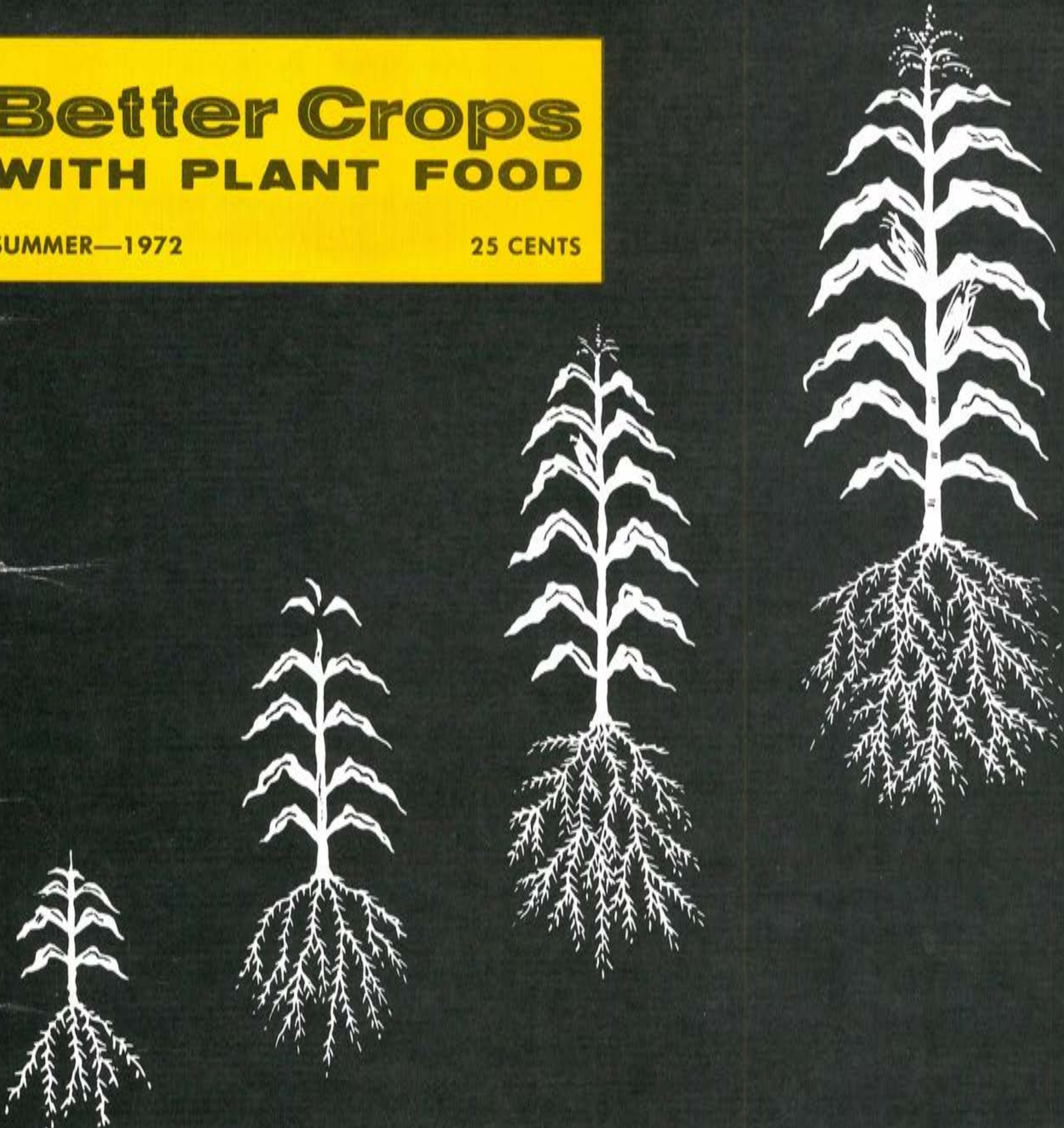
Better Crops
WITH PLANT FOOD

SUMMER—1972 25 CENTS



BIG BITE

Plant Food TAKEN UP

By 180 Bu/A

CORN

While It Grows

25-Day Periods

	Early	Growth	Silk	Grain	Mature	Total
N	19 Lb	84 Lb	75 Lb	48 Lb	14 Lb	240
P_2O_5	4	27	36	25	8	100
K_2O	22	104	72	36	6	240
DRY MATTER	468	3,212	5,687	6,022	1,338	16,727 Lb

UPTAKE: 580 Lb

Percentage of Plant Food Requirement Taken Up By Corn

	Early	Growth	Silk	Grain	Mature	Total
N	8 %	35 %	31 %	20 %	6 %	100 %
P_2O_5	4	27	36	25	8	100
K_2O	9	44	31	14	2	100

Know The Plant Food Your Corn TAKES UP While It Grows

A GOOD CORN CROP takes a big bite out of your soil—even a well nourished soil.

Corn continues to give more food as we develop new hybrids and better understanding of its needs. Keys to higher yields have included early planting, adequate nutrients, and excellent insect and weed control.

We now know much about how a corn crop grows and accumulates nutrients. Let's look at some facts behind 180 bushel (No. 2) corn. Such a crop would **TAKE UP** these nutrients to produce the following dry matter:

	Pounds Per Acre					
	N	P_2O_5	K_2O	Mg	S	D.M.
Grain (180 bu)	170	70	48	16	14	8,727 52%
Stover	70	30	192	34	16	8,000 48%
Total	240	100	240	50	30	16,727

That's a lot of plant food! When does the corn use it? When is the dry matter produced? Look at the table at the left of this text. It shows what happens during four 25-day growth periods, plus the last 15 days—the nitrogen, phosphate (P_2O_5), potash (K_2O), and dry matter 180 bushels accumulate during EACH PERIOD.

NITROGEN (N): Corn takes up about 43% of its N requirement—103 lbs—during the first 50 days, while the leaves (photosynthetic surface) are developing toward tasseling and silking when ear and grain will form. Nitrogen uptake peaks at 3.6 lb/A/day, about 40 days after emergence.

Ear filling requires about 140 lbs MORE nitrogen. Adequate nitrogen MUST be present to develop grain during this time.

PHOSPHATE (P_2O_5): Corn takes up about 30% of its P_2O_5 requirement—30 lbs—during the first 50 days. Phosphate is vital to early development. Uptake depends greatly on temperature and concentration, making row or seed placed P_2O_5 important, especially in northern areas.

Developing grain requires 70 lbs MORE phosphate (P_2O_5). Phosphate uptake peaks at 1.5 lb P_2O_5/A/day after about 60 days growth.

POTASH (K_2O): Corn takes up over 50% of its K_2O requirement—125 lbs—during the first 50 days. Potash uptake peaks at 4.5 lbs/A/day during the second 25-day growth period. Corn demands much potash during early growth, taking up 75% of its total K_2O need by silking time.

Potash is vital in opening leaf stomates and producing and translocating sugars to the developing ears.

Can we sustain high corn yields? Good farmers do by making sure their soil can supply ENOUGH plant food in RIGHT PROPORTIONS when the crop NEEDS it during the WHOLE growing season. They time their nitrogen application for best yield and environment protection.

Through right timing, a good farmer converts his soil into a SELF-FEEDER by applying recommended amounts of lime, N, P_2O_5, K_2O, S, Mg, and micronutrients. And he ALWAYS remembers silage removes much more plant food than grain alone—especially potash. He also remembers ear corn removes more plant food than shelled corn does. **THE END**

Turn A LOST Spring Into A WINNING Fall

We want to conduct a fall fertilization program based on scientific tests that have proved wise and successful. Please ship us the checked items:

	Sample Copy	Quantity Supply
WALL CHARTS—5¢ Each		
Facts FAVOR Fall-Winter Fertilization	______	______5¢ ea.
Plant Food Utilization—5 nutrients on 40 crops. (New)	______	______5¢ ea.
Plant Food Utilization—3 nutrients on 20 crops	______	______5¢ ea.
FOLDERS—4¢ Each		
Know The Plant Food Soybeans TAKE UP While They Grow—D-2-71	______	______4¢ ea.
Consider Plant Food CONTENT Of Crops—A-1-72 (New miniPFU chart-story)	______	______4¢ ea.
Know The Plant Food Corn ABSORBS While It Grows —B-2-72 (New)	______	______4¢ ea.
MINIFOLDERS—1¢ Each		
Why Is Alfalfa So VITAL?—F-1	______	______1¢ ea.
Everyone Wants TOP Yields—F-2	______	______1¢ ea.
Are You Fertilizing For BOTH Crops?—F-3	______	______1¢ ea.
PLACE MATS—2¢ Each		
Year-Round Fertilization Starts TODAY	______	______2¢ ea.
Grow TEN-Ton Alfalfa	______	______2¢ ea.
FERTILEGRAMS—(Questions & Answers) 4¢ Each		
Tips For YEAR-ROUND Fertility	______	______4¢ ea.
Tips For PROFITABLE Fall Potash Use	______	______4¢ ea.
Today's Farming Must Be UPTAKE Conscious (New)	______	______4¢ ea.
SLIDE SETS—$6.25 Per Set	**10-Day Loan**	
Fall-Winter Fertilization For Midwest—41 slides	______	______$6.25 Set
Fertilizer Time Is ANYTIME Down South—35 slides	______	______$6.25 Set

Total Payment Enclosed $______

Name ______________________ **Address** ______________________

City______________________ **State**______________________ **Zip Code**__________

Organization ____

Potash Institute of North America, 1649 Tullie Circle, N.E., Atlanta, Georgia 30329

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CONTENTS

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FORAGE PRODUCTION and use is vital to the total economy and environment of America.

The $8 billion annual income from sale of meat and milk produced on forage crops represents our largest single farm income source—greater than the combined income from cotton, wheat, rice, soybeans and tobacco . . . over twice the value of corn, even though 80% of the corn crop is fed to livestock.

Forage is grown on a **billion** acres—800 million of them not suitable for any other crop because of rock, climate, slope, etc. What better way can we use land to reduce erosion than with close-growing vegetative cover?

Forage is the prime producer of beef—80% or more of the feed used to produce beef in America is forage and 80% of the cost of producing beef is feed . . . 60-80% of the feed intake for the production of milk is forage and 60% of the cost of producing fluid milk is feed.

Some of America's most ambitious farmers are doing quite well with forages—some producing 6,000 to 9,000 lbs of milk per acre or 600 to 1,000 lbs of beef per acre from forage alone. In a few cases, some are producing as much as a ton of beef per acre from forage alone.

The prime concern of America's Grasslanders is to increase the income from forages (from meat and milk) without sacrificing soil to erosion and contributing to pollution.

FORAGE IS BIG business to the industry of this nation. Even though many areas produce only 20%-25% of their known forage potential, industry relies heavily on forage:

- **37% of annual farm equipment sales are for forage crops—about $200 million.**
- **Forage seed sales amount to $250 million—28% of the total volume.**
- **Fertilizer is another big item—24% or over $200 million.**
- **About $130 million for silos and $40 million for pesticides.**
- **Over 60% of the limestone sold annually is applied to forages.**

These sales will expand in direct proportion to the improvement of forage production and use systems.

Forage is very important in many sections of America, more so in some areas than others. By 1980, it has been estimated, we must increase meat production by 30% to feed 25 million more people. The 16 southeastern states are expected to produce 46% of this gain—Texas the leader, Oklahoma second, followed by Kentucky, Tennessee, Arkansas, Alabama, Mississippi, Louisiana, Georgia, and Florida.

THE COW-CALF proportion will be grown in small herds mostly. Currently 92% of America's beef cows and 90% of the beef cows in these southeastern states are in herds of 50 or less.

By 1975, the largest 2500 feed yards in America will be feeding out over 75% of the cattle for slaughter. So, forage is going to be produced at home for the cow herds. Sure, the herds will get larger, but they will be in much smaller units than the assembly for finishing and slaughter.

FERTILITY has been a big missing link in America's forage program. How often have we heard: **"Forages are our greatest untapped resource for new markets" . . . "you can double to triple production of grasses and legumes by increasing fertilizer use".**

In the next decade, we will see more people practicing what we preach than ever before. If this increased food is demanded, we will have no option but to produce it or import it. If the population is correctly projected, this will use more of the better lands to produce food for human consumption, putting more stress on non-cultivatable

ges

WARREN C. THOMPSON
UNIVERSITY OF KENTUCKY

THEIR PLACE AND FUTURE IN AMERICA

$8 BILLION ANNUAL VALUE

NOW ONLY 20-25% OF ITS KNOWN POTENTIAL

crop lands for forage to produce meat and milk.

In this situation, producers will move from the philosophy to action programs.

Farmers now use just a fraction of the fertilizers forages need—about 10% of the nitrogen, 13% of the phosphate, and 16% of the potash needed. Only 1.5 to 2.0% of the permanent pasture acreage, 18% of the improved pasture, and 15% of the hay and cropland pasture lands are fertilized annually.

Even at these low rates, fertilizer sales on forage crops make up 24% ($200 million) of the annual business for this American industry.

If 30% of the permanent pasture acreage was fertilized yearly at current rates for fertilized acres, this would mean 1,122,000 tons MORE nitrogen, 1,650,000 tons MORE phosphate, and 1,550,000 tons MORE potash—still only ⅓ of our known response for this crop.

Yet, it would represent 50% of the total present fertilizer sales for all crops in America.

Up until now, farmers have been able to produce all the meat and milk we need with this low-level fertilizer treatment. What about the future? It is doubtful. As grain production takes over more and more level and less erosive lands, producing meat and milk on the rougher lands will become more essential to retain our present food diets.

Table 1 shows today's pattern of fertilizer use:

Crop	Total Acres (000,000)	Annual Fertilized Acres (000,000)
Permanent Pastures and Range	486	**7.3**
Improved Pastures	36	**6.5**
Hay & Cropland Pasture	110	**16.5**

Table II shows how much fertilizer those acres receive yearly.

Crop	Pounds Used Per Acre Fertilizer N	P_2O_5	K_2O
Permanent Pasture & Range	20	30	10
Improved Pastures	70	73	70
Hay and Cropland Pasture	34	48	44

Only the improved pastures get anywhere near the rates recommended. This average level would not provide acceptable yields even by today's standards (except in few cases), let alone those of the future.

In addition to using more fertilizer and lime, we must (1) find and use better adapted, higher yielding varieties more able to withstand all environmental conditions . . . (2) harmonize livestock systems with the pattern of forage crop production.

For example, schedule calf births during time of year that provides best quality feed for the beef cow's milk needs and rapid re-breeding. This will come mostly under grazing conditions to reduce overhead costs, especially in the hilly areas.

While the cow is "dormant" or dry and pregnant, she needs about ½ the feed needed while milking. By synchronizing animal management with feed production, the grower can feed her through this period mostly on crop residues and stockpiled material accumulated and not used during the productive season.

Specialization has already affected much of the farming community. Beef cows and calves will be concentrated where grazing crops are grown, where forage is abundant, and where row crops are hazardous to produce.

Backgrounding will also be done in these areas as better higher energy feeds are produced to supplement grazing crops and also in the areas that have plenty of quality row crop residue.

Feeding out, for the most part, will go where the grain feed is produced. Some feeding will take place in the cow-calf areas, but it will be only a small fraction compared to the entire picture.

Dairy production will remain pretty much at the same location. Again, it's a matter of feed—and 60-80% of this feed intake for dairying is forage.

Yes, forage is big business in America—and it will get bigger with demand for more human food. If this crop's $8 billion annual value represents just 20-25% of its known potential, our future looks bright. **THE END**

TEACHING AIDS

ROGER L. COURSON
UNIVERSITY OF ILLINOIS

A LIVEWIRE has no trouble beating a deadline. But some do it with less sweat than others. Do you need accurate, up-to-date material or teaching aids on agriculture to use in your program or business?

The College of Agriculture at the University of Illinois has a "Materials Center" called **VAS**—Vocational Agriculture Service. It produces and distributes teaching aids and information on most phases of agriculture . . . for schools, colleges, individuals, and businesses. About 40 percent went to other states and individuals last year. It is priced only to recover the cost of production.

The **VAS** catalog lists nearly 500 aids—from filmstrips and tape recordings to subject-matter pamphlets and overhead transparencies.

The "lesson size" subject-matter pamphlets make up the basic student text material in Illinois agriculture classes. They are also great for individuals to answer questions on agriculture and its related occupations. Each subject-matter unit is checked by one of the College Specialists before being released.

FORTY OF THE 158 subject-matter units cover Plant and Soil Science. The others divide about equally among Ornamental Horticulture, Animal and Dairy Science, Agricultural Economics, and Agricultural Mechanics. A new growing category is Agricultural Business.

These units cost about 1 cent per page, running from 8 to 40 pages. For example:
VAS 4040a Corn Insects and Their Control, 20 pages—$.25

OVER 100 FILMSTRIPS are also available in these study areas—35 mm. single-frame, for standard filmstrip projector or for cutting and mounting as slides. No script is needed because all the text is included on the frames. They are available on sale rather than loan basis. For example:

708 Soil Color, 47 frames — $3.00
732 Corn Diseases in Illinois, 48 frames — $3.05
798 Recognizing Herbicide Injury, 61 frames — $3.45

New filmstrips on agriculture in "Ecology" are being developed . . . with tape recordings and programmed information for individualized instruction or adult class presentations.

PREPARED SETS of visuals and overhead transparencies are also available. **The Visuals:** 8½" x 11" instructional illustrations on heavy paper for making transparencies for overhead projection, for use with an opaque projector, or for direct viewing.

The Transparencies: printed on plastic for use on an overhead projector.

Each set is in a manila pocket folder for filing. Over 1000 are available in these various sets. Visuals cost about 3 cents, transparencies 5 cents each. For example:
Visuals: Weed Identification, Set of 33 — $ .95
Transparencies: Soil Science, Set of 32 — $1.70

New materials are constantly being developed. For teaching aids, write:
Vocational Agriculture Service
University of Illinois
434 Mumford Hall
Urbana, Illinois 61801
THE END

THIS FOURTH PART closes our series on the environment. There has been much demand to compress this series into a booklet for popular use—enough to warrant production. If you can use such a booklet in your area, please order your supply on page 6.

LAST IN A SERIES

Has fertilizer helped preserve our environment?

Yes—in several ways:

1—**FERTILIZER has stopped** and even reversed the decline in the fertility of our soils. When the first settlers turned that first clod, our nutrient levels started DOWN—and continued DOWN, only slowed by manure and legumes, until about 1940 when commercial fertilizers came into wide use.

2—**FERTILIZER has reduced** sediment runoff, the only vehicle for phosphorous transportation to streams. How? By enabling farmers to turn more marginal lands (too wet, too dry, too hilly, too erosion prone) into grass or natural cover, great for erosion control and wildlife-recreation in a day of MULTIPLYING mouths to feed.

3—**FERTILIZER has caused** multiplying man to disturb less of the environment by actually reducing the number of acres needed to produce food. Without fertilizer, **Dr. Aldrich** explains, Illinois would have to farm nearly 3 times its present corn acreage just to maintain today's total corn yield. This would cut down many forests, drain marshes, destroy many wildlife refuges, and plow up many parks ecologists love.

4—**FERTILIZER has insured** the feed and food needed to supply at least 25 percent of our population. Without it more than 50 million people would starve.

Could modern agricultural chemicals really mean the difference between life and death for 50 million Americans?

Apparently so. University tests continue to imply it . . . none better than recent **Virginia Polytechnic Institute** work. Led by **Dr. Robert C. Lambe,** plant pathologists planted two adjoining gardens ($^1/_{10}$ acre each) on same soil type "to determine need for fungicides and insecticides in preventing diseases and controlling insects in home vegetable production."

The results? "Frightening," **Dr. Lambe** said. The following facts (out of 13 vegetables and fruits) will make any person think about his next meal:

• **TOMATOES:**	446 lbs from five **cemically protected** rows.
	141.5 lbs from five **organically grown** rows.
• **CUCUMBERS:**	205 lbs from five **chemically protected** rows.
	28.75 lbs from five **organically grown** rows.
• **WHITE SQUASH:**	157 lbs from one **chemically protected** row.
	3 lbs from one **organically grown** row.
• **EGG PLANT:**	154.7 lbs from **chemically protected** plot.
	No crop from **organic plot** hit by flea beetles.
• **TOTAL YIELDS:**	1,954 lbs from **chemically protected** garden.
	237 lbs from **organically grown** garden.
• **TOTAL COSTS:**	$158.18 for **the chemically protected** garden.
	$141.95 for the **organically grown** garden.

Nutrient Note: To insure equal amounts of NPK (nitrogen, phosphorus, and potassium), the organic garden was fertilized with 1,000 lbs of dehydrated cow manure costing $50 . . . the chemically protected garden with 100 lbs of 10-10-10 fertilizer costing $3.15.

Someone said today's farmers have become "organic farmers" unknowingly. How?

Through chemical fertilizers that produce large quantities of organic residues on high-producing farms, **University of Minnesota soil scientist Curtis Overdahl,** says. These organic residues are incorporated into the soil . . . improving the soil physically so it holds more moisture, permits less runoff to pollute lakes and streams.

"Today's farming probably puts back twice as much organic residue as the farming of 30 to 40 years ago," Dr. Overdahl explains.

Much drugstore magazine literature calls commercial fertilizer "an intrusion of plant nutrients into a virgin environment, likely to upset the balance of nature." But **Dr. Aldrich** says there is no difference in the quality of nitrogen applied by fertilizers and by legumes and manures. He warns, "So-called natural farming accentuates a downward trend in nitrogen and other nutrients, leading to more losses of organic matter BECAUSE IT IS PRIMARILY NITROGEN that increases the rotting of materials to form such matter."

The large amounts of readily decomposable residues modern farmers return to many soils (after high-yield harvests) help pay the humus bill.

How much of our land does fertilizer actually save or substitute for?

Scientists estimate crop yield ADDED by one ton of nutrients (nitrogen, phosphate, and potash fertilizer) FREES 8 to 10 acres for other uses: suburban development, wildlife, recreation, and natural cover for better erosion control.

USDA Economic Report 92, by D. B. Ibach, projected two ways of getting our crop needs in 1980—by farming 450.8 million acres with 8.6 tons of nitrogen, phosphate, and potash fertilizers OR farming 300.5 acres with 26.2 tons of nitrogen, phosphate, and potash fertilizers. The extra 17.6 million tons of nutrients substitute for 150.3 million acres OR each ton FREES 8.5 acres.

Is phosphorus the real cause of algae growth on our lakes and ponds?

Phosphorus may not be the real villain. **Dr. Wiggans** says the process is much more complicated than some realize. He cites the work of a **prominent Pennsylvania soil scientist, Dr. Richard Terkeltoub,** who found "no discernible relation between soluble inorganic phosphorus concentration and the presence or absence of algae." He tested ponds in a 30-square mile area of eastern Pennsylvania.

Dr. Terkeltoub found algae growing in some ponds with relatively low concentrations of phosphorus and NOT growing in others with concentrations well above the so-called critical level of 15 parts per billion (ppb). And to complicate the picture, he found streams draining forested areas with little habitation or land use often exceeded 8 ppb.

"Some critics don't seem to know that some algae require about 200 times as much carbon as phosphorus," **Dr. Wiggans** explains. "One ton of algal tissue will contain 1,000 lb. of carbon and only about 5 lb. of phosphorus. This phosphorus can easily be supplied from accumulated organic deposits in bottom mud."

Dr. Wiggans says organic matter, such as sewage, is needed as a source of carbon. Bacteria use this and carbon dioxide is born. Then comes massive growth of algae. Once the process gets going, it's hard to control . . . as algae die, their carbon is consumed by more bacteria which leads to more carbon dioxide to grow more algae. The Vermont scientist says all details are not understood . . . but scientists say removing phosphorus from water effluents may not control excessive algae growth unless excess carbon inputs are also controlled.

Do nitrates actually cause eutrophication and excessive algae growth in water bodies?

It's difficult to pin the blame on nitrates. **A Soil Science Society of America report by Dr. W. H. Garman** recently explained why:

"Nitrogen is always present in lakes in ample amounts to grow water plants because an average of 0.7 to 1.0 ppm comes down in rainwater, and because more than 40 species of algae can add nitrogen to the medium through nitrogen fixation." That nitrogen fixation power enables the algae to reach into the air for much of its nitrogen. With 35,000 tons of nitrogen hovering over EACH acre, how can man or algae escape some "nitrogen influence?"

Current studies show agriculture sources to be a small fraction of nitrates entering water bodies.

What is the best way to control nitrate leaching into our ground water?

With a strong growing crop that takes up nitrate ions and free water to produce a top yield. **Dr. Victor J. Kilmer, prominent TVA scientist,** cites some reports on N losses from soils. They have shown . . .

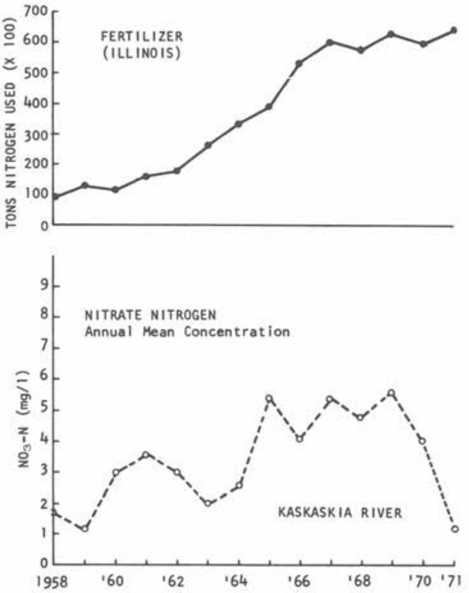
THAT deeper-rooted forages, for example, can reduce downward movement of nitrate 79 lb N/A (from 81 lb with shallow-rooted carpet grass to about 2 lb with deeper-rooted Pensacola Bahiagrass) after receiving unusually high N rates (480 lb) on sandy Florida soils.

THAT continuous crop cover reduced nitrate leaching from unfertilized silt loam, shown by Kentucky lysimeter tests—from 74 lb N leached by uncropped soil to only 2 lb N by alfalfa plus bluegrass.

THAT sloping cropped soils receiving over 30 inches precipitation yearly showed little or no water movement beyond a 4-foot depth in western Wisconsin.

THAT leaching losses of N fertilizer generally appear to be less than 5% of the N applied from soils that continuously support plant growth.

THAT nitrogen losses in runoff, as with leaching, are greatly reduced by vegetative cover—from 58 lb N/A on fallow plots cultivated with the slope to only 3 lbs on a hay rotation in Minnesota.



Many alarm bells have been rung. Have any been rung in error?

Many, **Dr. Aldrich** believes. A classic one concerned the nitrate level of the Kaskaskia River in Illinois. Four years ago a much-sought lecturer told a meeting of American scientists the nitrate level of this river had tripled between 1946-50 and 1956-68, "presumably due to runoff from agricultural fertilizer." It was an alarming approach, warning that public water supplies were threatened and the situation was a human health hazard. It got headlines and radio spots and TV klieg lights.

Unfortunately, water samples were not taken from the same place, but 100 miles apart. And further research proved nitrate concentration has NOT increased in the Kaskaskia River since 1946, with the exception of 1965.

"I am sure the erroneous conclusion those scientists received (from the much-sought lecturer) was an honest error," **Dr. Aldrich** grants. "But, to date, I have seen no comment to correct it."

If the lecturer had pursued his investigation, he would have found the nitrate level of the Kaskaskia actually plunging in 1970 and 1971 WHILE COMMERCIAL NITROGEN USAGE CONTINUED TO GROW IN ILLINOIS. Why the nitrate upsurge in 1965 and the plunges in 1970 and 71? Diligent research will find the answers.

Are pesticides new to man?

Not really. By 1900, pesticide production had reached several million pounds per year, **Utah's Director of Health, Dr. Lyman Olsen,** reports. Man has sought materials for centuries to control insects . . . to determine who would inherit the earth.

Nearly 3,000 years ago, Homer mentioned the "divine and purifying fumigation properties" of **sulfur** for fighting pests, **Utah University entomologist, Dr. Reed S. Roberts,** reports. About 1100 years ago Chinese reporters described the **arsenic** used to control garden insects.

About 400 years later Marco Polo described the oil used for mange on camels

. . . then came the use of tobacco as a contact insecticide in 1690, especially against soft-bodied insects.

Between 1800 and 1900 dozens of chemical compounds were tried and used to fight insects . . . ranging from carbon disulfide and hydrocyanic gas to nitrophenol compounds and rotenone.

Between 1930 and 1935 man introduced several new insecticides . . . ranging from chloropicrin to pentachlorophenol. Just before World War II the denitro and thiocyanate compounds . . . then in the 1940's the chlorinated hydrocarbons and organo-phosphorus compounds. And in the 1950's the carbamate insecticides.

Dr. Roberts sums it up well: "Man is the only one of millions of organisms which struggles for survival on this earth. His relationship with other living things ranges from mutualism to direct competition. It is with this latter (competition) that we are most often concerned. Historically speaking, the insect pests have been worthy competitors."

Why is the insect such a worthy competitor with man?

It has been explained this way: Man multiplies because he is the only creature able to change his environment. The insect multiplies because he is the only creature able to adapt to any changes man can make.

What is the earth's insect population?

More than 600,000 species KNOWN to science—an estimated 300,000 yet to be pinpointed or discovered by man, many believe.

What happened when Sweden banned DDT?

Certain insects thought to be under control stormed back in such numbers that Sweden's vast forest industry was threatened. After 2 or 3 years, they lifted the ban on DDT.

Can man populate as rapidly as the insect?

Some speculate if our world was destroyed, leaving just one man and one woman, it would take 1,000,000 years to build it back to what it is today . . .

. . . WHILE ants can re-build their world in two weeks.

Some emphasize it takes 3 months to develop a SINGLE human embryo . . .

. . . WHILE the coddling moth can reproduce 401,306,000,000 of his kind in 3 months.

Some contend that man learned to fly only in this century . . .

. . . WHILE the insect had accomplished flight 50 million years before the first bird appeared on earth.

Do pesticides leave poison in our food?

No. Government testers do find residues on fruits and vegetables, sometimes, but in very minute traces—so minute that the highest reading runs "no more than one-twentieth of the acceptable daily intake" set by "extremely conservative international standards," an **American Medical Association** release says.

A residue of 0.001 ppm to 0.066 ppm may show up in some milk butterfat tests . . . or 0.01 to 0.012 ppm in soybeans following corn . . . very minute traces, **(University of Illinois entomologist) Dr. H. B. Petty,** advises.

Also, crops are not harvested the day they are sprayed. Many days between application and harvest allow pesticide residue to dissipate, **Dr. Petty** explains. To get a lethal dose of a toxic insecticide from sweet corn, for example, a man would need to eat several hundred pounds of corn ensilage at one meal on the day it was sprayed OR eat the whole acre at one meal on harvest day.

How have pesticides affected our food supply?

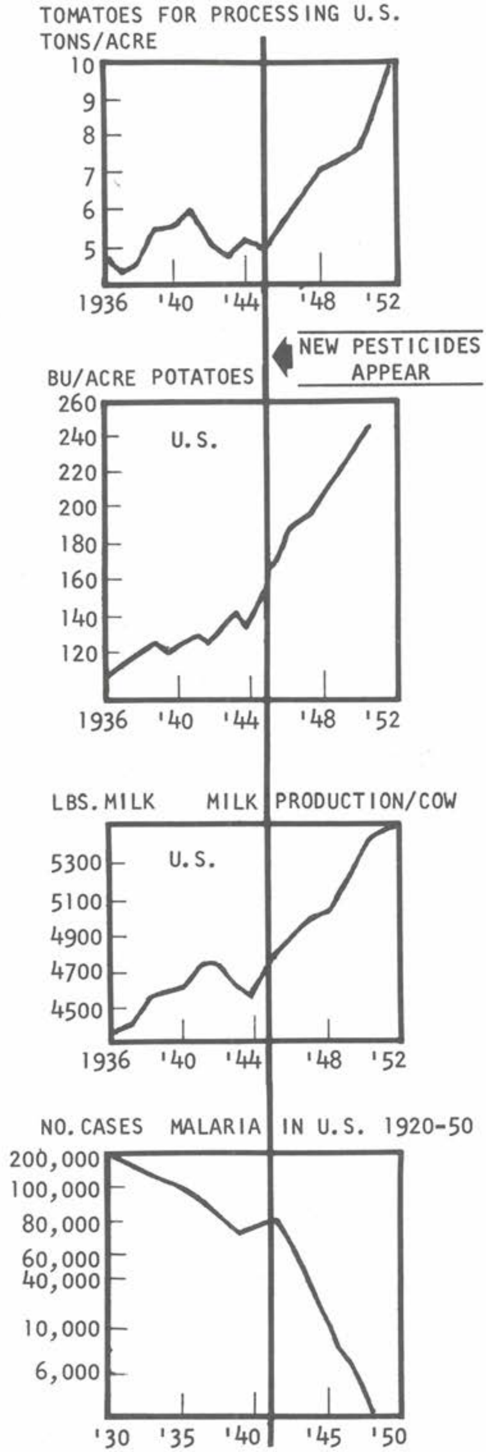
Both quantity and quality, **Dr. Petty** reports. They almost DOUBLED potato yields by controlling leafhoppers . . . ENABLED earlier corn planting (for higher yields) by controlling corn seed beetles, maggots, wireworms, and cutworms, etc. . . . SAVED millions of bushels of corn ANNUALLY from the deadly borer.

They REDUCED the percentage of wormy apples from 69% on unsprayed trees to 2.2% on sprayed trees in a typical area . . . CAUSED laws limiting insect parts in processed foods . . . CREATED a generation of consumers that demands attractive fruits and vegetables free of insect damage.

The official journal of the **American Medical Association** warns, "Without pesticides, every second or third tomato and potato crop would be wiped out, and oranges and grapefruit would be curiosities."

These may seem like far-out claims and statements. But their solid value is reflected in the trends portrayed in these 4 graphs —showing what happened to some U.S. crop yields, milk production, and malaria cases when new pesticides appeared.

This startling graph story appeared in a recent **Ohio State University** series of releases on the environment.



Do some plants tend to carry more pesticides than others?

Yes. Celery is a classic example. But **Dr. Leo Lutwak of Cornell University** estimates a man would have to eat ONLY celery for 75 years "to accumulate enough insecticides to do some damage."

What about insecticides accumulating in the human body?

Volunteers have actually eaten DDT and other pesticides to show that they are in fact excreted, an **American Medical Association** release reports. The release adds, "Some small amounts may be stored in body fat where they are harmless." Other chemicals are destroyed when they pass through the liver.

Have pesticides been checked for potential cancer agents?

For 20 years, the "teratogenic, tumorigenic, and carcinogenic properties" of DDT and other pesticides have been constantly investigated, **Dr. Petty** reports. Many **naturally occurring chemicals** in food, when extracted and fed in large doses to test animals, produce such effects.

When mice were fed all the pesticide their systems could tolerate, only 11 of the 120 test compounds induced "a significantly elevated evidence of tumors, mostly hepatomas, **Drs. J. R. M. Innes and R. A. Bates** report in the National Cancer Institute Journal. But it should be stressed the dose far exceeded anything "likely to be consumed by humans."

In another study, animals on "purified diets" developed leukemia, and adding DDT to the diet had no bearing on the development of leukemia, **Drs. Renate Kimbrough, Thomas B. Gaines, and Joseph D. Sherman** report in the National Cancer Institute Journal. The promoting factor may be a nutritional imbalance, some think. Animals on purified diets showed shorter lifespan and higher mortality rate, and adding DDT to their diet did not change this.

What is the death rate from agricultural use of pesticides?

One of the nation's most intensive farming states, Illinois, answers this very clearly. One death in the past 10 years was caused by the agricultural use of pesticides. That averages ONE-TENTH OF ONE PERSON per year.

Compare to deaths from Motor Vehicles:	2,353 per year
Firearms:	123 per year
Drugs & barbiturates:	126 per year
Aspirin:	11 per year
Lightning:	3.1 per year

How does the government test our food supply?

Through periodic "market basket" tests. **Dr. Petty** explains the process this way: "A two weeks' supply of food for a 19-year-old boy is purchased from the shelves of stores in several major cities. The foods are prepared and subsequently analyzed for residues.

"WHO (World Health Organization) and FAO (Food and Agriculture Organization) have established acceptable daily intake levels, a level of insecticide intake at which no possible harm could occur. In our intake, there is no level close to these levels which probably have a several hundredfold safety factor."

Our own Health, Education and Welfare Department and Food and Drug Administration have established tolerances that REQUIRE a 100-FOLD SAFETY FACTOR . . . and no tolerance is granted if the crop can be produced with no residue, such as, early control, etc.

What does future pest control look like from here?

All authorities seem to agree on one thing: We cannot go the route of the pure environmentalists unless we want starvation to solve the population problem. They agree chemicals, including pesticides, used to increase food production are so important to modern life that we must learn to live with them.

Tomorrow's housewife may occasionally accept less attractive fruits and vegetables . . . state and federal agencies may occasionally relax grading standards . . . but not so much that only half the wife's apple is usable, **Dr. Petty** says.

Along with the chemical pesticides will come biological controls through parasites, predators, and pathogens . . . cultural practices, including land and water management . . . mechanical and physical devices to attract, repel, or kill insects . . . sterilization and genetic manipulation . . . behaviour manipulation through hormones (largely theoretical now) . . . quarantines and other steps to prevent insect introductions.

It will be a continuing battle because some insects build up genetic immunities to many pesticides, according to **Dr. Ivan Palmblad, University of Utah botanist.** Mosquitoes, houseflies, and scale insects have shown amazing tendencies this way, just as some crop species tend to lose their disease resistance.

Why do we have so much animal waste in America?

Because we demand so much meat. We are a big meat-eating population. Our average consumption per person each year is 110 lbs of beef, 70 lbs of pork, 45 lbs of poultry, about 2 lbs of lamb and mutton, and 1½ lbs of veal. This represents 34 million cattle, 150 million hogs, and 450 million broilers PLUS breeding stock to produce these animals. And none of them are "manufactured" in the supermarket, **W. H. Witt of the University of Illinois,** reminds.

How much manure does this huge army of livestock produce?

Somewhere between 1.75 and 2 BILLION tons each year . . . enough to cover a 640-acre farm (1 sq. mi.) about 1,000 feet deep . . . **Prof. Witt** reports. And this does not include wastes from people, wild birds and animals, or zoo animals. Each person eliminates about 7 lb. of wastes per day . . . or 255 MILLION tons a year by the whole population. We have a lot of waste to place . . . somewhere.

But before we sound like an alarmist, we must admit about half the livestock wastes are widely dispersed over the land by grazing animals . . . the remaining half mostly applied mechanically in liquid or dry form on cropland, **Dr. Aldrich** explains.

"Of the total nutrient and B.O.D. (biological oxygen demand) load, only a small amount is carried to surface waters in rain runoff, though it can be very important locally," he says.

Are we doomed to mountains of manure and runoff?

No. University scientists and livestock producers are hard at work, all over the nation, experimenting with many ideas: Complete lagooning . . . oxidation ditches with rotors that beat fresh air into liquid manure to control odors . . . plow-furrow methods to return some wastes to the land . . . holding basins that trap runoff from big lots, preventing discharge of solids into streams during rain . . . complete incineration . . . and even movement of concentrated cattle feeding into drier areas, with feed hauled from wetter grain-producing areas 250 miles away. Many ideas are germinating. Solutions will come, because they always have.

Can farmers use city sewage wastes (sludge) to fertilize their fields?

If they want to risk loading their land with heavy-metal contaminants—such as nickel, lead, and cadmium, all known toxics.

Dr. Robert Metcalf, eminent head of the University of Illinois Zoology Department, warns, "We are not dealing with the same kind of sludge our fathers and grandfathers did. Today's wastes contain many different contaminants, ones that came out of the last years of the Industrial Revolution."

He then asks, "Who would like to have 63 lbs per acre of zinc put on his best farm land two or three times a year?"

He describes the amount of heavy-metal contaminants that would enter each acre with 1 inch of 3% sludge as "alarming." He cites the work of **Drs. B. B. Ewing and R. I. Dick (reported by University of Texas Press)** showing 55 lbs of lead, 30 lbs of chromium, 15 lbs of copper applied per acre-inch of 3% sludge—large doses of such metals.

And he warns, "If you look at the world's total production of heavy metals and the amount we use in the U.S.—between 25 and 50% of world production—you will see why I am alarmed."

What would continued applications of these metals do to our food crops and soils?

No one knows. These metals are chemically held by the soil, therefore accumulated. **University of Illinois scientists T. D. Hinsley, O. C. Braids, J. E. Molina, and R. L. Judson** are testing fertility benefits of sludge against possible pollution hazard.

What would happen if U. S. agriculture was confined to natural resources of plant nutrients as some recommend?

If all animal wastes could be spread over the 500 million acres of arable U. S. soils, they would average ½ lb of nitrogen per acre, **Dr. White-Stevens** calculates. In other words, the nation's total manure production "aggregates about 2% of the current fertilizer nitrogen use." Add all the nitrogen from domestic sewage and you "still amount to less than 4% of the present usage." **Dr. White-Stevens** concludes, "Were U. S. agriculture confined to natural sources of plant nutrients . . . the nation would rapidly starve to death."

In what other ways—besides removing carbon dioxide and adding oxygen—do well-fertilized plants fight pollution?

They trap airborne particles in the fine hairs on leaves and stems and hold the particle until rain washes it into the ground. In large cities, for example, trees are such good dust catchers they must be washed occasionally with a detergent, **University of Tennessee scientist James Pointer** reports.

They dilute polluted air with their own uncontaminated air they have released.

They deodorize unpleasant odors with the fragrance of their own blossoms.

They absorb toxic gases as long as functioning leaf tissue remains . . . with evergreens operating year-round.

They warn us of dangerous pollution levels by showing injury from air pollutants we can't always see (such as sulphur dioxide), **Auburn University horticulturist Terry Wilbourn** reports.

They cool the air on torrid summer days. On a 94° day, for example, the surface of **bare soil** registered 114° F while a **grass surface** just six feet away registered 84° F—a 30° difference—reported by **Drs. V. B. Youngner and V. A. Gibeault of the University of California.** Even greater differences occur with paved surfaces or artificial turf, emphasizing the athlete's plight.

Are weeds a hazard, a form of pollution?

One of the worst. A weed killed Abraham Lincoln's mother, Nancy, causing the family to move from Indiana to Illinois. She died from "milk sickness," passed on through cattle that had eaten the white snakeroot plant.

They had no chemical weed fighters in Nancy Lincoln's day. They were at the mercy of the many plants that can poison man and his animals . . . that can clog his respiratory system, his farming equipment, and his streams . . . that can scratch him and puncture him and infect him . . . that can "dis-flavor" his milk, steal nutrients from his crop, and drag down his yields almost to nothing.

The white snakeroot weed that killed Nancy is still around . . . and probably most of the others that plagued her people. The durability of some weed seeds is incredible . . . such as 91% of the Jimson seed and 38% of the velvetleaf seed that germinated after 38 years' storage in the soil . . . or the lambsquarter and spurry seeds growing after 2,000 years' reputed preservation . . . reported by **Wes Ritchie, managing editor of the highly respected FARM PROFIT magazine.**

How big a problem are weeds today?

Tremendous any way you look at them, **Mr. Ritchie** reports. For example:

THEY ROB plants of nutrients and water all summer and then try "to elbow them out of the combine at harvest." **One pigweed per foot of row** in 30-in rows cut soybean yields 25% (from 60 down to 45 bu/A) in Illinois research. **Two thistle plants per square yard** cut wheat yields 20% in Canadian research.

THEY COST U. S. farmers (in yields, crop quality, and control steps) over $5 billion in a recent year . . . **or** nearly one-third U. S. net farm income annually . . . **or** more than $1,500 per farmer . . . **or** more than all insects, plant diseases, and animal pests combined.

Can you bring such huge figures down to a homeowner's understanding?

Maybe. **Mr. Ritchie** suggests each "weekend weed warrior" check the weeds on his lawn. Now multiply the problems on a ½, 1, or 2-acre lawn times a 200, 500, or 2,000-acre farm. Get the idea? Take a row crop like soybeans, for example. At normal planting populations, three soybean seeds could be battling up to 4,000 weed seeds for the same nutrients and moisture. What a miracle our "three daily meals" are!

How prolific are weeds?

It boggles the mind. The parasitic witchweed up to 500,000 seeds per plant . . . the biennial wormwood over 1,000,000 seeds . . . and up to 200,000,000 weed seeds in an acre of land . . . are all possible.

A 10-year control program can reduce that 200 million to about 250,000 seeds per acre, **Mr. Ritchie** reports. But let just 1% of a typical uncontrolled stand of weeds escape control of cultivated land and you can ADD about 50,000,000 NEW weed seeds to that acre. Four Minnesota locations studying 24 plots counted 98 to over 3,000 viable weed seeds in the top 6 inches of one square foot of soil . . . meaning between 4,000,000 and 133,000,000 seeds per acre in the upper 6 inches of soil, **Ritchie** explains.

What is the best defense?

Most growers find the combination attack (cultivator and herbicides) does the best job. Even so, the battle goes on year in and out. He who once said the poor we will have with us always might well have included weeds, also.

Do herbicides (weed killers) pollute our food?

A market basket survey recently showed a typical diet giving a person about 0.00006 milligrams per kilogram of body weight per day of herbicide. At that rate, it would take 670 years for a 150 lb person to consume 1 gram (1/28 oz) of herbicide in his food.

Herbicides don't generally live long . . . don't normally store in animal body tissue . . . don't concentrate in the food chain. Low rates usually do the job once a year.

Are herbicides important to no-till farming?

Yes. **Purdue agronomist J. L. Williams, Jr.** has shown how loss of weed control can REDUCE yields 26% in conventional tillage, 59% in chisel systems, and 74% in no-tillage.

Two Kentucky farmers experienced this very dramatically when heavy rain or other factors caused their regular chemical program to "come up short." **The Kentucky Farmer** magazine reports how they used a "rescue herbicide" to save valuable corn crops threatened by 6-8 inch weeds. The herbicide enabled the corn to go on to 100 bu/A near Hopkinsville, 128 bu/A in Warren County.

This is important because no-till farming, which is coming in big, helps control sediment runoff, greatest polluter in agriculture.

Who is responsible for today's improved level of living?

Farmers . . . agriculture . . . to a great degree, though the average person will rarely think of the farmer. On our full stomachs, we usually credit the industrialists, scientists, and inventors with the great strides of this century. The following steps boil down FOUR FREEDOMS **Editor Ritchie** said farmers have brought the American people:

Freedom of manpower: In 50 years, more than 15 million workers have been "freed" to produce things other than food . . . clothes dryers, autos, antibiotics, atomic energy, vaccines, computers, electric can openers, etc.

Freedom of income: Fifty years ago, about 80% of a man's income went into basics—food, clothing, shelter. Today less than 65%. That leaves 35% of a family's take home pay for travel, recreation, education, health, and other items adding to life's quality. Americans now spend hardly 18% of their income on food each year . . . or about 4% less than 10 years ago.

Freedom of time: From an average work week of 51 hours in 1920 to 40 hours today, with paid vacations that were few and far between a half century ago. If food, fiber, and shelter were still costing 80% of consumer spending, workers could hardly have reduced their work week.

Freedom of space: When we were a nation of 107 million people, we used 350 million acres to grow our food and fiber. Today we feed 200+ million and EXPORT food from less than 300 million acres. Without such farm efficiency, we would need 530 million acres just to feed us, with nothing left to export. Farm efficiency has protected soil and water, wildlife, and recreation areas.

Why are farmers . . . why is agriculture . . . understood so little . . . appreciated so little?

Agriculture IS appreciated—but taken for granted. We have raised a generation that takes for granted our abundant, nutritious, service-laden farm products . . . a generation unaware that no other people on earth pay so little for so much, hardly 18¢ out of each take-home dollar . . . a generation that will not buy insect-damaged or diseased fruits and vegetables . . . a generation that EXPECTS to find a wide variety of food in their supermarket YEAR-ROUND . . . a generation that can never recall shortages, only surpluses and "high-cost politics" of all this abundance . . . a generation whose character has never been tested by hunger or even the threat of it.

Then farming must be an important business.

Very important! Farming is the nation's largest industry and most important business for 6 reasons:

BECAUSE it employs more people (4.5 million) than any other industry—more than the transportation, steel, and auto industries combined.

BECAUSE it spends over $40 billion a year for goods and services needed to produce our food . . . another $13 billion for its own food, clothing, medicine, furniture, etc.

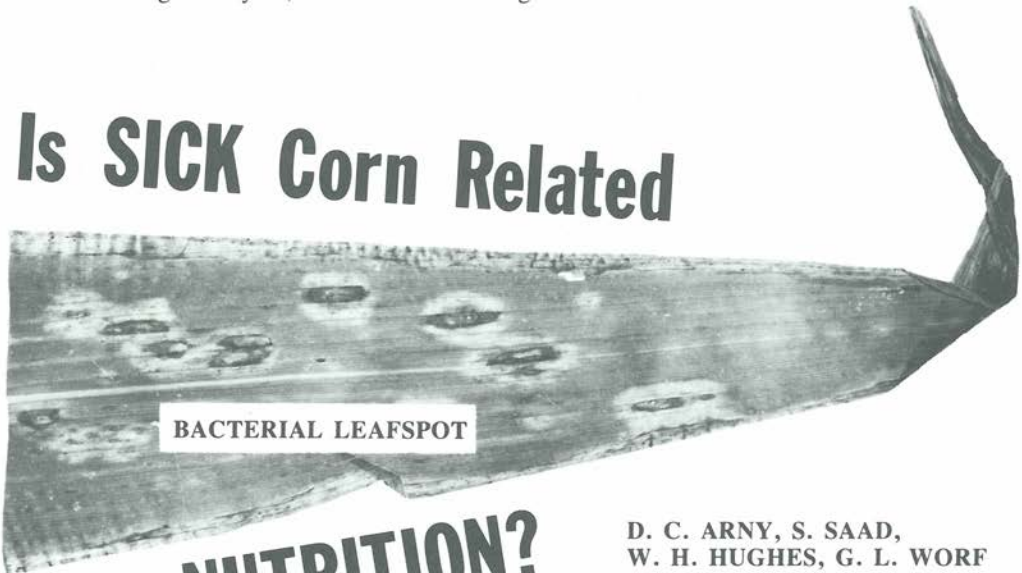
BECAUSE it pays $5.8 BILLION of our tax load—in real estate, personal property, income, and sales taxes.

BECAUSE it exports in a given year nearly $1 billion MORE agricultural products than our nation imports—helping offset deadly deficits ($1 billion in one industry, nearly $3 billion in another) in our nation's balance of trade.

BECAUSE its total assets could buy up half of the New York Stock Exchange (market value of all corporation stocks) on any given afternoon.

BUT MOSTLY BECAUSE one year's Iowa corn crop (1.18 BILLION bushels) can supply enough oxygen in one season to keep every person in New York City breathing for a year, not to mention eating.

Is SICK Corn Related to NUTRITION?



D. C. ARNY, S. SAAD,
W. H. HUGHES, G. L. WORF

UNIVERSITY OF WISCONSIN

A BACTERIAL LEAF disease we call "Chocolate Spot" was widespread over Wisconsin in 1971. The spots were **dark brown**, more or less **oval shape**, and up to **one inch long.** A distinct **yellow halo** surrounded them, as the leaf above shows.

The spots frequently ran together causing considerable dead leaf area, particularly along the leaf edge. The spotting and dead areas were more pronounced on the outer half of the leaf.

The disease had been observed, but not identified, in 1970 in a K-deficient plot at the Arlington Experiment Station. In 1971, it was found in 12 counties and was likely present in others.

The amount of damage from the disease is unknown at present. Plants were not killed, but effective leaf area was reduced.

THE CAUSE has been traced to a bacterium, *Pseudomonas syringae*. This organism has caused Holcus Spot for some years, but the symptoms are somewhat different.

In Holcus Spot the spots become brown centered with a somewhat darker brown to reddish brown narrow border and a narrow yellowish halo. Holcus Spot has been associated with rainy weather, while the "Chocolate Spot" developed under dry conditions in 1971.

The severity of the disease in the low K plot at Arlington prompted soil tests at several locations where the disease was

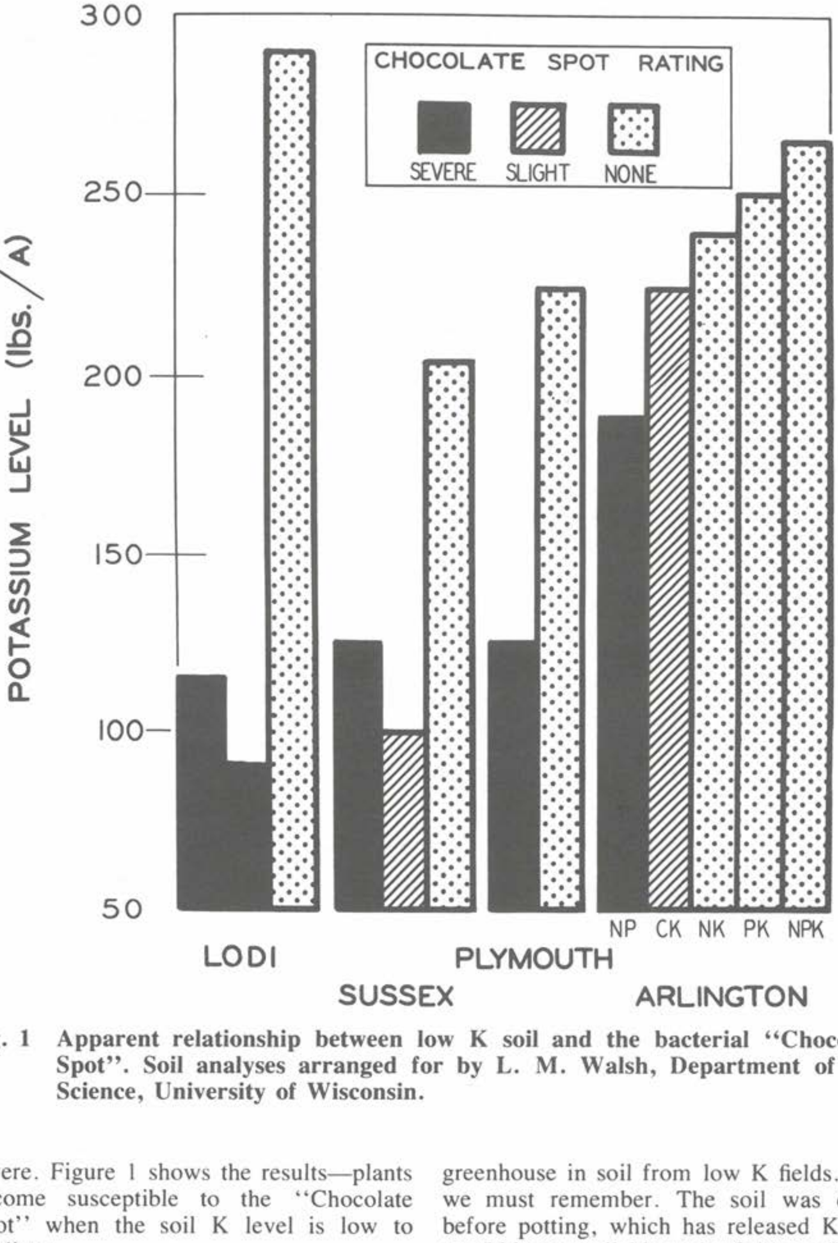


Fig. 1 Apparent relationship between low K soil and the bacterial "Chocolate Spot". Soil analyses arranged for by L. M. Walsh, Department of Soil Science, University of Wisconsin.

severe. Figure 1 shows the results—plants become susceptible to the "Chocolate Spot" when the soil K level is low to medium.

IN GREENHOUSE sand culture, we have been able to produce infection **only when K is absent from the nutrient solution.**

Plants grown at one-fourth the level of normal Hoagland's solution have not become infected nor have plants grown in the greenhouse in soil from low K fields. But we must remember. The soil was dried before potting, which has released K that would be unavailable under field conditions in some studies. This could explain the lack of infection on the plants grown in soil.

Observations on a few hybrids in the field and a few inbreds and hybrids in the greenhouse indicate differences in reaction to the disease under low K conditions. **THE END**

Table Beet RESPONSE

to Concentrated Superphosphate (CSP) and Potassium Chloride (KC1)

Nathan H. Peck
New York State Agricultural Experiment Station
Cornell University
Geneva, New York

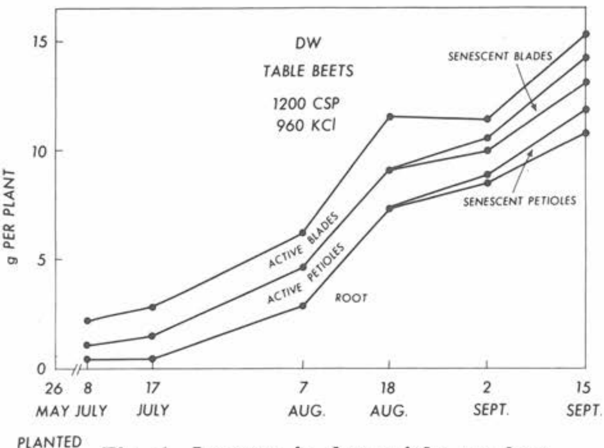


Fig. 1. Increase in dry weight per beet plant.

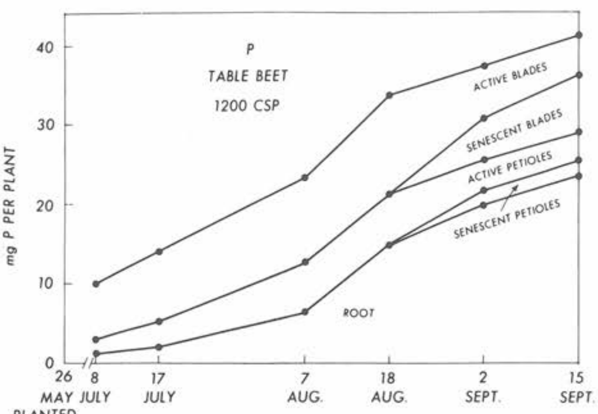


Fig. 2. Uptake of P per beet plant

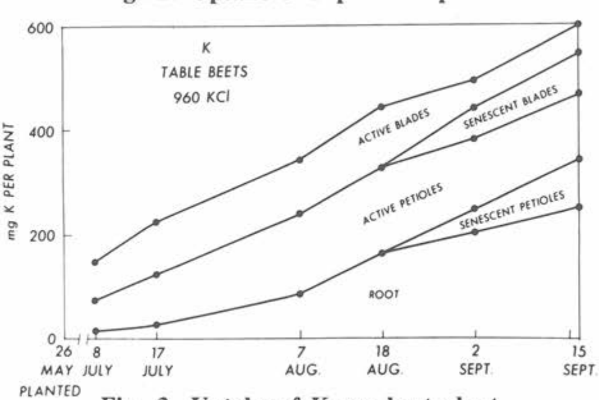


Fig. 3. Uptake of K per beet plant

TABLE BEET plants were grown in soil that had received six annual applications of 4 rates of concentrated superphosphate (CSP) and 4 rates of potassium chloride (KC1).

Ruby Queen, a variety commonly used for processing, was used to study uptake of P and K, as well as Na, Ca, Mg, Mn, Zn, N, NO_3, C1, S, and Fe, and the yield and quality of the roots for processing.

Increase in dry weight of the plants **(Figure 1)** and uptake of P and K by the plants **(Figures 2 and 3)** occurred throughout the growing season. Increase in the dry weight of the enlarged portion of the roots, the part used for processing, was very rapid during the last part of the growing season **(Figure 1)**. The leaf blades and petioles contained large amounts of P and K **(Figures 2 and 3).**

At harvest time the plants contained a maximum of 37 lbs of P and 630 lbs of K per acre **(Figures 4 and 5)**.

CSP without adequate KC1 decreased yield of table beet roots, while CSP with adequate KC1 increased yield of roots (Figure 6). KC1, especially with adequate CSP, caused a large increase in yield of roots and total dry weight of plants (Figures 6 and 7). THE END

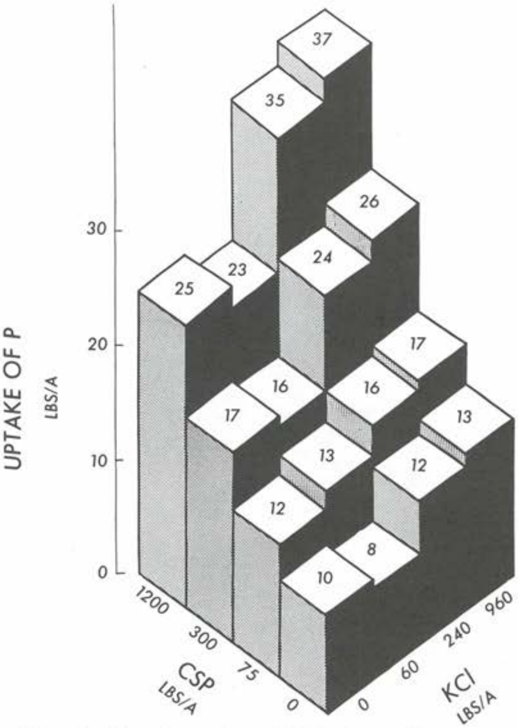


Fig. 4. Total uptake of P by beet plants

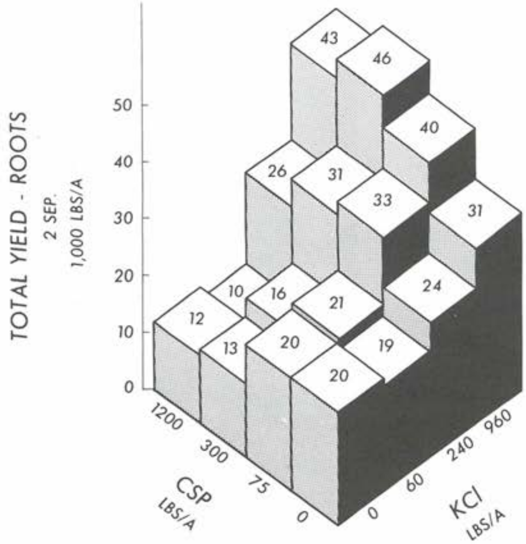


Fig. 6. Yield of roots of beet plants (fresh weight)

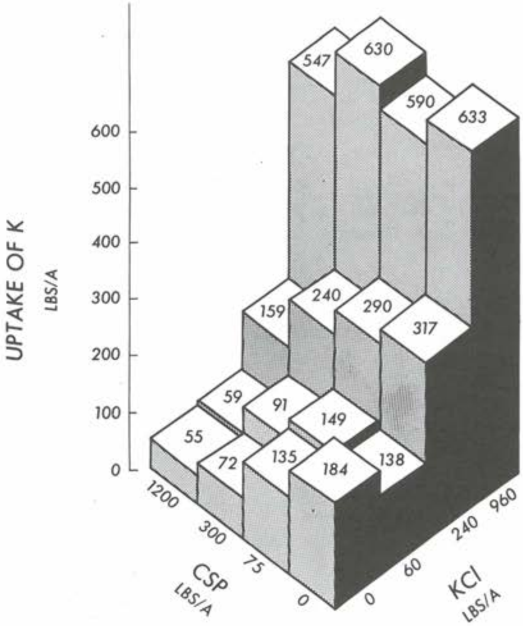


Fig. 5. Total uptake of K by beet plants

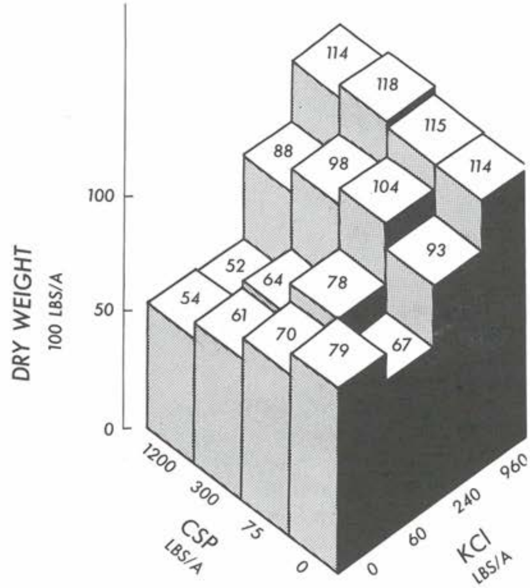


Fig. 7. Total dry weight of beet plants at harvest time

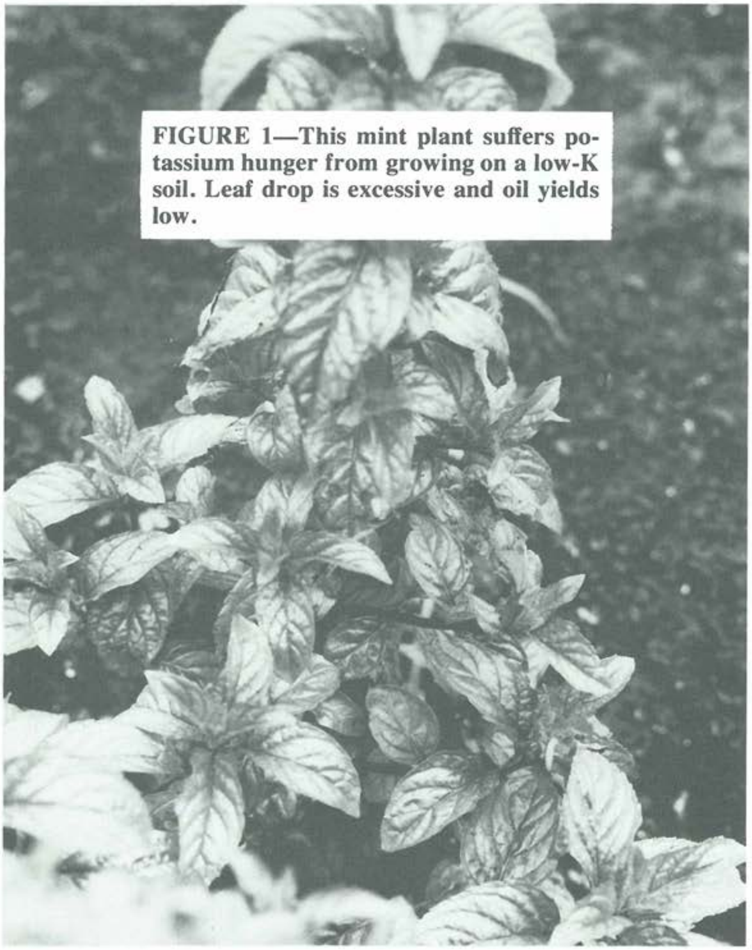


FIGURE 1—This mint plant suffers potassium hunger from growing on a low-K soil. Leaf drop is excessive and oil yields low.

New way to probe plant nutrient NEEDS

John C. Shickluna Michigan State University

LOOKING FOR a new way to probe nutrient contents of plants—such as potassium needs on organic soils?

The electron microprobe X-ray analyzer is a valuable tool, as demonstrated with mint plants on organic soils. It can be used to test nutrient status of other crops.

Organic soils are naturally low in potassium. Unlike mineral soils, they contain only low amounts of those clay minerals (such as illite) that can release potassium throughout the growing season and cannot fix applied potassium.

Potassium is relatively loosely bonded or held in organic soils. Because of this characteristic and their natural position on the landscape, they often flood, moving what little potassium they have out of the plow layer or the root zone.

This requires close monitoring of organic

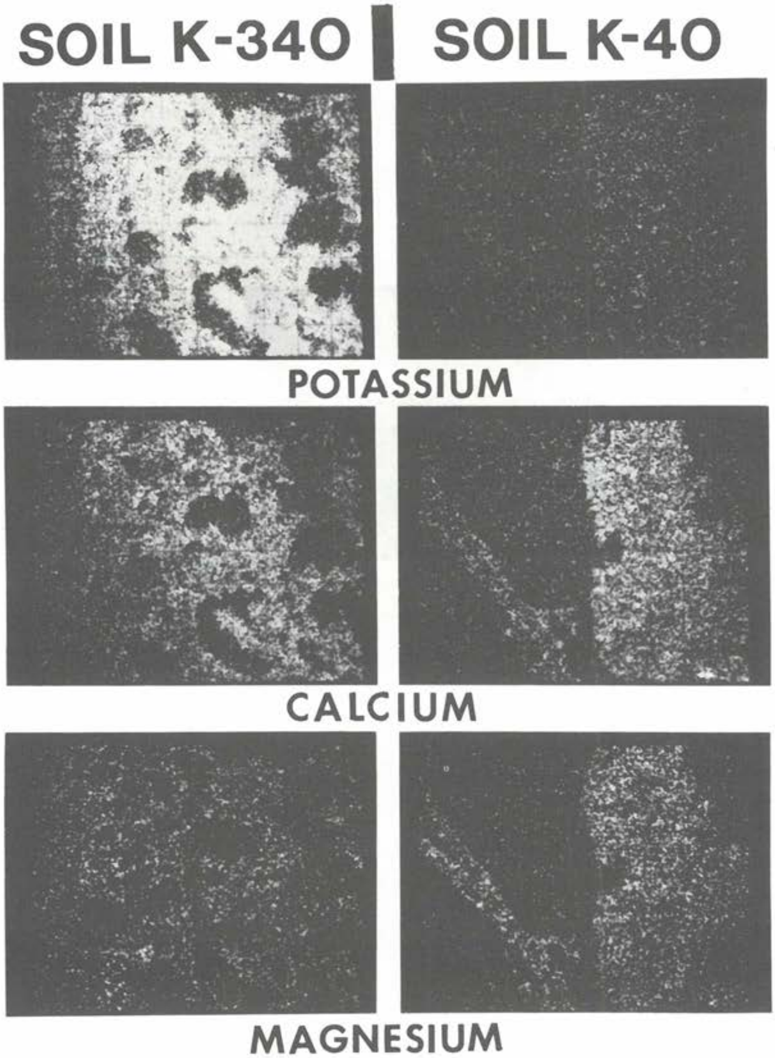


FIGURE 2—Here is the electron microprobe's visual picture of K, Ca, and Mg in mint stem tissue harvested from soils containing 340 and 40 lb K/A. Note high intensity of white dots in stem from high-K soil, low intensity from low-K soil.

soils by soil tests during the season to insure an adequate supply of potassium STAYS available for high yields and quality crops.

PLANTS GROWING on low-potassium soils must grow under potassium stress, and K deficiency will develop, unless supplemental potassium is sidedressed or applied. **Figure 1** shows typical symptoms of potassium deficiency on the mint plant. Leaf drop greatly exceeded healthy plants. **Plants with adequate potassium increase oil yield by 3.5 times.**

Figure 2 shows oscillograms obtained by the electron microprobe X-ray analyzer (Applied Research Laboratories) of mint tissue harvested from soils containing 340 lb and 40 lb of available potassium per acre. Oscillograms provide a visual picture of nutrient concentration as related to plant tissue and morphology.

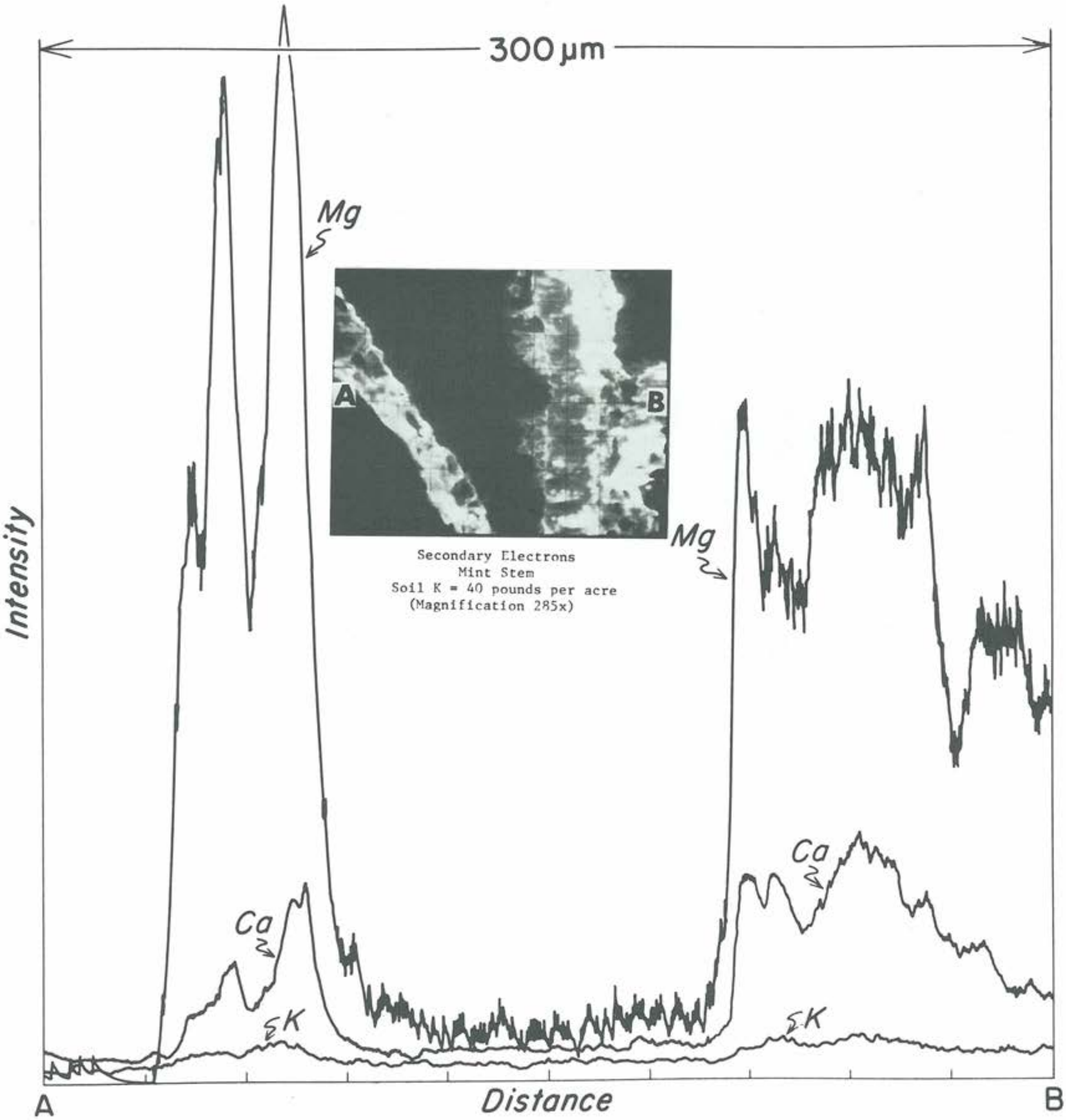


FIGURE 3—Line profile analysis of a mint stem grown on 40 lb K/A soil. It shows distribution of K, Ca, and Mg using the electron microprobe X-ray analyzer. The line scan progressed from Point A to B as on the inserted oscillogram (K = 1000 cps, Ca = 1000 cps, Mg = 100 cps full scale).

Electrons excite potassium molecules and subsequently emit X-rays. A high intensity of white dots means high potassium in the mint stem, from the soil containing 340 lb K. A low intensity of white dots means low K in the stem, from the soil with only 40 lb K.

MINT TISSUE harvested from low-potassium soil contained more calcium and magnesium than potassium, but tissue from

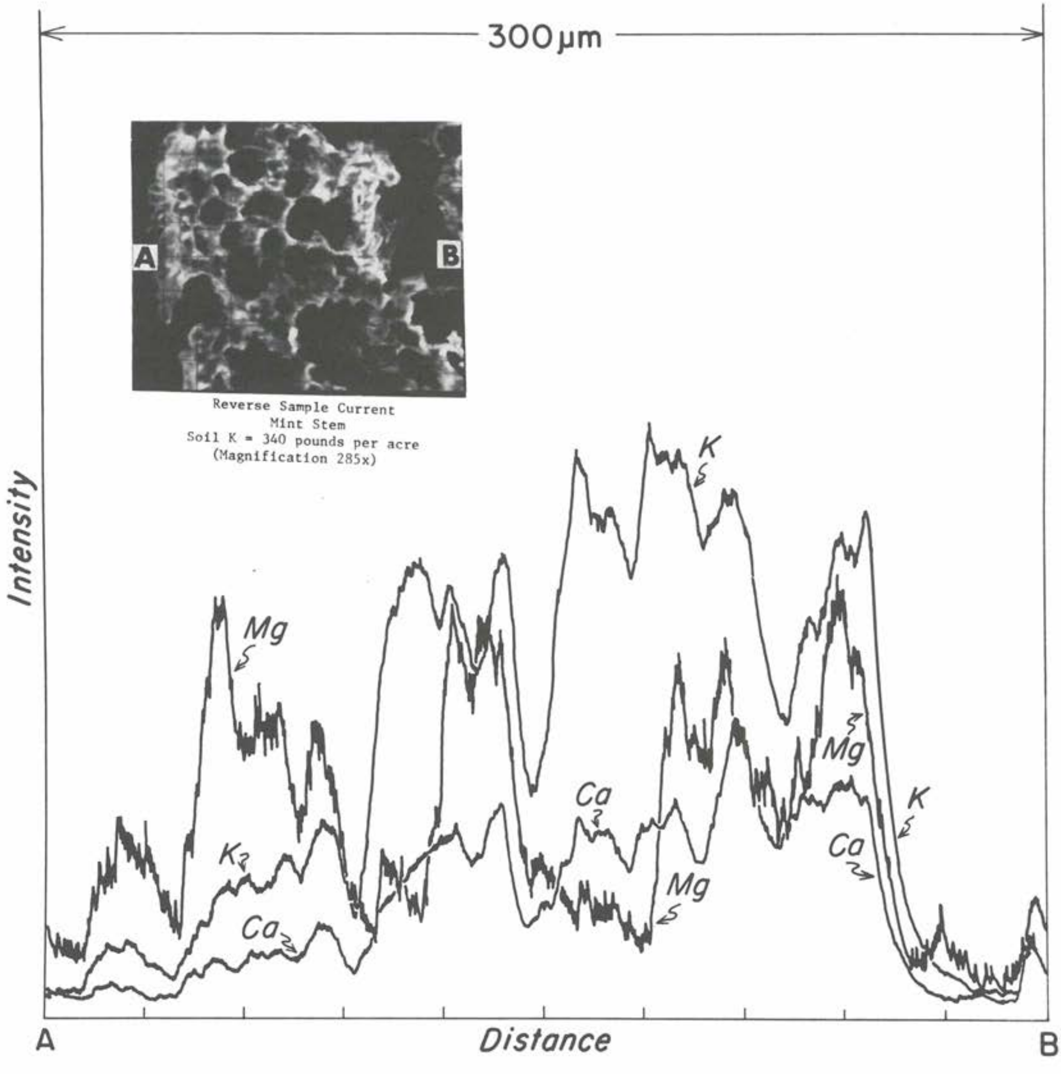


FIGURE 4—Line profile analysis of a mint stem grown on 340 lb K/A soil. It shows the distribution of K, Ca, and Mg using the electron microprobe X-ray analyzer. The line scan progressed from Point A to B as on the inserted oscillogram (K = 1000 cps, Ca = 1000 cps, Mg = 100 cps full scale).

high-K soil contained more potassium than calcium and magnesium, the oscillograms showed.

Figures 3 and 4 show line profile analyses of the same relationships. The line scans progress from points A to B as shown on the inserted oscillograms.

Potassium distribution is uniformly low across the 300 micron portion of mint stem harvested from the 40 lb K/A plots (**Figure**

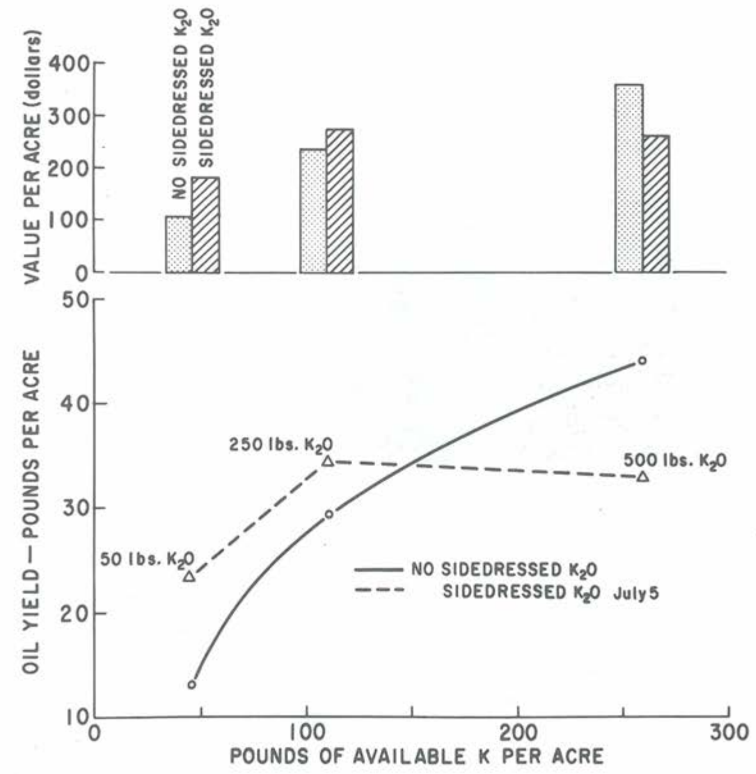


FIGURE 5

Sidedressed Potash Increased Oil And Dollars Per Acre

3), while a high-potassium intensity resulted from the mint tissue harvested from the high-potassium soils **(Figure 4).**

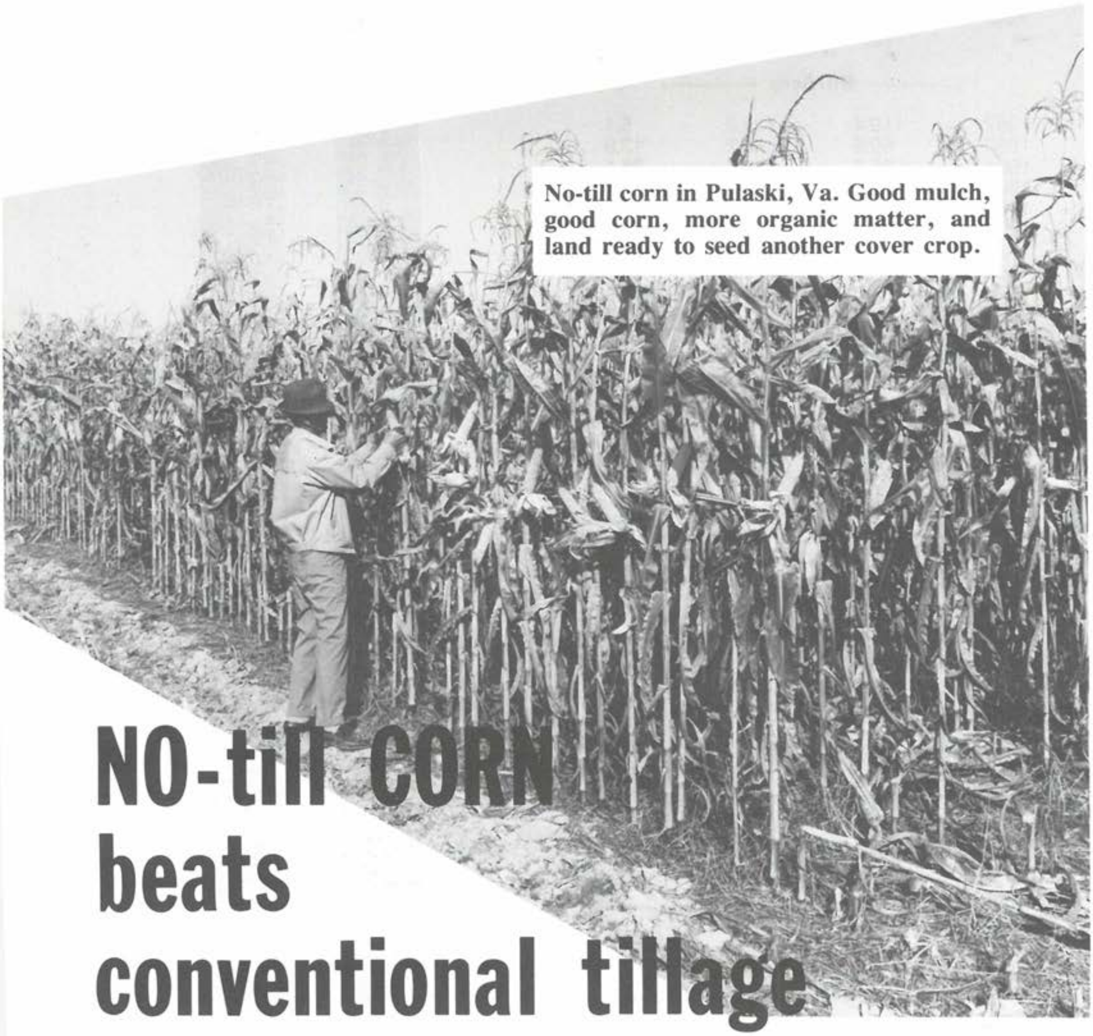
Nutrient imbalances resulted in higher calcium and magnesium levels than potassium in the mint tissue grown on the low-K soils **(Figure 4).** This resulted in low mint yields and less dollars returned per acre.

Sidedressed potash at lower potassium soil test levels or higher test levels increased both oil yields and dollars returned per acre **(Figure 5).**

Acknowledgments: The author gratefully acknowledges the assistance of Dr. H. P. Rasmussen and Mr. V. E. Shull for assistance in operation of the electron microprobe . . . and Drs. J. F. Davis, R. E. Lucas and J. B. Fitts for assistance in collecting the field data. **THE END**

New Environment Booklet

THIS MAGAZINE'S 4-part series on the environment is now being condensed into a pocket-sized handbook for use in answering many questions about agriculture's role in our environment. Demand has warranted a first printing of 100,000 copies. If you can use a supply (at 7¢ per booklet), please order on page 6.



No-till corn in Pulaski, Va. Good mulch, good corn, more organic matter, and land ready to seed another cover crop.

NO-till CORN beats conventional tillage

W. W. MOSCHLER, G. M. SHEAR, D. C. MARTENS, AND D. F. AMOS
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

TEN YEARS of continuous corn on Lodi silt loam at Blacksburg, Virginia has resulted in a 20.6% average yield increase for no-tillage over conventional tillage, as **Table 1** shows.

Soil fertility has also increased to a greater extent, although the fertilization and management for both have remained constant. Lime and fertilizer use is so important in continuous corn production that good corn crops cannot be produced without it, regardless of tillage method. But lime is more critically needed with no tillage, especially in the early years.

What steps do we believe necessary for the most successful no-tillage corn?

Table 1. Corn Yields From Two Methods

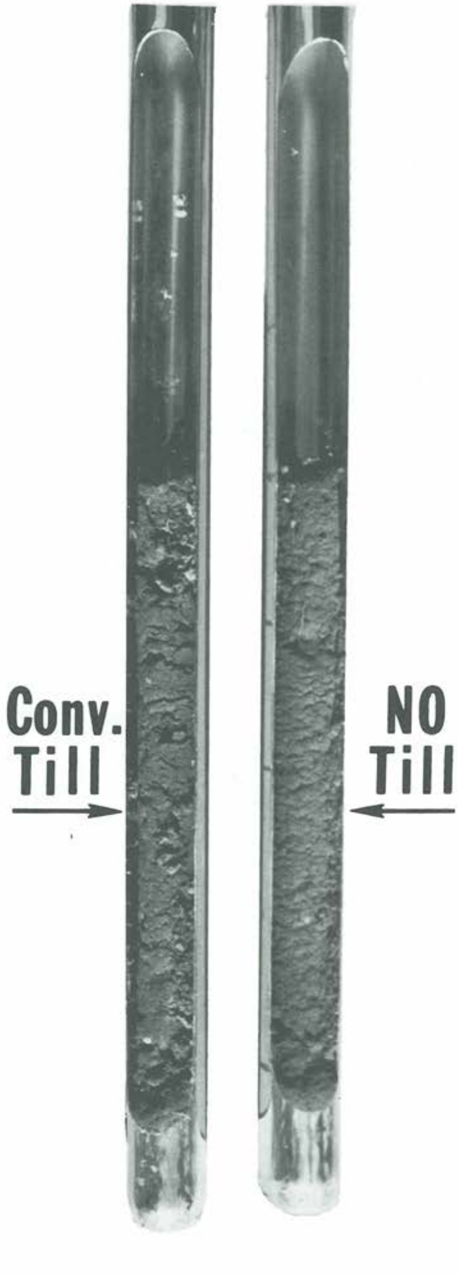
Year	Conv. Till	No Till	Increase from No-Tillage
	Bu/Acre		%
1962	110.4	116.0	**5.1**
1963	60.3	68.7	**13.9**
1964	95.7	122.6	**28.1**
1965	82.5	96.9	**17.4**
1966	113.1	120.0	**6.1**
1967	75.7	126.3	**66.8**
1968	107.8	133.9	**24.2**
1969	99.5	154.0	**54.8**
1970	129.7	144.4	**11.3**
1971	152.6	156.7	**2.7**
Average	102.7	123.9	**20.6**

FIRST, we provide a good cover crop. Abruzzi rye has been our best. We seed it in the fall, by October 15 if possible, by drilling the seed, after lightly discing the corn stubble from the previous crop. Then apply about 50 lbs/acre of nitrogen at seeding to promote as much growth as possible before cold weather.

We kill the rye with suitable herbicides in the spring when 12 to 24 inches tall and immediately plow it under for conventional tillage. This is usually several weeks before the intended planting date, normally about the first of May. If no cover crop is provided for mulch, a cover of chopped corn stalks supplemented with manure may be a reasonably good substitute. But the results reported in this article were made with an annual cover crop and commercial fertilizer.

SECONDLY, we fertilize by surface application. Our yearly fertilizer application has been 150-130-122 lbs/acre of N, P_2O_5, and K_2O, respectively, including nitrogen applied at rye seeding. We now believe this rate is too low for maximum yield, especially the potassium and possibly the nitrogen portions.

We started with a fertile soil. But after removing 10 corn crops (both grain and stover) averaging more than 100 bushels per acre, soil tests show available phosphorus has increased and available potassium has decreased with both types of tillage. Comparing no tillage to conventional tillage after 10 years showed available phosphorus and organic matter increased much more with



Lodi silt loam soil after 10 consecutive corn years. The no-till soil is more friable, crumbles more easily, and holds more moisture than conventional-till soil.

Table 2—Soil nutrients (0-8 inches deep) before and after 10 years of conventionally-tilled and no-tilled corn.

Tillage Method	When Sampled	Available P_2O_5	Available K_2O	Organic Matter	Total Nitrogen
Conventional tillage	BEFORE cropping	81	435	2.05	not tested
Conventional tillage	AFTER cropping	249	290	2.12	1.24
No-Tillage	BEFORE cropping	100	336	2.22	not tested
No-Tillage	AFTER cropping	426*	272	2.38**	1.22

*Significantly higher (5% level) than conventional tillage after cropping.
**Significantly higher (10% level) than conventional tillage after cropping.

no tillage than with conventional tillage. But there was no difference in available potassium or total nitrogen, as shown in **Table 2.**

THIRD, we also lime by surface application. We started with a pH of 6.5 and today where no lime has been applied the pH has fallen to 4.7 under no-tillage and 5.1 under conventional tillage (pH measured in topmost four inches of soil). But where we have applied 3.5 tons of ground limestone (½ ton per acre each of the last 7 years), the pH under no-tillage is 6.8 and under conventional tillage is 6.3.

Even more important are the substantial yield increases from lime—averaging 7.0 percent with conventional tillage and 26.2 percent with no-tillage. With no-tillage, lime produced almost four times more yield. But in the two most recent years (1970 and 1971), when acidity on non-limed soil was greatest, substantial need for lime was shown with both types of tillage, **Table 3** shows.

There are at least two explanations for this lime need: (1) Physiological—extreme acidity develops at the soil surface and probably limits proper growth until the roots can penetrate deeper and find a more favorable environment. (2) Summer grasses, especially fall panicum, are controlled more completely by herbicides at high pH levels than at low pH levels.

WHAT ABOUT ROTATIONS? Are they necessary to maintain yields? Our experience shows they are not. Yields from continuous corn and rotation corn (one or more years of grass and clover) have been approximately equal. And mere plowing of the land at intervals in continuous no-tillage corn has been slightly detrimental to yields.

The organic matter content of the soil has increased with no tillage over a ten year period. The soil is more friable, crumbles easier, and holds more moisture than soil conventionally tilled over the same period.

All told, physically as well as chemically, no-tillage makes a better environment for corn—and the increased yields show it. **THE END**

Table 3. How Lime Affected Corn Yields With Conventional And No-Tillage Methods

	Conventional Tillage			No-Tillage		
Year	No lime	lime	Increase	No lime	lime	Increase
	bu/ac	bu/ac	%	bu/ac	bu/ac	%
1965	97.2	82.6	**−15.0**	80.0	97.0	**21.2**
1966	106.4	113.1	**6.3**	116.7	120.1	**2.9**
1967	67.3	75.7	**12.5**	104.4	126.3	**21.0**
1968	104.1	107.8	**3.5**	91.6	133.9	**46.2**
1969	98.1	99.5	**1.4**	110.6	154.1	**39.3**
1970	116.3	129.7	**11.5**	119.0	144.4	**21.3**
1971	121.8	152.6	**25.3**	116.3	156.7	**34.7**
Average	101.6	108.7	**7.0**	105.5	133.2	**26.2**

CHOOSE YOUR

THIS COLUMN receives interesting mail—none more so than a copy of the letter a biology professor in a large university recently wrote an agricultural leader of a major farm state.

AT FIRST GLANCE, the letter seemed innocent enough—the usual attack on the "establishment" by a campus pundit:

- **"I suggest you abandon the untenable position that agri-business is 'humanitarian' and therefore 'good' . . . and get out from behind Borlaug's skirts (Nobel winner Norman Borlaug) and stand on your own merits."**

- **"Let's face it. No one questions Dr. Borlaug's motives. The same is most assuredly not true of agri-business. You have a built-in conflict of interest. You are interested not in promoting the welfare of mankind but in your own self-interest."**

- **"Your official opinion is at variance with the facts. The facts are there for everyone to see—in newspapers, magazines, on the radio and TV—facts supplied by concerned individuals without a conflict of interest."**

- **"Just as long as you and your industry continue to peddle the kind of twaddle that you are currently handing out, you will be doing an extreme disservice to this country and the rest of the world."**

- **"Only when you forsake the economic justification for everything and really start thinking in terms of people and human needs will we have a chance" (for survival).**

AT SECOND GLANCE, I saw my teenage son facing the prospect of learning from such a teacher in the near future. The thought did not appeal—not because such teachers question the motives of agri-business, but because they don't seem inclined to give their students BOTH sides of the question.

Certainly this letter did not sound like a detached teacher seeking the truth wherever it may be found—even in the tentacles of that mythical octopus called agri-business.

Fortunately, most university teachers work hard to give all the facts they know without revealing their personal convictions. This takes talent and a discipline only a great teacher possesses. Without this dedicated majority, our universities would collapse.

They do not thwart youthful rebellion fanned by honest questions. They know such restlessness is older than Socrates—and a healthy tradition. They also know youthful rebellion fanned by one-sided accusations against a system that supports them is not healthy.

Combine one-sided accusations with the highly nutritious (brain-building) food modern agriculture gives us to feed our youngsters and we get an explosive mixture.

Bright young minds, growing like rich spring grass under a heavy dose of plant food, suddenly look around and understand much earlier and more sensitively than we ever did (or think they do)—and sometimes call us elders hypocrites.

They may have a point. I salute their idealism and seek their mercy on my own hypocrisy. But I must add. . . .

Don't forget to search your own ranks, also, young people, for imperfections there. Surely you must have some:

FOLKS who have good intentions . . . but just don't like the labor of learning, of hard study for the truth . . . yet, love to talk and accuse and sometimes wreck.

HYPOCRISY CAREFULLY

WHO never heard of Big Hugh Bennett but can quickly cheer their "liberal" professor's "creative ideas" on grassed waterways and contoured fields as a "new day" in fighting corporate pollution evils . . . ideas Bennett and his Soil Conservation Service gave farmers 3 decades ago to protect the environment.

WHO sometimes march with placards condemning companies they can't even spell, handing out flyers with indictments they haven't read, much less checked for their honesty.

WHO paint the pesticide picture into the drug industry's image of "a new drug daily" when they should know it takes 30 separate research steps, 100,000 manhours of testing, 8 to 10 years costing $10 million to bring just one pesticide chemical to market for man's use.

WHO try to indoctrinate, not educate . . . propagandize, not enlighten uninformed, inexperienced, impressionable youngsters.

WHO grow intoxicated on the cheers they get from calling chemical (inorganic) fertilizer "an intrusion of plant nutrients into a virgin environment" when they should know nature converts ALL nutrients to inorganic form (if man doesn't do it) so plant roots will accept them.

WHOSE families send them to expensive private schools, use every tax loophole, and patronize Exclusive clubs while branding average parents "bigots" for questioning public school busing, higher taxes, and community deterioration.

WHO seek the adulation of bright young minds by urging sometimes-Godless schemes their students mistake for "the courage of Prof's convictions" when they are actually "the courage of Prof's tenure."

WHO seek every spotlight to warn about keeping nature "in balance" when they should know nature has never been in balance to favor man or animal and never will be, if the history of early man with his short life span and desperate quest for food is any lesson.

WHO blame society, not the criminal, for his criminal acts . . . and feed their youngsters rich allowances to go around in bluejeans with tailormade patches calling the masses "racist and fascist" for backing the police as their lawful defense against terror in the street.

WHO talk much idealism and revolution, but know the heritage of neither. Mention Samuel Gompers or Clarence Darrow to them and many will stare at you. The name, Tom Paine, means nothing to most.

Even the lyrical ring of Jefferson's passionate prose falls on vacant faces. Ask them to quote Adams or Lincoln—or Marx or Lenin, for that matter—and the silence will deafen you.

By all means, ask them about racial and religious and class discriminations in OTHER nations, especially the ones they sometimes chant in their rhythmic insults of their native land.

THEN, choose your hypocrisy—carefully, young people—those of you who believe life is but a series of pretenses. And remember:

In every age, youth has always awakened from its dreams to find another "establishment" of the strong STILL using, controlling, and sometimes helping the weak.

What about you? Will you wake up one morning to an "establishment" run by your comrades of today? Knowing them as you do, will you encourage your youngsters to shout and accuse and insult—that morning?

Will you urge your son and daughter to question THAT establishment—freely?

Stop The FAST This FALL

NO INDUSTRY takes as many licks from the weather as agriculture. Last spring was a good example. Many fields are working on "borrowed nutrients" right now—nutrients not from fertilizer, but from their own natural reserves. Others are struggling along on token fertilizer applications from last spring.

WHY? Because the weather kept many farmers out of their fields until the last possible planting days. These fields cannot live on their own fat for long. You can stop the fast this fall . . . and not risk another ruthless spring.

HOW? By sharing scientific facts that prove the value of wise fall fertilization . . . that tell how minerals like phosphate and potash cling to soil particles for next spring's fast action . . . how ENOUGH P and K on that winter grain can insure those soybeans a good second-table meal next spring . . . how today's high-yield crops pull MUCH HARDER on our soil reserves than yesterday's varieties.

ON PAGE 2, you will find a list of educational aids for a strong fall-winter fertilizer program . . . some new, some timeless . . . all popular and in easy-to-use forms. Map your plans today. **Order right away** . . . enough quantities to do the job.

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