use water in the process, methods have been devised to maximize reuse of wastewater from equipment washing. Wash water from equipment washing is collected in separate catchment systems. That is, the wastewater from a corn application is segregated from a soybean application's wastewater. The wash water is then used as make-up water for the process.

Outlook for The Future

Regulatory agencies are becoming increasingly critical of wastewater storage systems which have a significant potential to leak. Efforts are underway to restrict the use of unlined ponds, requiring installation of expensive liners and monitoring wells. Alternatively, a pond may be constructed with a double liner with a leak-detection system between the liners.

Underground storage tanks are also considered a high risk to groundwater. Federal law currently prohibits the use of "bare steel" tanks in many situations. New underground tanks are required to have corrosion protection, and requirements for leak-detection systems are under consideration.

Thus, the future for inexpensive storage of waste materials — such as wastewater from applicator washing — contains few options. Many of yesterday's solutions, such as ponds and underground tanks, are under critical review, and new facilities of this type are often discouraged, if not banned. The best solution is to avoid producing or storing wastewater from applicator washing at the fertilizer site. Where field washing is impractical, it is important to develop management practices to reduce the volume of wastewater generated. ■

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Helping Customers Achieve Greater Efficiency

by Jack V. Baird

The previous installments of this department have emphasized ways of maximizing fertilizer use efficiency while reducing non-point source pollution, a mandate of the federal Water Pollution Control Act. While crop and livestock producers are adapting past practices to comply with this responsibility, retailers have another opportunity to offer valuable assistance to farmers in their trade area.

We're all mindful of the economic stress that farm families are currently experiencing. They're struggling to survive in a climate of surplus production, weak market prices, and bearish prospects for expanded exports. Many retailers are also struggling amid this environment. Only by maintaining profitability can farmers be expected to give serious attention to reducing erosion and controlling runoff.

What Limits Crop Yields

As a retailer, your greatest opportunities for helping farmers are through strategies that maximize net returns and minimize per-unit costs. As growers make plans for the coming crop year, you can play an important role in identifying past reasons for yield shortfalls.

As a North Carolina extension specialist for more than 20 years, I've catalogued a list of the most common factors that limit yields:

■Ineffective supplemental water management in limited rainfall regions. Many growers fail to consider water use efficiency.

■Inadequate, non-uniform, or excessive plant populations. Mid-season stand counts can guide growers in determining optimum populations for the following year.

■Intensive farming on marginal land. Forage crops can reduce erosion potential and likely increase net profits.

■Inadequate scouting and crop management. A competent pest management advisor often pays for himself in yield savings.

■Inattention to changes in soil pH, causing reduced fertilizer efficiency and plant growth. Many plant growth problems in the Southeast are due to low soil pH.

■Untimely delays in crop planting dates.

■Excessive soil compaction from heavy equipment, which can reduce root development, water and nutrient uptake, or encourage excessive runoff.

■Damaging soil and water losses caused by heavy rains, an excessively high water table, or poorly channeled artificial drainage. Simple in-field diversion devices could reduce runoff dramatically.

■Inappropriate ratio of fertilizer-supplied nutrients, inadequate nutrients, or even excessive nutrients. A program of periodic soil testing (at least once every three years) routinely identifies such problems.

■Poorly adapted crop varieties. Results from local field trials can serve as valuable selection information.

Discuss these potential limiting factors with your customers. If you're planning a grower meeting this winter, include a second return card along with the invitation, asking them to list in order of priority what they believe to have limited '85 yields. Keep the reply card anonymous to encourage frank comments. From this array of responses, three to five problems will probably emerge as the most common yield limiters. Then, with help from local extension agents, area crop consultants, or other respected agronomists, develop a program for trouble-shooting the most frequently cited yield problems. Also, consider organizing a panel of area farmers for a "give and take" discussion of these concerns.

A second thrust for achieving greater profits is to reduce unit production costs. On the same survey card mentioned earlier, or one to be passed out during a farmer meeting, ask your customers to list per-unit production costs for the crops they grow. Sharing these anonymous figures during a customer meeting can help farmers assess their competitive position. Many industrial firms evaluate unit costs and continually strive to reduce them.

The more financial, advisory, or technical support your customers are exposed to, the better prepared they'll be to face adversity. Challenging customers to bolster their efficiency enhances your credibility. Only through striving for constant improvement can farmers expect to remain competitive — and profitable. Decisions aimed at maximizing production, while holding down unit costs, also instill lender confidence and support.

Some level of government assistance will undoubtedly be available for severely stressed farmers, however least-cost production strategies will always offer the best long-term hope for sustaining agriculture. ■

Jack V. Baird is an extension soils specialist at North Carolina State University in Raleigh.

PRESENTATION TO THE SENATE COMMITTEE ON AGRICULTURE

March 29, 1988

By

DeVern H. Phillips, State Sealer

Good morning Mr. Chairman, and Members of the Senate Agriculture Committee. My name is DeVern H. Phillips, State Sealer. I am responsible for the enforcement of Kansas Weights and Measures laws which includes vehicle tank meter testing and liquefied petroleum meter testing.

The Agency is here to address our position on Senate Bill 2965 regarding modification of existing law which will provide for annual testing of liquefied petroleum dispensing devices.

This proposed modification of the existing Vehicle Tank Meter (VTM) Law would include those meters dispensing liquefied petroleum gas (LPG). This would require the owner/operators of LPG meters (of which there are 634 devices), to have annual testing by a licensed service company of their meters as is now required of VTM owner/operators (of which there are more than 1,000).

LPG metering devices are presently being tested on an annual basis by Kansas Weights and Measures at no charge to the device owner/operator. All repairs or calibrations of the equipment must be done by commercial service companies. Device owner/operators have found that 99% of the mechanical errors in these devices favor the customer and not the device owner/operator. The majority of these device owners are presently using commercial service companies to maintain accuracy of these devices since Kansas Weights and Measures no longer adjusts meters.

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Since the change to commercial companies working on these devices in 1986, accuracy has risen from 70% when Kansas Weights and Measures adjusted these devices, to its present 93% when tested and calibrated by licensed service companies.

The fiscal impact to owner/operators of LPG meters will be minimal since the adjustment and repairs required on these devices must now be performed by commercial service companies. There will be no additional costs to the Kansas Weights and Measures Program.

Service companies that test and service vehicle tank meters are required to be licensed by Kansas Weights and Measures. They must maintain standards of performance set by Kansas Weights and Measures. This is done to assure the industries serviced by the vehicle tank meter repair companies that only competent service technicians are permitted to work on their equipment. These service companies pay an annual licensing fee of $50.00 to operate in the State of Kansas and must meet other criteria to operate in Kansas.

Service companies operating in Kansas that work only on LPG meters must meet none of the requirements under existing law, but enactment of Senate Bill 2965 would correct this deficiency.

Kansas Weights and Measures has had exceptional success with variable frequency testing of large capacity scales. Variable frequency testing permits us to monitor the service companies working on devices.

By proper utilization of our testing equipment and using one existing inspector, we will be able to utilize variable frequency testing with the vehicle tank meter testing program and the liquefied petroleum testing program. A proven monitoring program of the service companies will be established, and a more efficient and equitable program will exist.

WRITTEN STATEMENT

By The

KANSAS LP-GAS ASSOCIATION

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Concerning House Bill 2965
regulating testing services for
dispensing devices and
providing for the testing of
liquefied petroleum dispensing
devices.

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Submitted to the Senate Agriculture Committee
Senator Jim Allen, Chairman
Tuesday, March 29, 1988

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MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I am Lee Eisenhauer, Executive Vice-President of the Kansas LP-Gas Association. Due to an out-of-town commitment preventing personal presentation, please accept this written, brief comment on House Bill 2965, on behalf of our member LP-gas dealers and dispensing device service companies who are associate members of the Kansas LP-Gas Association.

Until recently, liquefied petroleum gas dispensing devices were tested and kept in proper adjustment and repair through the services of the state sealer or deputy state sealer of the Kansas Department of Agriculture's Weights and Measures Division. With the discontinuance of this service necessitating reliance on private dispensing device companies, the licensing and monitoring of such companies and their registered technical representatives is extremely important. We appreciate the

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(more)

Weights and Measures Division's concerns in setting forth the licensing and testing requirements.

The dispensing device service companies who are associate members of KLPGA have no objection to the requirements of House Bill 2965.

Section 3 (a) of the bill, lines 114 thru 131, sets forth the requirements of yearly testing of dispensing devices. Although not all of our member dealers are pleased with this requirement, we would not oppose the regulation, with the accuracy of the testing services certified by the state sealer.

Thank you, Mr. Chairman and members of the committee, for your time and consideration.

# # # # # # # # # #

As Amended by House Committee

Session of 1988

HOUSE BILL No. 2966

By Committee on Agriculture and Small Business

2-16

AN ACT relating to the farm assistance, counseling and training referral program; amending K.S.A. 1987 Supp. 74-545 and repealing the existing section.

Be it enacted by the Legislature of the State of Kansas:

Section 1. K.S.A. 1987 Supp. 74-545 is hereby amended to read as follows: 74-545. (a) The secretary of the state board of agriculture with the cooperation of the director of extension of Kansas state university shall coordinate a farm assistance, counseling and training referral program. For the purposes of providing such assistance and program, the secretary shall utilize the services of the director and division of extension of Kansas state university, other state agencies, county extension personnel, municipal and community services organizations and personnel and private business and professional agencies or services available for such purpose. The secretary shall compile a directory of programs and services which may be utilized in providing the assistance contemplated by this act. Staff required by the secretary for the purposes of implementing this act shall be employed by the secretary with the approval of the director of extension and shall serve in the offices of the division of extension at Kansas state university. Personnel employed by the secretary for the purpose of implementing this act shall be employed as special project employees and shall be in the unclassified service under the Kansas civil service act. The personnel employed by the secretary for this purpose and county extension personnel shall be utilized in: (1) Receiving requests for assistance; (2) determining the eligibility of persons requesting assistance; and (3) determining if such assistance can best be provided by staff or

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by referral to an appropriate public or private agency or party for direct assistance. Personnel receiving requests for assistance will provide where possible such assistance or refer the person requesting such assistance to an agency or person qualified to provide such assistance in the home community or county of the person requesting such assistance.

(b) Persons shall be eligible to receive assistance pursuant to this act if they: (1) Are primarily engaged in the business of farming, ranching, agribusiness or other agriculture-related activities; and (2) will be unable to continue in such business or activity or be seriously handicapped in such continued operation without the assistance provided pursuant to this act.

(c) The assistance to be made available to eligible persons by staff, *by contract* or by referral to appropriate persons or agencies shall include farm management, legal assistance, *legal advice and referrals*, financial planning, employment services, business planning ~~and other~~, voluntary mediation~~,~~ and personal and family support counseling ~~*and other related services*~~. The secretary may provide legal assistance through a contract for legal services with any private or corporate law firm.

(d) Meetings in which mediation assistance is provided through the voluntary mediation service authorized under subsection (c) shall be closed and shall not be subject to the provisions of K.S.A. 75-4317 to 75-4320, inclusive, and amendments thereto. The record of information relating to the finances of individual borrowers and creditors created, collected and maintained by the mediation service shall not constitute a public record and shall not be open for inspection under the open records act. Mediation sessions shall be confidential and the secretary shall ensure that all lenders and borrowers of agricultural loans receive adequate notification of the mediation service.

~~*(d)*~~ **(e)** *The secretary is hereby authorized to negotiate and enter into contracts for the performance of the powers, duties and functions of the program established under this section and under K.S.A. 74-544 and amendments thereto. All such contracts shall be exempt from the competitive bid requirements of K.S.A.*

75-3739 *and amendments thereto.*

~~(e)~~ (f) *The secretary is hereby authorized to receive grants, gifts or donations from the United States government, or its agencies, or any other source whatsoever for the purposes of the program established under this section and under K.S.A. 74-544 and amendments thereto, and any moneys so received shall be deposited in the state treasury and credited to the FACTS gifts and contributions fund which is hereby created. All expenditures from such fund shall be made in accordance with appropriation acts upon warrants of the director of accounts and reports issued pursuant to vouchers approved by the secretary of the state board of agriculture or a person designated by the secretary.*

~~(d)~~ ~~(f)~~ (g) The provisions of this act shall expire on July 1, 1990.

Sec. 2. K.S.A. 1987 Supp. 74-545 is hereby repealed.

Sec. 3. This act shall take effect and be in force from and after its publication in the Kansas register.

A creditor of a farm borrower, when notifying a farm borrower of intent to accelerate or call such note or, in the event none of the above notices has occurred, before filing suit to foreclose on a deed of trust or mortgage on agricultural land, shall notify the borrower of the availability of the mediation service as contracted by the secretary, and shall prominently include on or with the notice the address and telephone number of such mediation service unless the borrower and creditor have previously been involved with each other in mediation through such mediation service. A copy of the notice, including names, addresses and phone numbers of creditor and borrower, shall be sent to the mediation service at the same time it is mailed to the borrower, if the borrower consents thereto in writing.

(h)

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Fall Fertilizer Application Guidelines

by Gary W. Colliver

Applying fertilizer in the fall can benefit both you and your customers. Adequate product supplies are generally assured, costs are often lower than those during the spring sales season, and soils are usually drier and less susceptible to compaction. Moreover, fall fertilization spreads out application labor requirements and allows for more timely spring planting.

However, such benefits can be overshadowed by concern over misapplication and the potential risks of nutrient runoff and leaching losses. Fertilizer retailers can play an integral role in ensuring that fall nutrient applications are both agronomically and environmentally sound by observing the following application guidelines.

Consider Field Characteristics

Begin by determining the slopes in the fields scheduled for application. (Example: A 5-percent slope equals a five-foot change in elevation over a 100-foot distance.) If the slope is 2 percent or less, no water erosion loss problems are likely. If slopes range from 6 to 8 percent, nutrient runoff risks are minimal, provided that adequate physical barriers are in place to prevent surface washing. Such barriers include heavy stalk residues, forage crops, or terraces.

Slopes greater than 8 percent pose significant runoff potential and should not receive fall fertilizer applications unless the slopes are very short or in an area of low rainfall. If wind erosion is a problem, discourage fall nutrient applications unless customers implement an effective control plan, such as seeding a winter cover crop.

Fall-applied fertilizer should be incorporated even where erosion is not a problem. If tillage is not practical, then apply only where erosion potential is minimal. Also, avoid making applications on soils subject to flooding or poor drainage, such as bottomland clay soils.

Conversely, sandy soils encourage leaching and should not receive fall applications of mobile nutrients, such as nitrogen and potash. Follow similar precautions for secondary and micronutrients.

Nitrogen Poses Greatest Concern

If urea is used in fall applications, incorporate it into the soil to minimize volatilization losses. In addition, the microbes responsible for converting ammonia nitrogen into the more mobile and leachable nitrate form remain active at soil temperatures greater than 50 degrees. Thus, avoid applying nitrogen until the soil at 4 inches deep has dropped below this temperature.

If nitrification inhibitors are used in combination with anhydrous ammonia, applications can likely begin at soil temperatures up to 60 degrees without risk of microbial activity. In some temperate growing regions, nitrification inhibitors are recommended with fall nitrogen fertilization, regardless of the temperature at application time.

In the western Corn Belt and the Great Plains, fall nitrogen can be applied under warmer conditions with less risk of denitrification or leaching losses, due to the regions' relatively dry climates. In the more southern areas, where cold soil temperatures are short-term, fall nitrogen applications are not advisable for summer row crops. Finally, discourage fall applications on soils subject to flooding or with poor internal drainage.

Dryland Wheat Applications

In the wheat growing regions of the Pacific Northwest, precipitation is generally much less than in the temperate Midwest, thus greatly reducing nitrogen losses. Also, wheat produces most of its growth during the spring when fields are apt to be at their greatest moisture level. These factors combine to make fall nitrogen applications very beneficial. In fact, the majority of crop nitrogen needs are applied in late summer and early fall in the dry, low elevation growing regions.

In the central United States, fall applications should be adjusted according to differences in both temperature and rainfall. For southern Missouri, southern Illinois and points south — where winter temperatures are mild and rainfall high — fall nitrogen applications on wheat are discouraged. In these areas, encourage customers to limit nitrogen applications to minimum amounts at planting, and topdress the remainder in late winter.

For areas north — where moisture accumulations remain high, but winter temperatures are lower — fall nitrogen applications are less prone to denitrification losses. In addition, current research shows that urea, ammonium ni-

trate, and UAN solution are equally effective sources of nitrogen for top-dressing wheat during winter.

Forage Crops Favor Applications

Hay and pasture crops offer important ground cover protection, presenting fewer runoff and erosion concerns. In most instances, forage crops can be fertilized from early fall to late spring.

Fall is an excellent time to apply phosphate and potash, especially on legume crops, such as alfalfa. Fall nutrient applications can greatly improve winter survival and encourage early regrowth in the spring. Supplemental nitrogen applications on cool season grasses can also produce excellent fall growth for fall and winter pasture. Moreover, erosion and run-off losses are less likely on good forage stands, so steeper slopes can be fertilized safely, compared to row crop land.

Poor Absorption During Winter

Fertilizer applied to bare, frozen fields is often lost through wind and water erosion before it can be incorporated into the soil by tillage or rainfall. However, if the soil is not frozen, fertilizer can be applied according to fall fertilization guidelines. In addition, supplemental nutrients can be applied on a light snow cover if the underlying soil is not frozen. Fertilizer melts through to the soil surface and moves into the soil as the snow melts.

Although the previously mentioned guidelines offer effective overall advice, application rates should always be based on recommendations derived through a complete soil testing program. If recent soil test data are unavailable, insist on sampling customer fields before making recommendations.

Matching applications to actual crop needs minimizes the potential of excess nutrients that are subject to losses. Adopting such an integrated approach benefits both you and your customers by addressing public concern over nutrient runoff and assisting growers in producing maximum economic yields. ■

Gary Colliver is a chief agronomist in the fertilizer and ag chemical division of Farmland Industries, Kansas City, Mo.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Containing Fertilizer Spills at Retail Outlets

by Sheila Blower Lang

Minor product spills unfortunately do occur at retail fertilizer facilities. Not long ago, most spills were considered insignificant. Even their cumulative effect created little concern.

Increased public awareness over the hazards of such spills has fostered a new generation of environmental legislation. Urban and rural residents alike have become increasingly concerned that material spills may eventually make their way into surface or groundwater if it cannot be assimilated by the soil. Many segments of the fertilizer industry are recognizing that economics favor a preventive attitude toward environmental contamination.

Moreover, concern about injury to community relations, fines, and potential jail sentences have prompted increased vigilance among dealers.

As a retailer, you should also strive to control spills and assure compliance with environmental regulations. For some, compliance may require waiving operational convenience in order to reduce contamination hazards.

Transfer Losses Lead Concern

Fluid fertilizer spills can be traced to three major sources in the liquid fertilizer storage area: receiving operations, loading operations, and tank failure. One of the most frequent sources of product loss occurs when supply trucks disconnect their fill hoses from storage tanks.

Evidence of such spills often shows up as an absence of vegetation in the vicinity of liquid fertilizer storage tanks due to excessive nutrient levels. This unprotected soil is subject to erosion and can result in clogged catch basins and sedimentation of tile and ditch lines. An economical solution to transfer spills is to install a permanently connected hose with a check valve and adapters for transfer trucks. Additional valves strategically placed within the manifold system allow operators to use one pump for several different fertilizer blends without changing hoses.

Inspect Tank Valves

Preventing spills caused by tank failure can require a more substantial financial commitment. First, ensure that all tank openings are equipped with stainless steel or victaulic valves and plugs, and insist on a minimum number of openings for each tank. It's also a good practice to require that all tank valves be locked when not in use.

Guidelines For Diking

Many state environmental agencies have encouraged fertilizer retailers to install dikes following spill incidents. However, these agencies seldom offer advice or construction guidelines for dikes and retaining walls.

Achieving the greatest level of overall protection requires an evaluation as to where spills are most apt to occur, and their effect on the surrounding environment. All dikes should be large enough to prevent material from simply squirting across them.

In the Midwest, dike bases should be constructed of impervious clay with a 1-percent slope to a sump pit (making up the difference in grade with a washed gravel pad). The inside walls of the dike should also be covered with two inches of washed gravel to maintain moisture and thus prevent cracking during dry weather. Periodic pumping of stormwater accumulations must be a conscious decision based on the likelihood of contaminants present in the waste water.

Dry Products Present Less Risks

The potential for environmental contamination through dry fertilizer storage and handling is much less compared to liquid fertilizers.

One area, however, where dry fertilizer handling has posed a problem is in controlling dust from load-out chutes. Mechanically operated extendable shrouds are effective for large manufacturing facilities. Yet, their initial cost and maintenance expense make them impractical for the average dealer. The extendable shroud concept is simple: A weighted canvas tube is attached around the load-out chute by two nylon cords. The cords are secured to the chute with eye hooks. At optimum height the cords are joined at a small ring. The ring is then attached to a crank to raise and lower the shroud. Keeping the shroud as close as possible to the spreader hopper reduces material drift.

The preceeding represents a broad sampling of alternatives for preventing and containing fertilizer spills. Remember to consult the appropriate state or federal agency in your area for construction standards before attempting to comply with spill-way requirements.

Your willingness to implement recommended containment facilities bolsters your company's image as a responsible member of the community, and reduces the likelihood of future penalties for noncompliance. ■

Sheila Lang is manager of environmental affairs with Terra Chemicals International in Lima, Ohio.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Cutting Leaching Losses During Irrigation

by Gary W. Hergert
and
Norman L. Klocke

According to the latest agriculture census, American farmers utilize irrigation on more than 49 million acres of cropland annually.

In most regions where irrigation supplements rainfall, water applications should be matched to a crop's actual moisture needs because no minimum level of leaching is needed to restrict salt accumulations. Indeed, growers should take steps to minimize leaching, since it's often responsible for nitrogen losses.

Although nitrogen may be applied in different forms, such as nitrate, ammonium, ammonia or urea, nearly all nitrogen is eventually converted to nitrate by soil microbes. Nitrate nitrogen is the most mobile of the three primary nutrients—and is often lost from the root zone by leaching and denitrification.

Assessing Nitrogen Needs

Many soil testing laboratories base recommendations for supplemental nitrogen on the customer's stated yield goal, local growing conditions, and level of management. Combining these recommendations with proper irrigation management enables farmers to achieve their production goals with minimum risk of nutrient leaching and denitrification.

Your goal in providing nitrogen management advice for crops produced under irrigated agriculture should be to recommend sufficient nitrogen to ensure the potential for maximum economic yields while minimizing nitrate carryover in the soil. To accomplish this goal, consider the following:

- Encouraging the customer to set realistic yield goals based on previous yield averages;
- Measuring all sources of nitrogen, including residual soil nitrate at depths to 4 feet, nitrogen supplied through legumes or manure, and nitrogen applied through irrigation water;
- Ensuring that the total amount of supplied nitrogen doesn't exceed crop yield requirements;
- Using fertilizer application methods, such as band injection, that encourage efficient plant utilization;
- Considering nitrification inhibitors to maximize nitrogen availability during the growing season; and
- Scheduling irrigation application rates and timing to reduce fertilizer susceptibility to leaching.

Nitrogen management is only part of an overall program. Proper management also requires a complete understanding of irrigation principles.

Maturity Affects Moisture Use

Crop water requirements depend on both soil evaporation and plant transpiration. Early in the season, soil evaporation is the primary factor in moisture loss.

As the crop continues to grow, shading reduces evaporation, and transpiration becomes dominant. The peak water use period for corn, wheat, grain sorghum, and soybeans occurs during pollination. Crop moisture needs decline somewhat during grain filling, but are still important in determining ultimate yield levels.

Your customers' ability to maintain awareness of field soil moisture status depends on frequent field monitoring. Assessing soil moisture—with a soil probe, by hand examination, or other soil moisture monitoring equipment—is essential.

Determining Irrigation Rates

A soil's water-holding capacity varies according to soil type. *Table 1* illustrates the difference between sandy and clay soil's ability to store plant-available water. Grower knowledge of such information is important when determining irrigation applications.

For example, if an irrigator applied 1½ inches of water on a field whose maximum holding capacity was only 1 inch of water, leaching would likely occur.

When all these factors are considered together, your customers will be able to balance stored soil moisture, rainfall, and irrigation water with crop moisture needs—maximizing yield capacity with a minimum of nutrient loss. ■

Soils specialist Gary Hergert and agricultural engineer Norman Klocke are with the University of Nebraska West Central Research and Extension Center in North Platte.

Table 1. Plant Available Water Capacity For Soils.

Soil texture	Available water in./ft.*
Fine sand or loamy sand	1.0 to 1.1
Sandy loam	1.4
Loam or silt loam	2.0 to 2.5
Silty clay loam or clay loam	1.8

*Inches of water per foot of soil.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Matching Tillage Practices to Field Conditions

by

Dave M. Van Doren, Jr.

Reduced tillage systems can provide impressive results in controlling erosion, but they can also adversely affect yields if not matched to specific soil and growing conditions.

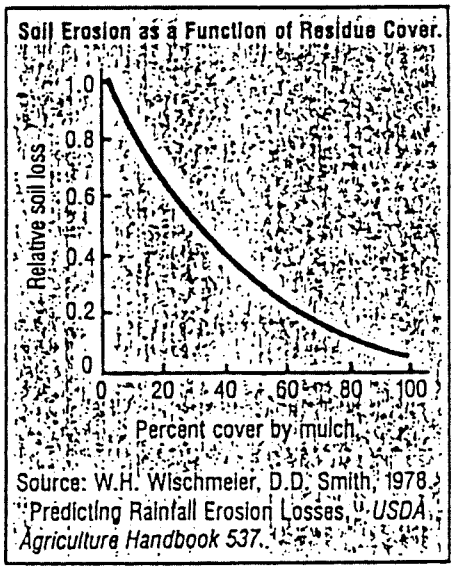
Conservation tillage's most widely recognized drawing card is in checking runoff. This orientation toward tillage also benefits water quality by reducing sediment and nutrient runoff into area lakes and streams. In the process, your customers can realize lower energy costs and require less field preparation time, depending on the specific tillage alternative they choose.

Yet, in order for any form of conservation tillage to attract farmer participation, it must also produce yields that are comparable to those achieved through conventional tillage. Much confusion exists over selecting the appropriate tillage alternative. For example, a field plagued with serious compaction problems could suffer greater runoff losses if farmed under no-till than if chisel plowed. Conversely, a soil that is easily crusted by rain probably will experience less runoff under a no-till system.

Increased yields under conservation tillage are quite likely when practiced on moderate to well-drained soils. Such soils often have permeable profiles or slopes which encourage runoff. The greatest benefits from conservation tillage are usually realized on sloping soils (greater than 3 percent) where erosion causes yield losses.

In addition to protection against erosion, soil moisture loss is less significant with residue cover. This can be particularly important, even in the semi-humid areas of moisture stress. Depending on actual water savings and the time of stress, yield increases up to 40 bushels per acre have been reported for no-till corn, when compared to conventionally tilled fields.

Conservation tillage also has limits on its capacity to prevent erosion. For example, slopes that exceed 12 to 15 percent require a minimum residue cover of 85 percent for sufficient protection. It's nearly impossible to provide this level of cover using a disk or chisel plow. On the other hand, a no-till program could provide the necessary cover.



Source: W.H. Wischmeier, D.D. Smith, 1978. Predicting Rainfall Erosion Losses, USDA Agriculture Handbook 537.

Any one field characteristic seldom points to the use of one tillage system over another. In practice, many farmers find the slope of a field will often favor one form of tillage while its soil structure suggests another. As a result, conservation tillage programs must often be combined and altered to respond effectively to individual characteristics. The following are frequently used methods:

- *Plow plant and wheel-track planting* use a moldboard plow, but limit all secondary tillage to a narrow band within the planted row. These options are best suited to soils with a stable clod structure and on slopes less than 8 to 10 percent. Still, they are generally not as effective as less intensive practices which leave residues on the soil surface.
- *Disking and sweep tillage* rely on natural crop residue cover for erosion control. This alternative involves fewer trips across the field, thus leaving surface plant residue intact, regardless of the shape or action of the tillage tools used.
- *Chiseling, listing, and ridge planting* rely on both a rough soil surface and residue cover for erosion control, with residues generally most important. Listing is popular in low rainfall areas because it concentrates soil moisture near the crop row. Ridge planting is used in higher rainfall areas to keep excess water away from plants early in the growing season.

Farmers can combine still other tillage alternatives to enhance runoff protection. Contour farming, for example, provides the greatest erosion benefits when combined with plow planting, wheel-track planting, chiseling, and especially listing and ridging. ■

Dr. Van Doren is a professor of agronomy at the Ohio State University, Ohio Agricultural Research and Development Center, Wooster.

Best Management Practices

Fertilizer Timing And Placement Management

by L.F. Welch

While most agronomists agree that the plant residues which accompany high crop yields reduce erosion losses, ensuring efficient nutrient use under high production systems demands strict attention to fertility management. Haphazard applications of fertilizer with little regard for potential runoff or leaching can result in costly nutrient losses.

Tailor Application to Conditions

Fertilizer must be present in a chemically available form if it is to be effective. Several factors should be evaluated when calculating the rate, method, and timing of fertilizer applications. These considerations vary among geographical areas and between fields within a farm. However, this is one primary area that you, as a local fertilizer supplier, can play an important role in encouraging proper fertilizer use.

Your customers' management practices determine nutrient efficiency and profit. Supplemental fertilizer applications cannot increase yields unless they are absorbed by the crop. And, efficient absorption cannot occur when nutrients are lost from the root zone through leaching or runoff. Proper timing and placement of fertilizer determines whether nutrients will be present when needed by the crop. This is especially true for immobile nutrients such as phosphorus and potassium.

Moisture Affects Availability

Phosphate and potash availability are also influenced by soil moisture conditions—with moist soils enhancing availability. Therefore, surface incorporation, 4 to 6 inches deep, encourages more efficient utilization by the crop. In addition, phosphate and potash losses are closely tied to soil erosion. As a result, it is important to encourage rapid incorporation of surface applications on highly erosive soils. Although well-drained, relatively flat fields can receive supplemental fertilizer through surface applications without substantial runoff risks, such applications should be incorporated when applied in the fall. Nutrient loss through soil runoff becomes magnified under intense production systems.

Concern over application timing assumes even greater importance with nitrogen. Nitrogen losses can occur through leaching, denitrification, and chemical volatilization. Leaching and denitrification occur only when nitrogen is present in the nitrate form.

Any management technique that would prevent nitrogen from changing to the nitrate form reduces the probability of loss. Your customers can accomplish this by reducing the interval between application and absorption by the crop, applying nitrogen in a form other than nitrate, or through the use of nitrification inhibitors.

Curbing Volatilization Losses

Ammonia volatilization occurs when nitrogen reacts to become ammonia gas. Urea and urea-containing materials, are most likely to be lost through volatilization when weather is warm and dry after application. Anhydrous ammonia losses can be minimized by following recommended injection practices and ensuring a proper soil seal as the injector knife passes through the soil. Urea may not necessarily be lost if applied as a surface application, however incorporation minimizes the possibility of loss. Again, any management practice that reduces losses will result in greater efficiency.

Farmer purchases of fertilizer which are designed to replace excessive nutrient leaching reduce their ability to produce crops profitably, and ultimately their capacity to compete in the marketplace. Moreover, growing public concern over agricultural runoff could prompt restrictions on crop production practices governing fertilizer use. In the end, you'll help ensure the long-term viability of your business and that of your customers. ■

L.F. Welch is a professor of soil fertility at the University of Illinois, Urbana-Champaign.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Slowing Nutrient Losses With Covers and Residue

by K. L. Wells

Retail agricultural suppliers have long been recognized by educators as strong influencers of farmer crop production practices. This stands to reason, since you're often called upon to provide agronomic advice as well as the products you market.

Increased public concern over the effects of nutrient runoff and soil erosion offers an ideal opportunity for you to position your dealership as a responsible supplier of crop production inputs. In addition, such an approach helps to preserve valuable topsoil, and eliminates the need for stringent governmental regulations.

Current government programs are aimed at controlling nonpoint pollution through voluntary adoption of management practices which discourage runoff and erosion. In Kentucky, where 75 percent of cropland is subject to some degree of erosion, proper management of residues can serve as an effective, low-cost method of reducing nutrient and soil losses.

But, topsoil losses threaten the productivity of cropland nationwide. An increased farmer emphasis on proper residue management is in your interest. Your support of cultural practices which minimize runoff helps to ensure that the products you sell remain in fields where they're applied rather than collecting in streams.

The following crop residue management guidelines are provided to increase your familiarity with more technical information concerning their use, and to encourage you to offer similar advice to your customers.

Ensuring Adequate Cover

The goal of residue management is to maintain sufficient cover, thereby discouraging the erosive effects of wind and water. Crop residues enhance water infiltration and reduce surface runoff. In the same way, residues help to hold soil in place and protect it from the stripping action of strong winds. The significance of maintaining crop residues is shown in *Table 1*.

These data help illustrate the two extremes of surface residues. Virtually no erosion losses occurred when crop residues were allowed to remain on the soil surface year-round, while per-acre erosion losses under conventional tillage ranged from 3 tons annually on a 5-percent slope to nearly 8.5 tons on a 9-percent slope.

Data in *Table 2* illustrate the extent of losses in terms of nutrient depletion.

The nutrient content of sediments which wash from a field is often greater than that of the surface soil which remains behind. Even at what could be considered a tolerable range of sediment loss (3 to 5 tons per acre per year), nutrients can be lost at per-acre levels of 15 to 30 pounds of nitrogen; 6 to 10 pounds of phosphate; 5 to 8 pounds of potash; and 90 to 150 pounds of calcium and magnesium.

What's more, it may have taken a 10-pound application of phosphate and an 8-pound application of potash to provide a 1-pound soil test of each of these nutrients. Typical erosion losses (3 to 5 tons of sediment per acre) would require annual fertilizer applications of 50 to 100 pounds of phosphate and 30 to 70 pounds of potash just to replace the amount carried away through runoff. So, protection against surface erosion is worth your customer's time, even if only for the value of the nutrients they would otherwise need to replace.

Still, the impact of topsoil loss is perhaps even more important to the long-term yield potential of many upland soils, particularly those with poor underlying layers. One recent yield study showed that typical erosion losses on cropland with a 5-percent slope cut yields 12 bushels per acre. In addition, soil water-holding capacity decreased 6 percent.

Preserving Surface Residues

Maintaining the protective effects of crop residues on sloping fields requires

Table 1. Soil loss as a function of tillage systems.

Surface residue management	Crop system	Soil loss (T/A/Yr)* 5% slope	9% slope
Conventional tillage	Wheat/corn, doublecropped	3.04	8.42
No-tillage	Wheat/corn, doublecropped	0.34	0.54
No-tillage	Continuous corn	0.25	0.36

*Averaged data collected over four years.
Source: Gard, L.E. 1973. University of Illinois, Dixon Springs Agricultural Center.

Table 2. Typical nutrient composition of eroded soil.

Component	Pounds per ton contained in: Surface soil	Material eroded from surface
Organic matter	67	83
Total nitrogen	3	5.5
Available P_2O_5	1	1.9
Available K_2O	0.2	1.5
Available $CaCO_3$ and $MgCO_3$	20	30

Stoltenberg and White, 1953. *Selective Loss of Nutrients by Erosion.* Soil Science Society of America Proceedings 17(4): 406–10.

a shift away from conventional tillage systems that leave surface soil susceptible to erosion. Encourage customers to evaluate tillage options on an individual basis—choosing those practices which improve the land's soil- and nutrient-holding capacity.

If fall tillage is necessary for a particular field, encourage some form of conservation tillage to help preserve the natural erosion buffer which crop residues provide. Chisel plows, for example, will loosen soil 8 to 16 inches deep and still leave 70 to 90 percent of crop residues on the surface. A para-plow also provides deep tillage, while leaving the soil surface virtually undisturbed.

Still, a farmer's crop choice largely influences the amount of plant residue he'll have left to manage. A typical corn crop harvested for grain produces close to 6,000 pounds of residue per acre. Other per-acre crop residue averages are 4,500 pounds for rye; 4,000 pounds for wheat; 4,000 pounds for hairy vetch; and 3,000 pounds for soybeans. An acre of double-cropped wheat and soybeans provides almost 5,000 pounds of residues throughout the production cycle.

Providing Protection In Winter

Winter cover crops also offer effective protection against soil erosion and nutrient loss. Small grains such as rye, wheat, barley, and oats provide excellent cover. Wheat is frequently favored in the central Corn Belt, since it provides winter cover and can be used in a corn-wheat-soybean rotation.

Surface erosion can be virtually eliminated in fields where no-till planting is practiced in combination with a corn-wheat-soybean rotation. The combined effects of a dense crop canopy and substantial surface mulch production throughout the year make this a frequently recommended option on sloping fields. An added value to this system is that the winter cover crop will absorb and hold any unused nitrogen from the previous crop and prevent it from leaching into groundwater.

In regions too cold for winter cover crops, corn residues—particularly when chopped—provide excellent protection against erosion. Also, encourage your customers to eliminate all unnecessary fall tillage operations on erodible land.

Promoting the use of proper residue management practices helps to increase moisture infiltration while reducing surface runoff. Such practices not only save your customers the expense of replacing fertilizer lost through erosion, but also help conserve soil moisture and preserve the soil's long-term production capacity. And, that boosts your image as a supplier concerned about your customers' livelihood. ■

K. L. Wells is an extension soils specialist at the University of Kentucky, Lexington.

Best Management Practices

Reducing erosion, controlling nutrient runoff, and preserving the soil.

Promoting Efficient Nutrient Use

by Vernon W. Case

Efficient plant uptake of nutrients is essential to maximize your customer's returns on investment and to minimize nutrient losses from erosion and leaching. Proper fertilization techniques, combined with other modern crop production practices, help to build soil productivity, increase yields and profits, and minimize nutrient losses from production practices.

Rapid crop canopy development and increased root growth—two characteristics that result from high yields—help to protect the soil and bind it together. This slows surface water movement, increases water infiltration, and improves water uptake by plants.

A recent pamphlet published by the Potash & Phosphate Institute, *Maximum Economic Yield Systems . . . How They Work For Conservation*, illustrates these points. Research trials involving alfalfa in Illinois show that poor crop management provided only 60 percent cover and resulted in 9.2 tons per acre annual soil loss, compared to a good management control system which produced 95 percent crop canopy and allowed only slightly more than one ton per acre soil loss. In addition, a recent corn study in New Jersey demonstrated the benefits of high yields in increased residue and improved water use efficiency.

Accurate Soil Tests Are Key

As a fertilizer dealer, you can derive many benefits from working with your customers to build a sound soil fertility program. Strive to recommend fertilizer applications which provide the proper amounts of nutrients based upon the crop to be grown in each field. This requires the use of accurate soil sampling and analysis techniques, along with recommendations based on realistic yield goals, as determined by the customer's level of management. You and your fellow employees can play a major role in bridging the communication gap between the farmer, the soil test lab, and extension agronomists. Your local production experience, tempered with broad agronomic, economic, and ecological principles, are essential ingredients in providing fertility recommendations which ensure efficient nutrient utilization.

Concern Centers on Nitrogen

Because of its mobile nature, nitrogen may be lost through surface runoff and soil leaching. As such, it could eventually represent one of your customer's greatest environmental concerns. Application recommendations should be based on the amount of nitrogen released from organic matter, crop residues, livestock wastes, and the amount retained in the root zone. Since soil tests for nitrogen vary widely depending on soil temperature, region of the country, and so on, you must combine your past experience with similar soil types, crop response to fertilization, customer yield goals and individual field conditions to help ensure the development of recommendations which discourage nitrogen loss. If proper fertilizer recommendations are provided and sound tillage practices utilized, any nitrogen not utilized by the current crop likely will attach to crop residues and be protected from loss through denitrification, leaching, and erosion.

In dry regions of the western states, where water movement through the soil is significantly less during fall and spring, soil nitrate tests taken from the top 24 inches of soil can improve the accuracy of nitrogen recommendations and promote more efficienct plant utilization.

Monitoring P & K Levels

Good soil samples and properly calibrated soil test procedures will give good estimates of the amounts of phosphate, potash, and lime. Interpretation of soil test results for deficiencies in magnesium, sulfur, manganese, zinc, and boron can be well worth the effort to enhance potential benefits to overall plant development and minimize nutrient losses.

Proper fertility levels of phosphate and potash also promote more efficient crop utilization of nitrogen. Fertility research trials conducted in Maryland show that phosphate and potash deficiencies occurring over a four-year period can cut crop utilization of nitrogen by 50 percent. If such a deficiency persisted during a nine-year period, nitrogen application costs could increase. Therefore, it's both agronomically and economically sound to ensure that adequate phosphate and potash fertilization is made a consistent part of a good nitrogen fertility program.

The benefit of minimizing nutrient and soil losses while maximizing profits for both you and your customer is a realistic goal. It is one that can help preserve the productive capacity of valuable cropland—and maintain your customer base as well. ■

Vernon W. Case is manager of agronomic research and development for International Minerals and Chemical Corp., Terre Haute, Ind.

CHECK LIST...for protecting surface water and ground water

* * *

Compare your plant practice with what you have seen in the MACA film "WATER GUARDIANS AT WORK":

Good Housekeeping:

___ Vehicles are washed after use and before parking overnight

___ Empty containers are rinsed, punctured and flattened for disposal in an approved site

___ Valves are kept locked on tanks, rail cars, and nurse tanks

___ Pesticides are kept under lock and key inside a fence or building - and well separated from other commodities

___ Storage areas and tanks are inspected regularly and records are kept of these inspections

___ Reports are filed on any spills or discharges

Site Planning:

___ Diking has been installed for bulk pesticides/fertilizers

___ Loading pad and washing pad have proper drainage into tanks to contain spills and recycle material into the field

___ Safety and emergency equipment and supplies are readily available on the plant and on vehicles

___ Emergency shower and eye wash fountain are installed

Field Practice:

___ Left-over chemicals are sprayed out in the field

___ Applications are made according to the label

___ Spray rigs and trucks or nurse tanks have fresh water for driver use in the field

Training:

___ Product training sessions are held with employees

___ Employees receive safety instruction on chemical handling

MIDWEST AGRICULTURAL CHEMICALS ASSOCIATION

Protecting Water Resources

New MACA film shows how conscientious ag chemical dealers protect water quality at their plants.

By LISA SCHUESSLER

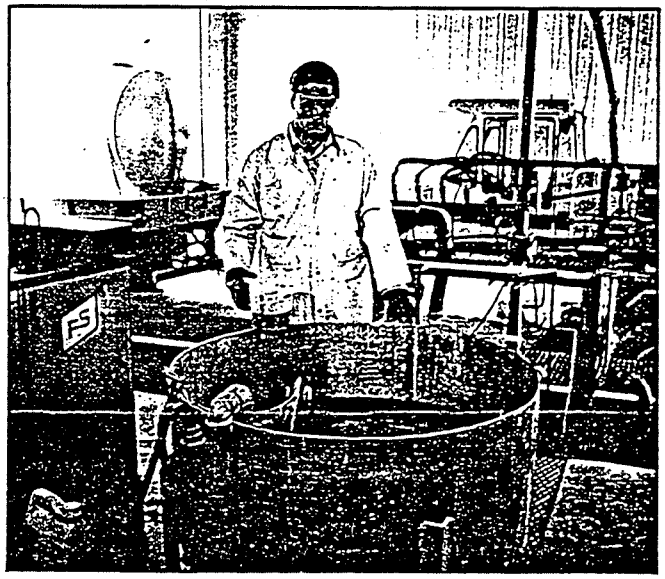
AG chemical dealers throughout the U.S. are working to protect surface and groundwater. To focus attention on their efforts, the Midwest Agricultural Chemicals Association has produced "Water Guardians at Work," a new 17-minute film featuring water protection programs of four Midwest ag chemical dealers.

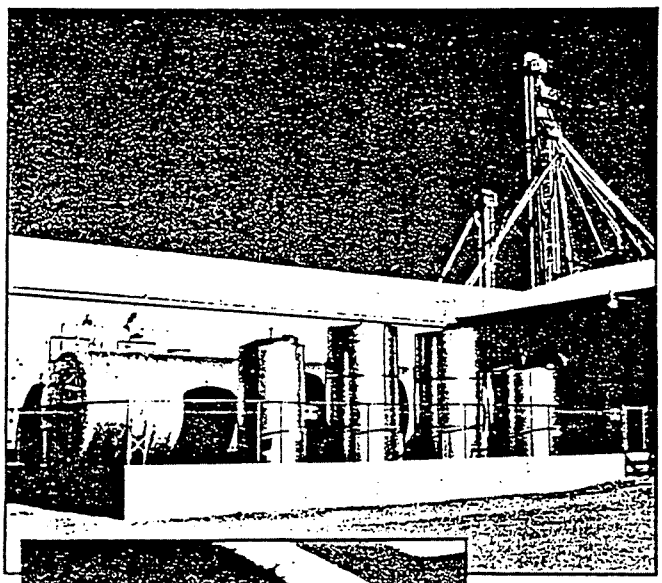
At Effingham-Clay Service Co. in Effingham, IL, a decision to expand into bulk handling and repackaging led the company to install its containment system. "When we started storing the chemicals in bulk, we wanted a way to contain them," explains general manager Bob Faulkner.

The full service dealer purchased stainless steel tanks to hold the bulk chemicals. "Stainless steel costs considerably more, but in the long run it's a safety factor," says Faulkner. "And those stainless steel tanks are inside of a concrete dike."

The company installed the diking system during the winter and spring of 1984 at which time it also installed a concrete loading pad. "When we're loading the trucks and unloading them is when the possibility of the greatest hazard exists for spillage," says Faulkner.

The loading pad slopes to a center drain which leads to three separate holding tanks underneath. Rinsate or spillage can be diverted to any of the three tanks for use in subsequent trips





Above left, at Effingham-Clay Service Co., prepackaged materials are mixed inside the enclosed loading pad by a worker wearing protective clothing. Above right, chemicals are stored in stainless steel tanks and diked with a concrete wall to confine spills. Cyclone fence provides added security. Right, stainless steel valves are padlocked.

into the field. The system protects against runoff onto neighboring property. It also protects against crop injury, since a bean herbicide caught in one of the holding tanks can be recycled into a batch of chemicals going out on beans while a corn herbicide caught in another tank can be incorporated into a batch of chemicals going out on corn.

As an added safety feature, Effingham-Clay Service had the loading pad completely enclosed, a precaution that Faulkner thinks is very important. "When we get a lot of rainfall, if it weren't covered it would fill up those holding tanks real quick," he explains. "If we get very much wind, we can close the doors and no dust blows out of the building."

Also part of the company's water protection program is proper container disposal. Faulkner takes great care to see that containers are triple rinsed before taking them to the landfill. He explains that leaving a few drops in one container wouldn't cause much of a problem, "but if there's a couple of drops in 500 containers, it could be a problem.

"The industry needs to work extremely hard to take care of correcting this problem on their own without regulatory agencies having to do it," he says. "We have a moral obligation to do it right."

Also careful to "do it right" is Steve Wilson of Wilson Fertilizer Inc., Brook, IN. Because the plant is located in town not far from a river and well, the full service dealer makes containment a top priority.

"We just make damn sure that we've got everything covered," says Wilson. "We use all stainless steel pipes to make sure that we don't have any leaks."

Bulk chemical tanks are also stainless steel, and the company is switching to stainless steel for fertilizer storage. "It doesn't rust out, and it has a longer life," explains Wilson. "It just reduces the risk of leakage."

To protect against vandalism, storage tanks are located inside of the company's chemical building. "We had some people cutting sight gauge hoses and that kind of stuff," says Wilson. "We just lost a little bit, but we felt like we wanted a lot more security. So we moved them all inside and put padlocks on them too."

The chemical building is also designed to protect against chemical loss should a spill occur. An isolated 3000 gallon tank is hooked into the building to collect any spilled chemical. Since no rainwater enters the building, spillage would be straight chemical which could be pumped from the holding tank for later use. A fertilizer spill would be handled in the same way.

Steve Wilson, secretary/treasurer of Wilson Fertilizer Inc.

"Water Guardians at Work" was developed by MACA's Groundwater Committee under the chairmanship of Carl Bartenhagen of the Monsanto Co., Omaha, NE. It was written and directed by Leavitt White.

MACA released the film last fall in hopes of reaching every Midwest ag chemical dealer by the end of the winter. Requests for the 16 mm film or VHS videocassette should be directed to:

Dr. E.E. Waller
MACA
P.O. Box 2125
Northside Station
Sioux City, IA 55104
712-277-7380

or

Gary Smith
Venard Films
P.O. Box 1332
Peoria, IL 61600
309-699-3911

Other safety features include a cement loading platform and a clay dike at the back of the plant. The company installed the dike about 12 years ago after learning that a neighboring corn field wasn't producing well because of runoff from the plant. A 30,000 gallon tank buried at one end of the dike catches any runoff before it can reach the neighbor's property.

"We've got a natural slope on our plant," says Wilson. "The height at the front of it is approximately the same as the top of the dike."

The dike is made of clay and covered with gravel to prevent erosion. Wilson explains his preference for clay, "We store a lot of acid here. If acid comes in contact with stone or cement, it eats it away. That's the reason we went with clay, and that's the reason I believe in clay."

A series of 10 or so drains throughout the plant lead to the 30,000 gallon tank by way of one main drain located underneath the dike. Runoff collected in the tank can be sprayed on the field.

Educating Employees

Also a high priority at Wilson Fertilizer is employee education. "We have a meeting right before spring where we basically deal with the safety and the hazards of chemicals from our liability standpoint and from their health standpoint, so they know what they're dealing with and know what the consequences are of misusing them," says Wilson.

"We issue them all rubber gloves and goggles at the beginning of every year, and then we also keep a supply on hand," he adds. Rubber Glove Zone stickers on tanks remind employees to wear their gloves and goggles.

Hovey Tinsman, president of Twin-State Engineering & Chemical Co., Davenport, IA, agrees that employee education is a top priority. "That's one of those things where you can really fall down, but you've got to continually keep people informed as to what products they're working with," he says.

Tinsman's major concern is that his employees know what to do in case of a spill. "If something happens I want to make awfully sure that certain people are notified — the manager of the retail location is number one and I'm number two," he says. "If there's a spill outside the contained area then you're required by law to notify DEQ (Department of Environmental Quality)."

Tinsman fears that employees may feel their jobs are threatened if a spill should occur. "They'd like to clean it up and not notify anybody," he says. "That's what you have to protect against."

In addition to keeping his employees informed, he also keeps his community informed. "I don't care whether you're out in the country or in town, there's a fair awareness by all people

about the risk of pollution of drinking water. I think it's something you have to recognize," he says.

Tinsman has brought the fire department to Twin-State's various manufacturing plants and retail outlets to go over blueprints of the property and show them where bulk chemicals are stored. He has also taken community awareness one step further by inviting a variety of interested people to visit the company's facilities.

"You want to take as many people as possible to your facility so that they understand what you've got so they at least feel comfortable with it," he says. "If anybody's ever interested in knowing what we do environmentally, you bet we want to show it to them."

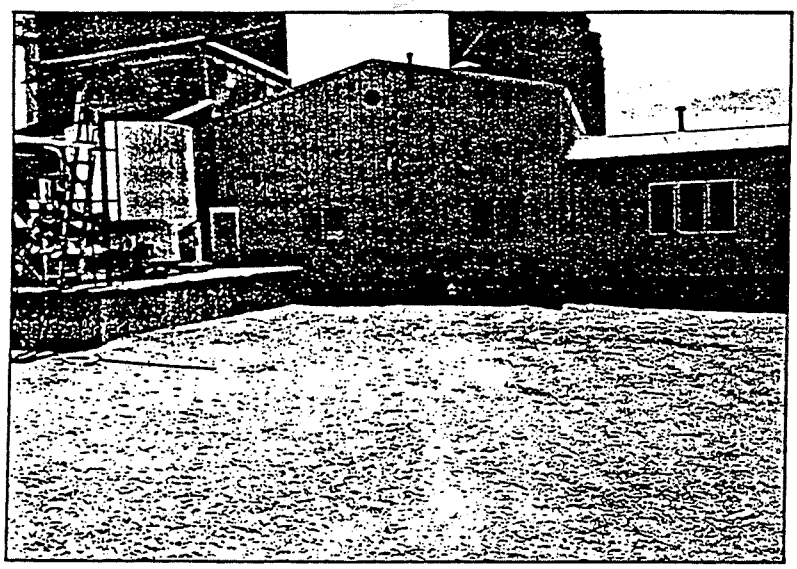
Tinsman sees improved public relations as one of the primary benefits of Twin-State's containment system. Another benefit is reduced insurance premiums. "I'm convinced in two years you won't be able to buy insurance without being diked," he says.

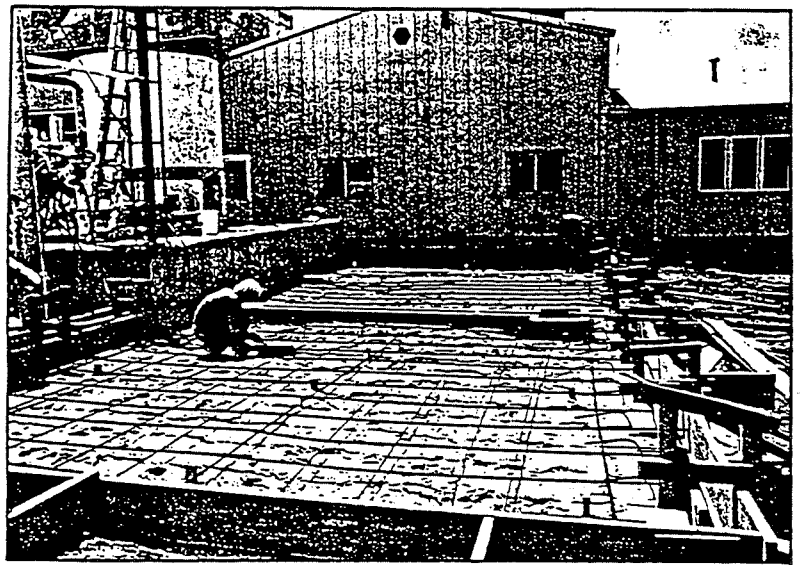
An Ongoing Process

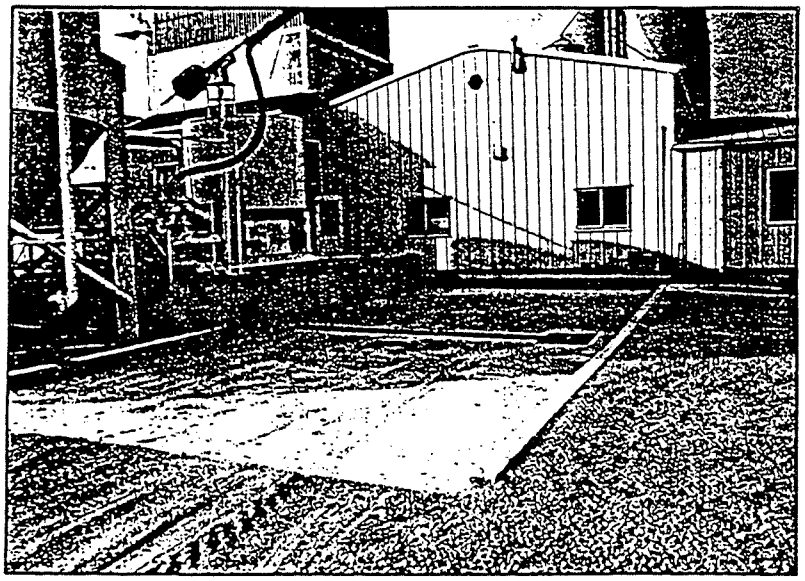
The company began the process of installing containment systems at its facilities around 1976 when they built their major manufacturing plant at Durant, IA. "We entered into a contract making product for a major producer," explains Tinsman. "They had said that they probably would not consider us doing the formulating for them unless we had a diked facility."

Twin-State has since transferred concepts developed at the Durant plant to its smaller production plants in Hampton, IA and Janesville, WI. Eight of its 10 retail locations have also been diked. The last two will be diked this summer. "It's just an ongoing process," explains Tinsman.

When installing a containment system, Twin-State is careful to protect the following four areas: 1) fertilizer storage, 2) bulk chemical storage, 3) the mixer, and 4) the loadout. In describing the DeWitt, IA retail location, which is featured in the film, Tinsman says, "All of the fertilizer storage tanks are within a secondary storage area that is made of concrete. It's 125% of capacity of the largest tank. The bulk chemicals are stored in a separate sec-







Before, during, and after construction of the wash pad collection system at Galesville Chemical Co.

ondary confinement, and that's on a cement pad with cement walls. Its size is about 125% of the largest tank."

In the event of a spill, the diking system not only guards against water contamination but also allows the dealer to recover any product that has spilled into the diked area. After a hose ruptured on one of Twin-State's fertilizer tanks, about 25,000 gallons of product moved out of the tank into the diked area. Since pesticide and fertilizer recovery systems are separate, the fertilizer wasn't contaminated and could be pumped back into the tank with no loss of product.

Dealing with Rainwater

On a day to day basis Tinsman finds that rainwater presents a bigger problem than spills. "You have to keep the confinement area designed tightly so that you accumulate less rainwater. That's by far the biggest problem," he says. Twin-State disposes of rainwater by spreading it on fields.

Sam Foster, who manages Galesville Chemical Co. in Mansfield, IL, disposes of rainwater and rinsate in the same way. "You don't want to store it and contain it, you want to get rid of it, and the place to put it is back on the field where it should be," he says.

Galesville Chemical has also been involved in a study to determine if soil contaminated with pesticides can be land spread. The study came about after EPA found contaminated soil on property adjoining the plant.

Rather than take the contaminated soil to a landfill, Foster hoped to find a way to recycle it. He and A.G. Taylor of the Illinois EPA discussed the possibility of land spreading the soil. "We wanted to find a practical solution to these kinds of problems," explains Foster.

The result was a study put together by the Illinois Department of Energy and Natural Resources together with the University of Illinois. Allan Felsot of the Illinois Natural History Survey in Champaign, IL headed the project.

Most of the contaminated soil found near the Galesville Chemical plant was land spread on research plots which were then compared to control plots. Findings from the project are still under evaluation, but Foster hopes the study will allow other ag chemical dealers faced with a similar problem to recyle contaminated soil.

"If we're going to have pesticides, we're going to have this problem. We've got to learn to live with it and manage it," says Foster. "We've got to have some data to find out whether we can do this feasibly and not harm the environment."

Galesville Chemical already had a chemical dike in place when EPA discovered the contaminated soil in 1984. Since that time, the company has installed a concrete wash pad where two underground tanks catch any spillage or rinsate. EPA approved the plan for the wash pad which is licensed by the agency as a collection facility.

The four dealers featured in "Water Guardians at Work" are taking the steps necessary to protect surface and groundwater at their plants. In so doing, Bob Faulkner, Steve Wilson, Hovey Tinsman, and Sam Foster demonstrate a variety of ways in which ag chemical dealers can become a part of the solution. **FC**

NEWS

United States Department of Agriculture

Office of Information

USDA News Division
Room 404-A
Washington, D.C. 20250

Sean Adams (301) 344-2739
Ben Hardin (309) 685-4011
Dave Warren (202) 447-4026

FUNGI, PLANTS, INSECTS ARE KEY FUTURE SOURCES OF SAFE CHEMICALS

NEW ORLEANS, Sept. 1--Fungi grown on breakfast cereal in a U.S. Department of Agriculture laboratory produce substances that may lead the way to a new generation of useful, environmentally safe chemicals, a USDA scientist said today.

Plants and insects also produce potentially useful chemicals, according to other scientists with USDA's Agricultural Research Service.

"We've found that certain fungi produce chemicals that regulate plant growth, repel diseases and have potential as antibiotics similar to penicillin," said Hank Cutler, a plant physiologist with the agency in Athens, Ga. "And these chemicals work against specific targets, are extremely potent and don't pose environmental hazards because they're biodegradable."

Cutler and ARS colleagues are reporting their findings this week at the 194th national meeting of the Amerian Chemical Society here. They are taking part in an ACS symposium on potential uses of natural products from microorganisms, plants and insects.

"Our findings are preliminary, and industry would have to conduct further studies to confirm them," he said. "But chemical companies are interested in what we've found, and they realize there will be international competition to produce these chemicals in the future."

Cutler, who grows fungi on cereal in glass flasks and then studies the compounds they produce, said the compounds could be commercially produced

-more-

in fermentation, or could serve as templates for synthesized chemicals.

Cutler, based at the Richard B. Russell Research Center in Athens, has found a number with commercial potential:

Cyclopenin, produced by the fungi Penicillium cyclopium, stunted leaf growth in green bean plants and killed or stunted the growth of corn. But it had no effect on tobacco plants. In other studies, 250 milligrams of cyclopenin made chicks drowsy and 500 milligrams completely tranquilized them. He said it is similar to Valium and has potential as a drug.

Cyclopenol, also produced by P. cyclopium, kills the same fungi that caused the Irish potato famine of the 1840s. Those fungi occasionally cause problems on a smaller scale today. "Cyclopenol has potential as a fungicide," he said.

Cytochalasin H, produced by Phomopsis sp. fungi, controlled flowering in six-week-old tobacco seedlings. In field tests, three-tenths of an ounce in water controlled flowering in an acre of tobacco, a model test plant. "This has great potential as a growth regulator and could replace costly and time-consuming hand labor in the field," he said.

6-pentyl-pyrone, from the fungus Trichoderma viride, inhibited the growth of Aspergillus flavus in laboratory studies. Under certain environmental conditions, A. flavus grows on grains and other field crops and produces aflatoxin, a potent carcinogen.

"6-pentyl-pyrone has potential to be sprayed on these crops in the field to cut back the growth of A. flavus and reduce or eliminate aflatoxins," he said.

Other findings by agency scientists:

* A fungal toxin called tentoxin is a model for new compounds that control johnsongrass, mustard seed, barnyard grass and morning glory.

Judson V. Edwards of the agency's Southern Regional Research Center has developed peptide chemicals based on tentoxin that, in laboratory studies, kill the weeds without harming corn or soybeans. Alan R. Lax and Hurley Shepherd, also based at the research center, are working on how these peptides work and on genetic engineering techniques to get fungi to produce these chemicals more efficiently.

* Another weed, velvetleaf, may someday be controlled by compounds in plants, according to chemist Richard G. Powell of the agency's Northern Regional Research Center, Peoria, Ill. Some of these compounds, such as one from a wild plant called Eryngium paniculatum found in Uruguay, could probably be made synthetically at prices competitive with present commercial herbicides, Powell said.

* Also showing promise as herbicides are chemicals that make up about 20 percent of the seed oil in some plants in the carrot family. Chemist Robert Kleiman of the Peoria center isolated six of these compounds, called phenylpropenoids. At a concentration as low as 0.025 percent, one of these compounds completely prevented germination of ryegrass but had no effect on cucumber and radish seeds.

* Speeding up a cotton plant's self-defense mechanisms would help protect it against a fungal wilt disease. Robert D. Stipanovic of College Station, Tex., said he has begun preliminary studies to see which cotton plants respond most quickly to the Verticillium fungus that causes a wilt disease. The idea is to breed cotton varieties that are the quickest at producing photoalexins -- chemicals inside the cotton plant that block the fungi from spreading inside the plant.

* Insect and other pests may also be controlled someday by chemicals from plants, or such chemicals could serve as models for chemical insecticides.

Chemist Kenneth L. Mikolajczak of Peoria said crude extracts from plants related to a tropical tree called neem are as toxic as neem extracts themselves to fall armyworms and striped cucumber beetles. He and his colleagues also isolated a compound from the Midwest's common pawpaw plant that they found was as lethal as some commercial pesticides to nematodes, Mexican bean beetles and mosquito larvae.

* The stink bug family includes pests harmful to certain crops, but also includes predators that can kill other insect pests. Jeffrey R. Aldrich of Beltsville, Md., is studying this family of insects and the chemical attractants, called pheromones, they give off. He said if these attractants can be identified and synthesized, they could help scientists find new beneficial stink bugs and find natural enemies of harmful stink bugs that feed on soybeans in the southern U.S.

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NOTE TO EDITORS: Contact for details Hank Cutler, plant physiologist, Richard B. Russell Research Center, Agricultural Research Service, USDA, Athens, Ga. 30613, telephone (404) 546-3311; Judson V. Edwards, chemist, and Alan R. Lax, plant physiologist, Southern Regional Research Center, ARS-USDA, New Orleans, La. 70179, telephone (504) 286-4200; Richard G. Powell, Robert Kleiman and Kenneth L. Mikolajczak, chemists, Northern Regional Research Center, ARS-USDA, Peoria, Ill. 61604, telephone (309) 685-4011; Robert D. Stipanovich, chemist, Cotton and Grain Crop Research Lab, ARS-USDA, College Station, Tex. 77841, telephone (409) 260-9233; and Jeffrey R. Aldrich, entomologist, Beltsville Agricultural Research Center, ARS-USDA, Beltsville, Md. 20705, telephone (301) 344-2389.

To reach Dr. Cutler at the ACS meeting, call the ACS press office at Le Meridien Hotel, (504) 581-7040, or call him at the Holiday Inn, Crown Plaza, (504) 525-9444.

Information Needs

Perhaps the major need is for official health-advisory concentrations for individual pesticides. Analytical techniques are capable of detecting pesticides at concentrations far below those of biological significance. When no official guidelines are established, however, members of the public are not inclined to accept any concentration as safe, no matter how low it may be, because they have no basis for judgment. The basic information on the no-observable-effect level must be available before a pesticide is registered, and the Environmental Protection Agency publishes this value and the acceptable daily intake in the *Federal Register* when it establishes tolerances for pesticide residues in raw agricultural commodities. For pesticides approved since these information requirements were established, therefore, all that is lacking is an official designation by the Environmental Protection Agency of the health-advisory concentrations for these pesticides in drinking water.

From the physical standpoint, there are additional information needs. These have to do with the behavior of agricultural chemicals in the environment. Much is known about these chemicals and their potential for moving to groundwater, but it is evident from the coverage of the subject in this report that the knowledge is mostly qualitative. The interactions of the various processes and factors are not well understood. Quantitative predictions for specific circumstances are of limited accuracy. The value of the capability for quantitative predictions is that when the appropriate measurements are made, one can predict what would happen under specific circumstances of interest without resorting to experimentation or trial and error. One can then avoid use of the chemicals under conditions that in the end would turn out to be inappropriate. Information needs considered important for improving quantitative predictions in the future include the following:

1. Improved concepts are needed to clarify the movement of agricultural chemicals through soil and the unsaturated zone below, and in groundwater.

2. More information is needed on the fate of agricultural chemicals applied to soils to answer questions such as the following: Does a particular chemical break down to harmless products in the soil, how long does the decomposition process require, what causes the decomposition, and what environmental conditions affect the decomposition? Does a particular chemical move through the soil to reach groundwater, in what concentration does it move, and how long does it persist in groundwater?

3. As a follow-up on item 2, information is needed on the conditions favorable for breakdown of chemicals by soil microorganisms, including the importance of microbial activity at lower depths in soils and possible ways to manipulate the soil microbial population to decompose pesticide residues in soils and waters.

4. Information on management techniques to reduce the potential for downward movement of agricultural chemicals is needed. Answers are needed to questions about the effects of irrigation scheduling, methods of applying chemicals (including application in the irrigation water), and the significance of different chemical formulations.

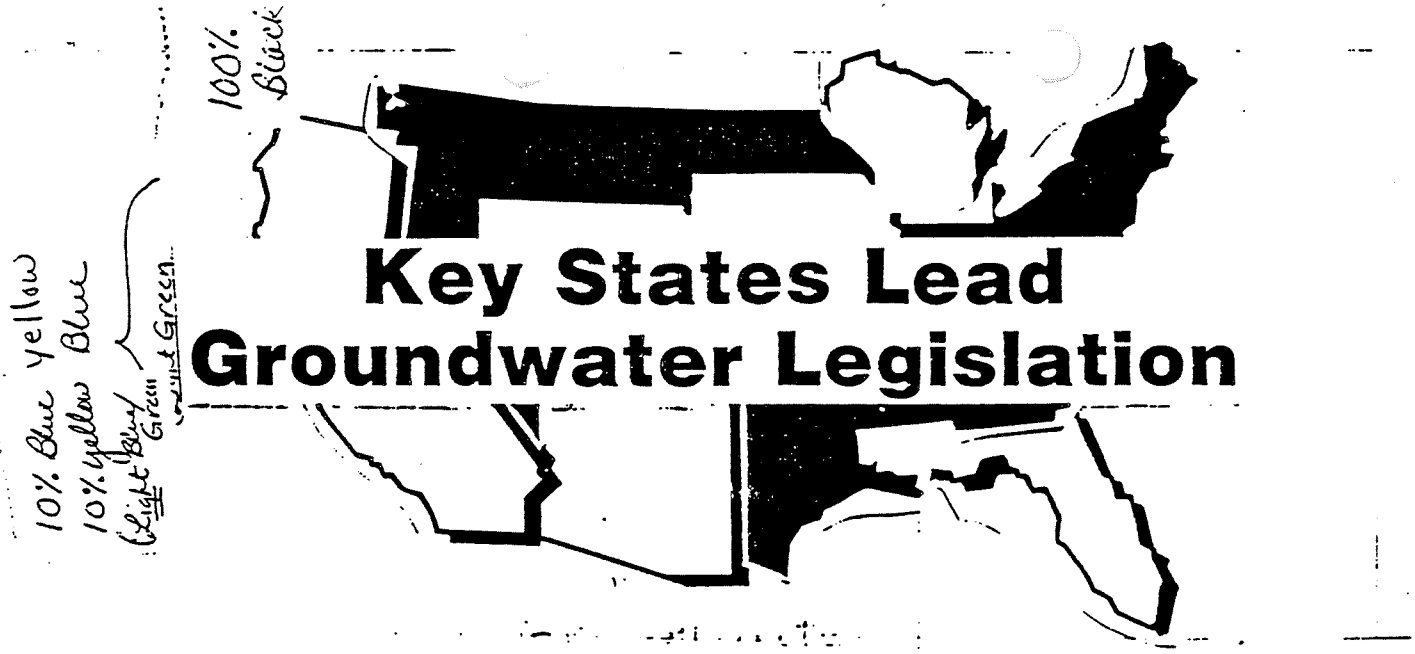
5. Improved methods are needed to assess hydrogeologic and environmental variability.

6. Mathematical models suitable for making accurate computerized projections of long-term movement of chemicals in the environment under different circumstances are needed.

7. More complete information is needed on the potential health effects of some agricultural chemicals.

8. Improved communication of research findings to the public is needed to provide for better understanding and decision making.

Research on these points is underway for many chemicals. Results are generally reassuring, but work must be continued to confirm that residues detected are not a valid cause for public concern with regard to use of water for drinking.



Key States Lead Groundwater Legislation

The actions of individual state legislatures on the groundwater issue have increased tremendously during the past three to five years. The legislative lead taken by several key states is likely to have an impact on other states as they take up the issue. Mr. Morandi's article is reprinted for SOLUTIONS readers as background for understanding several "model" legislative approaches to the groundwater debate.—Ed.

State governments are increasingly shouldering the responsibility for protecting groundwater quality from contamination caused by agricultural chemicals. In the absence of comprehensive congressional legislation, the U.S. Environomental Protection Agency's (EPA) 1984 National Groundwater Protection Strategy has emphasized the predominant role of states in groundwater protection. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) has provided states with but a framework for federal compliance, offering them opportunities for

The initiative for establishing state groundwater programs in the late 1970s and early 1980s often came from executive agencies. Groundwater quality standards in New York, Connecticut, and New Mexico, for example, were developed under general water quality enabling statutes enacted primarily to address surface water problems. State legislatures have since provided greater direction in formulating groundwater programs, including those designed to managing pesticides to prevent groundwater pollution.

control agricultural chemical contamination. Legislative policy guidance is especially important where administrative jurisdiction may be split between agriculture, environment and health agencies whose charges (and constituencies) may not coincide. This article describes a range of statutory approaches adopted in several states to manage pesticide use for groundwater protection purposes.

Federal Framework

There is nothing comparable at the federal level to the surface water protection provisions contained in the Clean Water Act (CWA) for groundwater. FIFRA has established a pesticide registration program with components—training and certification of pesticide applicators and enforcement—delegated to the states. The Safe Drinking Water Act (SDWA) requires EPA to set Maximum Contaminant Levels (MCLs) for pollutants found in public drinking water, surface or underground (recommended MCLs for several pesticides have been issued). States may administer the SDWA program if the drinking water standards they adopt are no less stringent than those promulgated by EPA. SDWA amendments adopted in 1986 established a state-run wellhead protection program designed to protect underground public drinking water supplies from contaminants leaching into groundwater by managing land activities surrounding the wellhead area. The 1987 CWA amendments mandate the preparation of state nonpoint source pollution programs that may address agricultural water quality problems, including pesticide use.

The lack of federal direction in regulating discharges to groundwater generally, and agricultural chemicals in particular, has provided states with a degree of policy flexibility unmatched in most other national environmental programs.

States may cancel pesticide registrations or restrict the geographic area of use. Where federal drinking water standards exist, state standards may be more stringent; in the absence of federal numbers, states may adopt their own.

On the broader issue of aquifer protection, states are free to classify aquifers by type of use, set water quality standards and regulate discharges that exceed (or approach) threshold levels. State legislation has had its most direct impact by providing standard-setting criteria and the authority to regulate waste discharges and land use activities that affect groundwater quality. Agricultural chemical use is receiving greater scrutiny through the enactment of new statutes and through the incorporation of pesticide policies into existing legislative frameworks.

State Legislation: Conceptual Approaches

Groundwater protection legislation designed to control pesticide pollution generally takes one of three forms: (1) comprehensive groundwater strategies that incorporate agricultural chemicals

into the same regulatory framework as other pollutants; (2) specific legi on aimed primarily at protecting groundwater quality from the effects of pesticide applications; and (3) blends of both approaches.

Wisconsin is an example of a state program that fits into the first category. California, Iowa and Nebraska more closely identify with the second. Arizona and Florida exemplify the third. In each instance, legislation was essential to initiating or supplementing state groundwater policy. The statutory provisions adopted in these states, which were selected because they represent a range—and not a conclusive set—of state options, are described in the following paragraphs.

(1) Comprehensive Groundwater Legislation Wisconsin—Wisconsin's 1983 Act 410 represents a comprehensive policy approach to prevent groundwater contamination from a range of sources. Unlike some other state groundwater programs that react to contamination only after a water quality standard has been breached, Wisconsin's statute requires the Department of Natural Resources (DNR) with advice from the Department of Health and Social Services, to establish two sets of standards: an enforcement level beyond which a violation would occur; and a preventive action limit designed as an early warning device to notify dischargers that continued waste disposal will result in noncompliance.

The preventive action limits are percentages of the enforcement levels and are based on the health impacts of the regulated substance. If the contaminant is potentially carcinogenic, the preventive action limit is 10 percent of the enforcement standard. For other public health concerns, the level is 20 percent; for public welfare concerns, 50 percent.

DNR is the lead agency in the groundwater management process; four other state agencies that issue permits for waste discharges monitor groundwater to track contamination and regulate activities from sources under their control.

The statute listed two specific agricultural chemicals for which groundwater quality standards must be adopted: aldicarb and carbfuran. DNR has set standards for nine additional pesticides; they are pending for six others (the preventive action limits are at 10 or 20 percent of the enforcement standard for each agricultural chemical).

Groundwater monitoring has produced evidence that the standards for aldicarb have been breached, resulting in curtailment of the chemical's use in specific geographic areas (the pesticide's manufacturer has subsequently withdrawn the product from sale in the state).

(2) Agricultural Chemical Legislation California—California's 1985 Pesticide Contamination Prevention Act sets up a five-part program for managing agricultural chemical use to protect groundwater quality. The initial component requires the registrant of an agricultural chemical to submit information on the substance's effect on groundwater (its "environmental fate") to the Department of Food and Agriculture. The department must then establish numeric values for specified pesticide characteristics (water solubility, soil adsorption, field dissipation, hydrolysis, aerobic and anaerobic soil metabolism), and publish a list of chemicals with the potential to pollute groundwater (a "groundwater protection list").

The statute's regulatory measures are triggered by the results of soil and groundwater monitoring in those aquifers of the state most likely to be affected by chemicals on the groundwater protection list. If an agricultural chemical is detected in groundwater or at certain depths in the soil, the department must cancel its registration unless the registrant can demonstrate that there is no health risk or that cancellation will cause severe economic hardship due to a lack of available alternatives (means short of cancellation have been found to mitigate the effects of pesticides on groundwater).

The use of numeric values in California assumes that certain physical characteristics determine the capability of a pesticide to migrate through the soil in groundwater. Numeric values have been assigned for water solubility, soil adsorption and hydrolysis. The groundwater protection list has not yet been formally adopted; it was scheduled for legislative review in December 1987.

Iowa—Unlike California's regulatory program, Iowa's 1987 Groundwater Protection Act emphasizes education, research and demonstration projects financed primarily through user fees. The act allocates $65 million over five years (fiscal years 1988-92) to resolve groundwater problems caused by a range of sources, including agricultural chemicals, solid waste landfills, household hazardous wastes and leaking underground storage tanks.

One-third of the money will come from agricultural sources. Farmers will pay 75 cents more per ton c fertilizers ($3.5 million); t registration fee for chemica turers will rise from a flat a sliding scale of $250 to $3 on sales ($15 million); and n face an increase in pesti license fees of from $25 to c one percent of sales ($2.5 million). Nearly $6 million of that revenue will support research on environmentally benign agricultural practices at the newly established Leopold Center for Sustainable Agriculture.

40% yellow
20% Blue

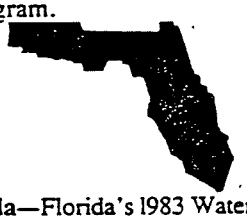
Nebraska—Legislation enacted during the 1986 session not only addressed agricultural chemical problems but combined the often ignored relationship of water quality to water quantity.

At issue was high nitrate levels from agricultural irrigation practices that were leaching fertilizers into groundwater. Local natural resource districts (there are 24 statewide) had been authorized to manage irrigation to control groundwater contamination since 1980. The local option had not been effectively utilized, however, this prompted the state Department of Environmental Control (DEC) to press

(Continued on p.42)

sions of California's 1985 Pesticide Contamination Prevention Act.

It requires pesticide registrants to provide a DEQ director with information on the environmental fate of their products. The director must establish numeric values for the same set of pesticide characteristics contained in the California law and prepare a groundwater protection list of chemicals most likely to pollute groundwater. The director may modify or cancel the registration of those pesticides found in groundwater or at certain depths in the soil as a result of a statewide monitoring program.



Florida—Florida's 1983 Water Quality Assurance Act formulated a number of programs designed primarily to protect groundwater quality. In requiring the Department of Environmental Regulation (DER) to set up a statewide groundwater quality monitoring network, the act incorporated pesticide contamination into the overall groundwater protection effort (part of DER's data collection effort is aimed at locating nonpoint sources of pollution, including agricultural areas where pesticide use may be a problem). The department plans to adopt groundwater quality standards for those pesticides that may leach into aquifers once sufficient data is available.

The act also contains specific pesticide provisions that emphasize the state's role in registering agricultural chemicals. It created a Pesticide Review Council within the Department of Agriculture and Consumer Services (DACS) empowered to review EPA data and findings on newly registered restricted-use pesticides; initiate studies on restricted use pesticides when the data suggests that a pesticide poses adverse environmental or health effects; and make recommendations to the DACS commissioner regarding the sale or application of restricted-use pesticides.

The council also is granted standing as a "substantially interested person" in pesticide registration proceeding before DACS (the agency responsible for registering agricultural chemicals).

The act further authorizes DER to review and comment on the proposed registration of any restricted use pesticide that poses environmental concerns. While providing environmental oversight, the act precludes any provisions for affecting the DACS commissioner's authority to register a pesticide and includes a statement of legislative intent emphasizing the importance of an efficient and profitable agriculture industry to the state's economy.

Conclusion

Although there has been increasing federal interest in developing groundwater protection programs in recent years, states continue to take the policy initiative. The leadership role has extended from groundwater protection generally to managing agricultural chemical use. Federal policy has at times mirrored those approaches adopted in specific states. EPA's aquifer classification guidelines resemble those in effect in Connecticut since 1988; proposed amendments to FIFRA include preventive action limits comparable to those in Wisconsin. While states will continue to rely on EPA for technical support in developing scientific standards, they are not reluctant to enact policy that incorporates such standards into a state management framework.

The role of legislation in formulating state policy will vary. Where new direction in how a state addresses groundwater problems is necessary, legislation will be significant.

Where the focus is on agricultural chemicals, legislation may be needed to dovetail the reponsibilities of an agriculture department and an environmental agency to prevent turf battles from adversely affecting groundwater quality or the agricultural economy. Legislative determination of financial resources to support the development of data on which to base management decisions will be essential in all cases. The case studies presented in this article illustrate a range of possibilities for achieving these objectives.

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Groundwater

(Continued from p. 27)

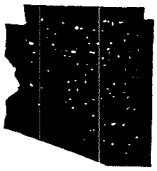
for legislative authorization to step in.

Legislative Bill 894 attempts to deal with the irrigation-based nitrate problem by empowering DEC to designate special groundwater quality protection areas where nonpoint sources (e.g., irrigation) are the principle concern. Once designated, the local natural resources district must prepare a management plant to curtail pollution. The plan may require changes in irrigation practices, including irrigation scheduling and more efficient timing of fertilizer applications. DEC must approve the plan; if a plan is not prepared or disapproved, the department can enforce irrigation regulations.

In the same session, the Nebraska Unicameral enacted Legislative Bill 284 to strengthen its chemigation program. Chemigation is the process that mixes pesticides with irrigation water in center-pivot systems to treat crops with agricultural chemicals and irrigation water at the same time. Groundwater contamination may occur if the center-pivot irrigation system stops, causing chemicals to back down into the well from which water is being pumped.

Legislative Bill 284 requires irrigators to obtain an annual chemigation permit from the local natural resources district. DEC is reponsible for certifying chemigators once they have passed a chemigation safety course.

In addition to the existing check-valve requirement, the legislation requires chemigation systems to be equipped with a vacuum relief valve, an inspection port, an automatic low pressure drain, and a simultaneous interlock device to shut off the flow of chemicals in the event of a system stoppage. The bill is similar to legislation adopted in Kansas during the 1985 session.



(3) Legislative Variations

Arizona—Arizona's 1986 Environmental Quality Act created a new Department of Environmental Quality (DEQ) responsible for administering the state's water quality, air quality and solid and hazardous waste management programs. Its principal provisions, however, relate to groundwater. The act established a permit program for all waste discharges to groundwater from both point and nonpoint sources. It requires the classification of aquifers by use (initially all aquifers are classified as being suitable for drinking water purposes), and the assignment of water quality standards to protect such uses. Agricultural chemicals must adhere to the appropriate standards at specific point of compliance or face restrictions on use comparable to other potential sources of contamination.

While incorporating pesticide management into the overall groundwater protection framework, the act differs from Wisconsin's approach by establishing a separate regulatory scheme for agricultural chemicals under the joint administration of DEQ and the Comission of Agriculture and Horticulture that largely follows the provi-

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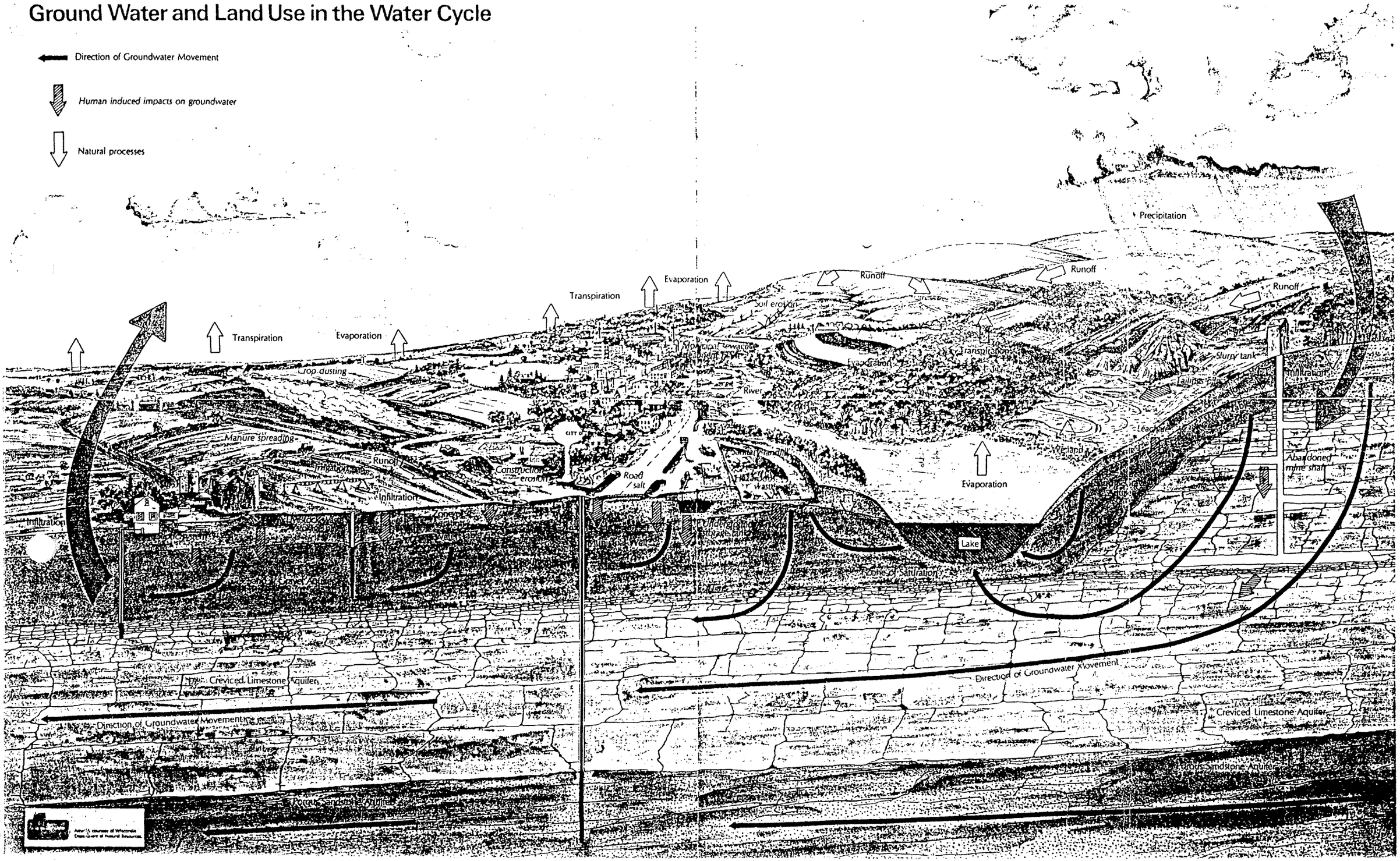
Ground Water and Land Use in the Water Cycle



THE VALUE OF FERTILIZERS - PLANT NUTRIENTS

American agriculture absolutely depends upon the use of fertilizers for maintaining soil productivity. In may instances, per-acre yields of key grain crops would be half of what they are today without fertilizers. A farmer can achieve his yield goals only if nutrients are sufficiently available in the soil - whether they come from commercial fertilizers, the soil itself or other sources such as manures.

Without adequate nutrients available, we could not enjoy foods of our choice at such affordable prices.

THE VALUE OF PESTICIDES - PLANT PROTECTORS

Pesticides provide a strategic resource in the battle to control pests that would otherwise cause widespread and economically significant damage to almost all crops grown in the United States. Pesticides lead to increased availability of commodities, lower prices for commodities, and improved quality of commodities, especially fruits and vegetables.

The benefits of pesticide use are derived directly from the control of insects, nematodes, weeds, rodents, and plant pathogens.

Stopping the use of pesticides, it has been estimated, would result in a 9% to 50% decrease in crop production. A 9% decrease would be associated with an $8.7 billion increase in crop losses and a 12% increase in the retail price of commodities. A 50% decrease has been estimated to cause up to 400% to 500% increase in retail food prices.