Better Crops WITH PLANT FOOD

NUMBER 2—1975 25 CENTS

Steps to top yields are built on the proof of scientific research and the skill of farmers who say:

"I CAN!"

What kind of a man is the modern farmer . . . the one who says, "I CAN!"

He likes to compete . . . and will enter crop growing contests to WIN. But he competes for more than a prize check or a free trip to Miami. He pulls out all stops on his contest acres . . . to find steps that will UP yields on all fields.

He is not gun-shy with fertilizer . . . and will change application method and ratio if his contest field points that way. He has a modern mind that instantly registers "HIGH FERTILITY" each time it thinks "HIGH YIELD."

He tries steps he doesn't believe will pay . . . and will latch onto them fast if they do pay off. He will also endorse them . . . and admit he first felt the practices would not pay off.

He is a great observer . . . and will roam his fields regularly looking for insect or disease attacks early enough to head them off. He saves many bushels the pests would have gotten if he had not been a sharp private eye.

He is a great listener . . . and will attend meetings to learn the experiences of farmers from other areas. He listens

to university and extension voices because he knows they are working to break yield barriers for the least cost to him.

He takes nothing for granted . . . and will tell you this little ball of constantly bickering creatures survives through an alarmingly thin layer of topsoil, the fact it rains, and the remarkable patience of an Almighty Creator.

WHAT ARE YOUR yield goals? What do **YOU** believe your best fields should yield? What do **YOU** believe your highest farm average should really be? What do **YOU** believe is keeping your yield below that level? If you have hit your goal, then your goal is too low.

DON'T BLAME THE WEATHER . . . or the soil every time for a low yield. They are important, **BUT** modern technology is helping us overcome some of the weather and soil problems.

STUDY YOUR CROPS AND SOILS this summer . . . and ask questions of crop production leaders. Find out what you might try in order to reach your goal—if not this year, then next year.

How deep are crop roots penetrating? Can you reduce soil compaction with less tillage? Is drainage a problem?

CHOOSE A "LABORATORY" FIELD for future testing . . . and try new practices there. From there you can expand the best practices over other fields. Be an innovator, not a gambler.

Once you find the potential yield, work at determining the top-profit yield by reducing or omitting certain inputs. A burst of power gets a plane in the air, then at cruising speed the pilot cuts back. The hidden value of contests is what you may learn later to apply to the rest of your crops.

IMPROVED PRACTICES have additive effects . . . and sometimes multiple effects. Input levels may need adjusting. A new corn hybrid with higher capacity or closer soybean rows may need higher fertility.

Remember: Research continually turns out new facts to improve yields and quality. Farmers who average 150 bushels of corn or 50 bushels of soybeans per acre over their entire acreage . . . who reach 200-bushel corn or 80-bushel soybeans in contest fields . . . are the farmers who believe they **CAN**.

Then they **DO** it . . . with the right combinations of moisture, nutrition, hybrid, planting date, population, pest control, and tillage.

IN THIS ISSUE, you will find some questions top farmers ask researchers about weather stress and fertility. The answers may help you use **THIS YEAR'S** experiences to plan a fertilewise program for **NEXT YEAR'S** crop.

Better Crops WITH PLANT FOOD

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Potash Institute PRESIDENT

DR. ROBERT E. WAGNER, former Director of the University of Maryland's Cooperative Extension Service, has succeeded Dr. J. Fielding Reed as fourth president of the Potash Institute.

Dr. Wagner assumed leadership July 1, on the 40th birthday of the internationally known research and education organization.

Since Dr. Reed's retirement on March 31, the Institute's Senior Vice President, Dr. Werner L. Nelson, has served as Interim President. He is a former president of the American Society of Agronomy and co-author of an agronomy textbook used around the world.

The Institute's new president, Dr. Wagner, is an internationally known scientist and educator. He has been described by university officials as an administrator of "outstanding leadership with enthusiasm, energy, and integrity."

When the American Society of Agronomy named him a Fellow, the highest honor it extends a few scientists, they concluded, "Before he is a highly productive scientist and searching scholar, Robert Wagner is first of all a straightforward colleague whose dedication to scientific knowledge is well known."

Bob Wagner is not new to the potash industry. He served as Eastern Director and then Vice President of the Potash Institute for nine years, 1959-1967, succeeding Dr. E. T. York, now Chancellor of all state universities in Florida. Before that, Dr. Wagner was Chairman of the Agronomy Department at the University of Maryland where his encouragement of professional development by his students became well known.

HIS CAREER BEGAN as a forage crops specialist at the Kansas Agricultural Experiment Station in Hays. From there he joined the USDA Plant Industry Station at Beltsville to become a research agronomist and project leader of important pasture work. He earned his professional degrees from Kansas State University and the University of Wisconsin.

Dr. Wagner brings with him a well known reputation for scientific integrity. As a research scientist, his early work in methodology enabled forage investigators to measure results more critically on the road to accurate information.

His work on methods of improving stands of small seeded legumes and grasses made two major contributions to agriculture, according to agronomic colleagues. It contributed significantly to the science of plant ecology. It helped improve the economy of the livestock industry in the humid half of the United States.

As a State Extension Director, he gave much energy to many areas. The governor appointed him to two commissions on farm labor and nutrition. Extension directors of the northeastern states tapped him chairman. The Farm Bureau named him ex-officio member

Dr. Robert E. Wagner

"**WE HEAR MUCH** about doomsday just over the horizon. That day when a whole generation will wait for the second table to be set . . . and wait and wait and wait until they rise up mad with hunger. I don't see that day. I see another day. A day when scientific truth will replace superstition and injustice. To make poor fields rich with food. To make mad people peaceful with nourishment. Agronomy, the science of survival, can do it. If this be idealism, then make the most of it—because the alternative is extinction."

Robert Wagner

of their Board. Baltimore invited him to serve on their Wholesale Food Market Authority.

He served on the advisory committees of many groups—ranging from the Southern Regional Education Board to the National Association of State Universities and Land Grant Colleges—helping guide graduate education, agricultural research, and rural development in changing times.

Dr. Wagner also brings with him a well known talent for educational communication. During much of his career he has been a prolific writer.

One of his most notable works was a series on forage fertilization which the nation's longest-lived dairy journal, HOARD'S DAIRYMAN, invited him to prepare. He was also asked to edit the proceedings of the Sixth International Grassland Congress.

HIS CAREER HAS attracted citations in Who's Who in America, American Men of Science, Who's Who in the East, Who's Who in the South, Men of Achievement, Personalities of the South.

Four national fraternities have honored him—Alpha Zeta, Gamma Sigma Delta, Phi Kappa Phi, and Sigma Xi.

He has served on the American Society of Agronomy Board and as chairman of many committees, including Grassland Improvement.

He has been a U.S. delegate to four International Grassland Congresses in America, England, New Zealand and Brazil and has served as president and board chairman of the American Forage and Grassland Council. This group awarded him their highly coveted Medallion Award for outstanding service to grassland farming.

Dr. Wagner is a native of Garden City, Kansas. He and his wife, Mrs. Bernice B. Wagner, have three sons: Robert E., Jr., a graduate student at Harvard University; James W., a student at the University of Delaware; and Douglas A., a college freshman this fall. **The End**

Don't SHORT-K Corn

. . . by using the "critical K percent" in leaves at early tassel to interpret K status of the whole plant at an earlier stage of growth.

W. M. WALKER and T. R. PECK
UNIVERSITY of ILLINOIS

THE RELATION between nutrient composition of plants and later yields has been recognized for many years—and critical nutrient percentages have been established for most plant nutrients on major crops.

For corn, usual sampling time is at early tassel and the most frequently sampled part is the sixth (ear) leaf. Although plant sampling at this stage has some advantages, one disadvantage is timing. Early tassel is too late in the growing season to apply corrective fertilization. If critical nutrient values were determined at earlier growth stages, corrective fertilization could be applied during the current growing season.

Recent Illinois research has determined a critical K percentage for corn at three stages of growth.

Corn yields and plant composition data from experimental plots at the University of Illinois Research Center at Brownstown were used to investigate the relationship between corn yield and plant K.

These plots were located on a Cisne silt loam, a soil frequently low in K until K fertilizer is applied. Four K rates—from 0 to 160 lbs per acre—were applied in early spring before planting on plots testing from 104 to 628 lbs exchangeable K per acre. The plots, which had received adequate N, P, and lime, were seeded to about 20,000 plants per acre.

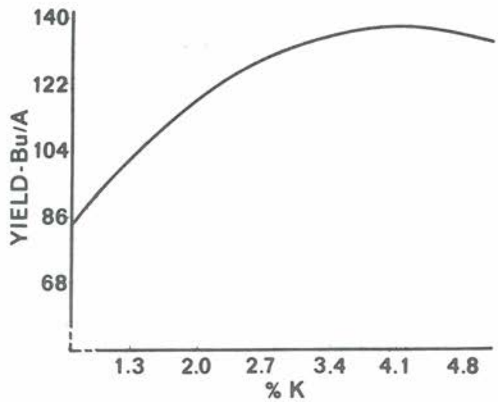


FIGURE 1—Relationship between corn yield and K percentage in whole corn plants 10 inches in height. Critical point is 3.8% K.

EARLY PLANT SAMPLE. When corn plants averaged about 10 inches high, 15 plants were taken from each plot. At this stage, K in the plants ranged from 0.56-5.13%.

Corn yields were regressed on the percent K in the plant using a quadratic equation as the algebraic model. **Figure 1** shows the relation between corn yield and percent K. The maximum predicted yield occurs at about 3.8% K in the corn plant.

Various definitions of critical nutrient percentages have been used in this study. Critical percentage is defined as that nutrient percentage resulting in the maximum predicted yield. The 3.8% K may be used as the critical K value for corn at this growth stage and under the conditions of this experiment.

Further research in different years and over more locations is needed to define a more consistent critical K percentage for corn at this growth stage.

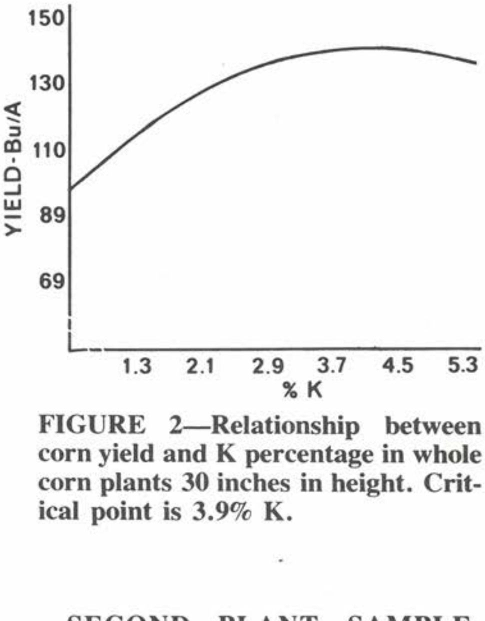


FIGURE 2—Relationship between corn yield and K percentage in whole corn plants 30 inches in height. Critical point is 3.9% K.

SECOND PLANT SAMPLE. When corn plants averaged about 30 inches high, six plants were taken from each plot—about 5 weeks after emergence. At this stage, K in the plants ranged from 0.52 to 5.92%. **Figure 2** shows the relation between corn yield and percent K. The maximum predicted yield occurs at a K percentage of about 3.90% which is the critical percentage at this stage of growth.

THIRD PLANT SAMPLE. At early tassel, only four plants per plot

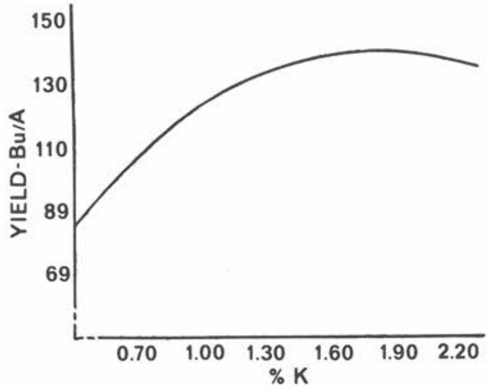


FIGURE 3—Relationship between corn yield and leaf percent K at early tassel. Critical point is 1.8% K.

were available for sampling. So three leaves were taken from each of four plants—(1) the leaf beside and below the ear, (2) the leaf below the ear leaf, (3) the leaf immediately above the ear.

At this stage, K in the leaf sample ranged from 0.41 to 2.29%. **Figure 3** shows the relation between corn yield and percent K. The maximum predicted yield occurs at a leaf K level of about 1.80%.

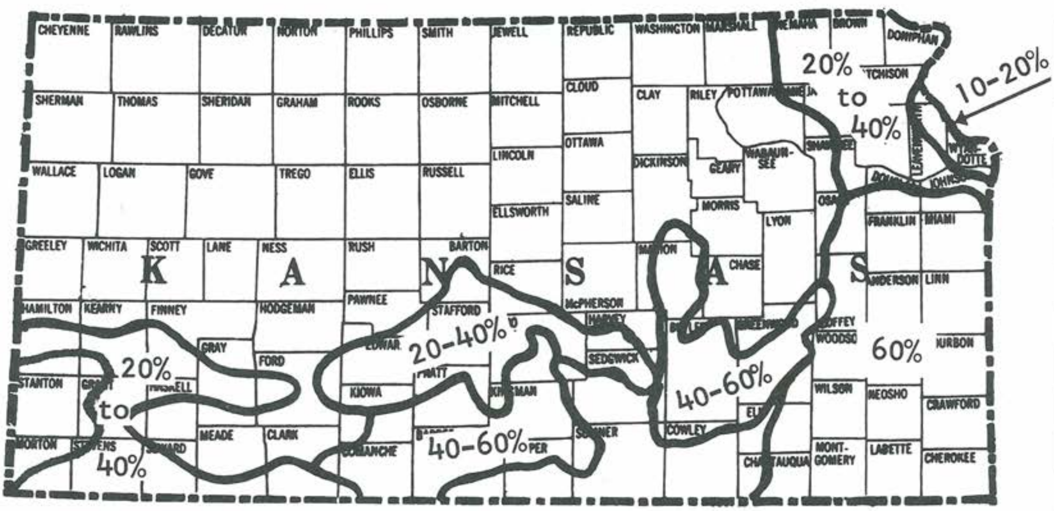
This value agrees reasonably well with published critical K percentages in the ear leaf at early tassel stage. This means corn in this experiment was grown in a "reasonably representative" environment.

IN SUMMARY. This study indicates the critical K percent in **whole corn plants** at early growth is much higher than critical K in the corn leaf at early tassel.

Using the critical K percent in corn leaves at early tassel to interpret K status of whole corn plants at an earlier growth stage could cause UNDER-fertilization with K.

And this could lead to lower yields and profits. **The End**

SUMMARY (%) OF SOIL TESTS SHOWING AREAS OF LOWEST EXCHANGEABLE POTASSIUM (240 Lb K/Acre) 1/



1/ Summary of 1970-73 Soil Tests By County Converted To Major Soil Association Areas

LOW-K Soils Showing Up

DAVID A. WHITNEY
KANSAS STATE UNIVERSITY

POTASSIUM FERTILIZER needs in Kansas generally have not been as great as nitrogen or phosphorus primarily because low soil tests and crop responses to potash applications have not been as widespread.

But soil test facts and potash response data on several crops are pinpointing areas where more and more soils are testing low potassium.

The K content of Kansas soils, as in other states, is influenced by many factors: **(1) Geological soil parent material. (2) The length of time the soil has been forming (including the amount of rainfall and type of vegetation under which it was formed). (3) The length of time it has been cropped. (4) The yields removed.**

Increased use of other fertilizer nutrients, along with irrigation in some areas, has boosted yields and increased K drawdown, particularly on coarse textured soils.

Soil tests in these situations help monitor trends for increased K needs.

Potash is giving profitable results in Kansas, according to experiments with K rates on corn, sorghum, alfalfa, and soybeans grown on low K soils.

Through soil test summaries and soil type information, we can spot general soil association areas of the state where responses to potash are most likely. But you may still run into low K or potash responsive areas in other parts of the state. Yet, soil test summaries usually cover the areas of a higher probability for crop response to potash.

It should also be emphasized not all soil types in these areas are likely to respond.

FIGURE 1 shows the soil areas lower in K and the percentages of soil samples testing medium (240 lb/A exchangeable K) or less. These areas were derived by summarizing soil test results over the past three years.

You will notice the highest proportion of these lower K soils are along the eastern and southern portions of the state, **conforming to the higher rainfall area and coarser soil types.**

The western areas along the southern portion of the state are the coarse textured soils. Much irrigation development is taking place on these sands.

In 1965, Kansas farmers used less than 12,000 tons of K_2O. By 1973-74 they were using over 61,000 tons of K_2O—a fivefold increase.

WHAT CAUSED THIS increase in potash use? (1) More industrial activity. (2) Use of soil tests. (3) Increased interest of dealers and farmers in boosting yields.

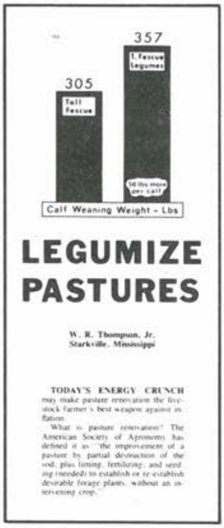
High yielding crops take up much potash (K_2O). **TABLE 1** shows this trend. Achieving such yields requires good management, good weather or proper irrigation, and high soil fertility.

TABLE 1

Crop	Yield/A	K_2O uptake: Total crop	K_2O uptake: Grain only
		lb/A	lb/A
Wheat	60 bu	120	20
Grain sorghum	135 bu	185	31
Corn	150 bu	200	40
Alfalfa	6 ton	300	—
Soybeans	50 bu	120	72

If soil K is low, added potash may provide the key element for higher yields. **The End**

Renovate GRASS PASTURES With Legumes



LEGUMES ARE BLUE CHIP investments for grass pastures in today's energy crunch.

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How legumes boost average daily gains of calves . . . and increase weaning weights of calves, often by 40 to 50 more pounds per animal.

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FERTILIZER APPLICATION FOR TOP PROFIT YIELDS

FERTILIZER APPLICATION FOR TOP PROFIT YIELDS

SLIDE 1—Top growers apply fertilizer for top profit yields. They never allow INADEQUATE fertility to hold them back.

MODERN CROP YIELDS RAPIDLY EXHAUST SOIL NUTRIENTS

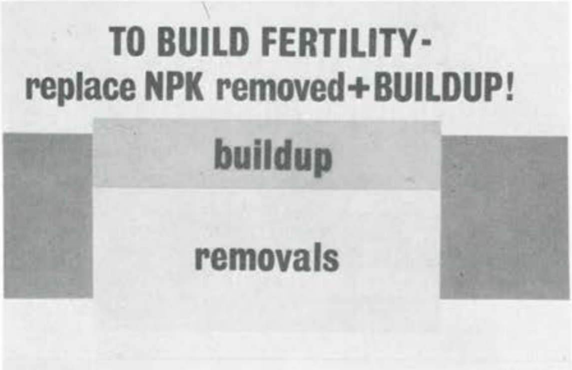
	CORN	SOYBEANS*	ALFALFA*	WHEAT	TOMATOES
YIELD	180 bu	60 bu	8 T	80 bu	40 T
	---------------	lb per acre	-----------	-----------	-----------
N	240	336	450	186	232
P_2O_5	100	65	80	54	87
K_2O	240	145	480	162	463
Mg	50	27	40	24	36
S	30	25	40	20	54

*Legumes can get much of their nitrogen from the air

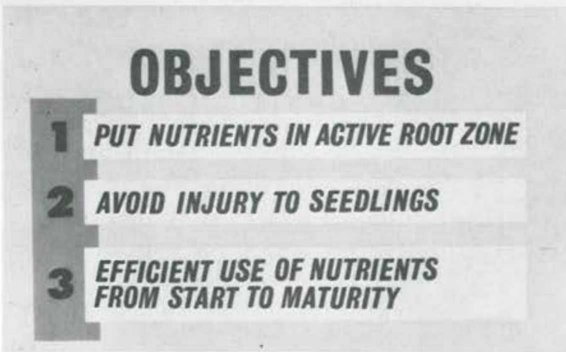
SLIDE 2—Modern crop yields USE UP soil nutrients fast. These high yields contain big amounts of NPKMgS. Do YOUR soils supply enough for high yields?

SLIDE 3—What is the highest profit per acre? It is NOT the highest return per dollar spent. It is a dollar's worth of EXTRA CROP for the highest dollar spent on fertilizer. Top growers push each practice to the limit on each acre to insure top returns on their total investment. Certain fixed costs—land, labor, equipment, interest, and taxes—should be spread over as many bushels or tons per acre as possible.

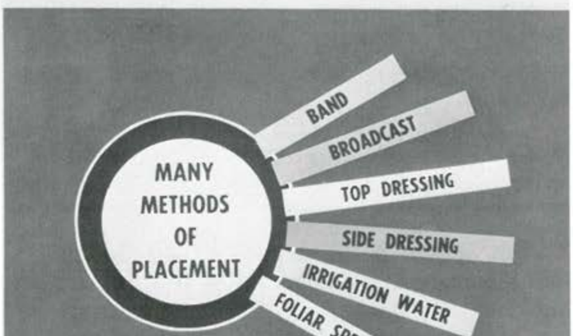
SLIDE 4—The soil can become a chemical self-feeder, much like the mechanical self-feeders livestock producers use. A soil can call on many fertility sources: (1) Native fertility. (2) Crop residues. (3) Residual fertility. (4) Fertilizer applied yearly. Top growers insure FULL FERTILITY throughout the plow layer from planting to maturity.



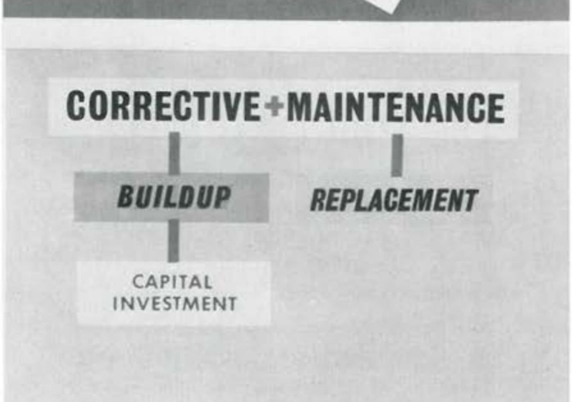
SLIDE 5—High yields remove much NPK. Fertilize enough not only TO REPLACE it, but also TO BUILD soil fertility for future production. Amount depends on the soil. Heavier fertilizer applications pay off on medium to low test soils. And high test soils should receive enough fertilizer to maintain the test.



SLIDE 6—Right placement does three things: (1) Puts nutrients in active root zone. (2) Puts soil between seed and fertilizer band to avoid injury. (3) Puts nutrients where they will intercept new roots AND meet heavy growth demand later on.



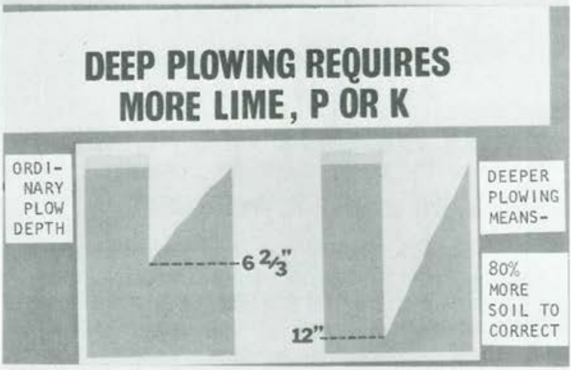
SLIDE 7—The method of fertilizer placement depends on soil traits, fertility level, crop and equipment. Many soils need two types: Corrective fertilization followed by maintenance fertilization.



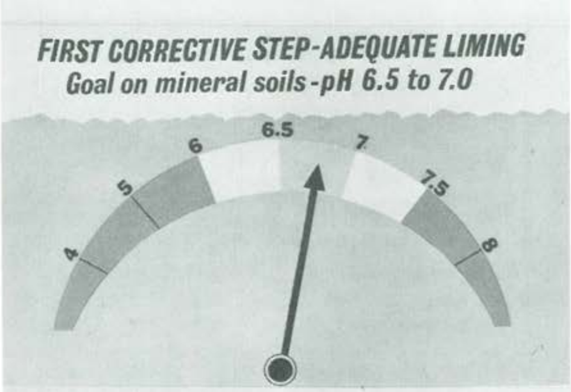
SLIDE 8—Corrective fertilization builds up your soil . . . like adding to your bank account. Heavy broadcast and plowdown application will do it. *Maintenance fertilization* replaces nutrients lost to crop removal, fixation, soil and water movement . . . like keeping your bank account balanced. Annual band and/or broadcast application will do it.

SLIDE 9—Soil tests help you find acid, low P, and low K soils. Retest every 2 or 3 years. One corrective application might take care of inadequate amounts, poor mixing in soil, fixation, or crop removal. A new soil test might uncover need for another corrective application to reach desired nutrient levels.

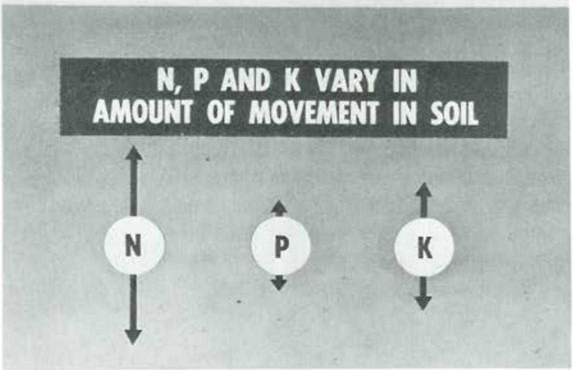
SLIDE 10—Although some growers use minimum tillage, many are plowing deeper than before . . . loosening plowpans and enlarging root zones . . . using more lime, P and K. Remember: A 12″ furrow slice contains 80 to 100% more soil to correct than the traditional 6″ to 7″. This extra soil may be more acid or lower in PK than the traditional 6″ to 7″ slice. So, sample as deep as you intend to plow and record it.

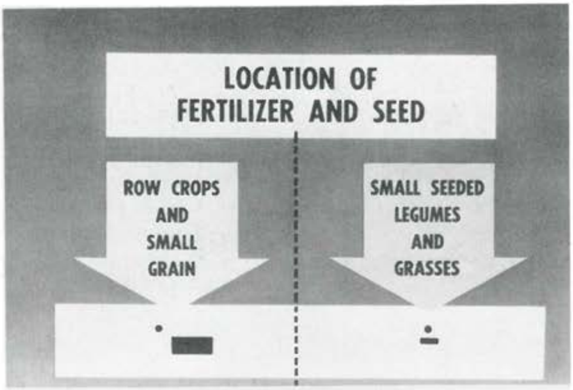


SLIDE 11—Use lime to keep your soil factory working at full capacity. Best soil pH depends on crop. Alfalfa and most legumes demand higher pH than grain crops. Adjusting pH to 6.5-7.0 can help do 3 things: (1) make phosphorus more available, (2) provide better environment for soil micro-organisms, and (3) reduce possible toxic effects of iron, aluminum, and manganese. You may need to apply 2 to 5 lbs of lime to correct acidity from each pound of N. Liming can make Zn, Mn, Fe, and B less available and Mo more available. Yet, if micronutrient hunger occurs with a 6.5-7.0 pH, it may not be too much lime but not enough of something else.

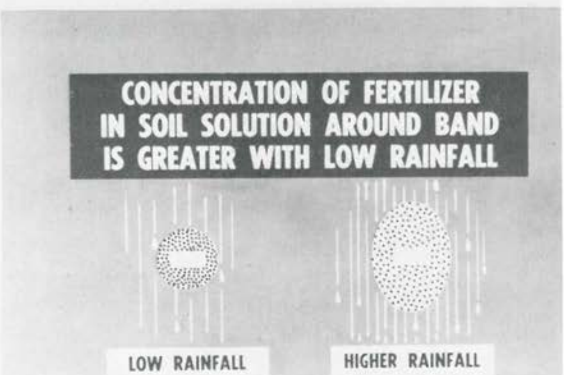


SLIDE 12—N, P, and K move differently in soil. Nitrates dissolve and move with water in the soil. Ammonia N moves little until it changes to nitrate. Phosphorus stays where it's placed. And potassium moves little except in very sandy or organic soils.

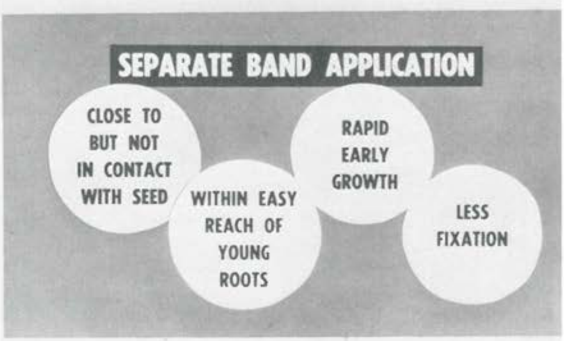




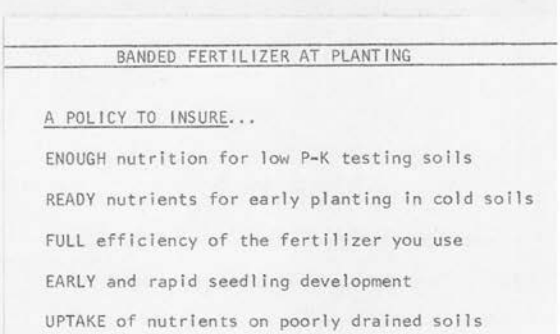
SLIDE 13—Right placement depends on crop. Fertilizer to the side and below seed level or young plant is best for most row crops and small grains. Part of it directly under the row (as in band seeding) is best for small seeded legumes and grasses. Remember to place it where young roots can get it for early growth.



SLIDE 14—Wrong placement damages most when moisture is limited. With low moisture, fertilizer can dissolve but is concentrated enough to inhibit germination and injure seedlings. With high moisture, it damages little close to the seed because heavy rains dilute the salts around the seed or young roots. When large amounts of fertilizer salts dissolve in the soil and bathe the germinating seed, the plant cannot get water and literally dries out as in an oven.

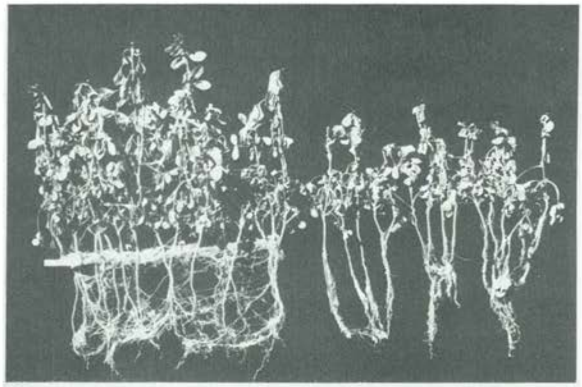


SLIDE 15—Separate band or starter fertilizer helps meet that critical period after the seed exhausts reserve nutrients and before a good root system develops. Locally placed P is vital.

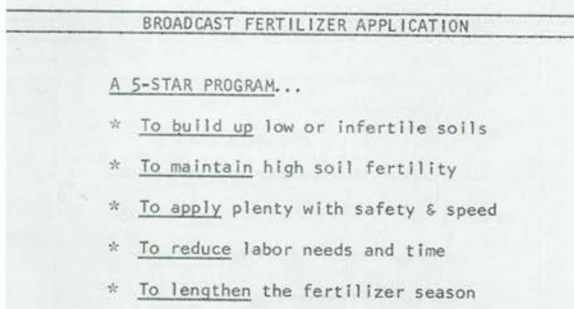


SLIDE 16—Band placement is good insurance at planting . . . when low temperature or low oxygen from poor drainage hampers nutrient (N, P, K, Zn, etc.) uptake. It helps insure uptake and early, rapid seedling development.

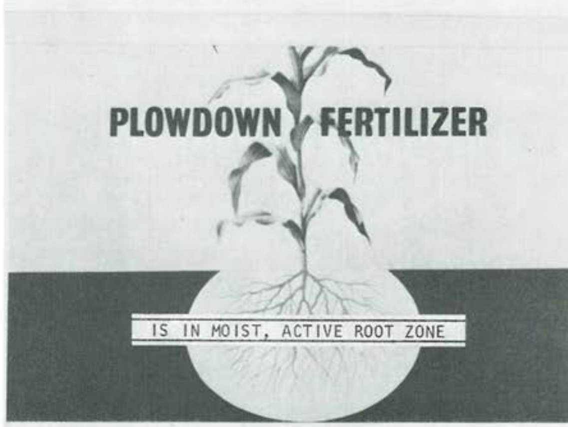
SLIDE 17—A fertilizer band encourages vigorous root and seedling growth . . . shown with the alfalfa on left. The right alfalfa received no fertilizer. Note roots on left . . . more absorbing surface for greater nutrient uptake, faster growth. You can add N with P to increase P uptake and root expansion . . . more than P alone will do.



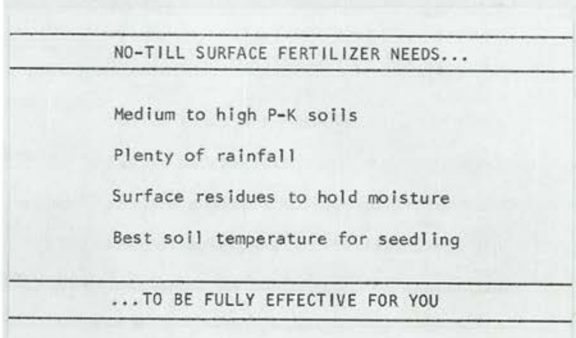
SLIDE 18—Broadcast fertilizer overcomes shortages and maintains fertility levels . . . gets large amounts on safely, quickly, economically . . . especially on soils low to medium in P and K. It saves costly labor at planting and lengthens the fertilizer season.

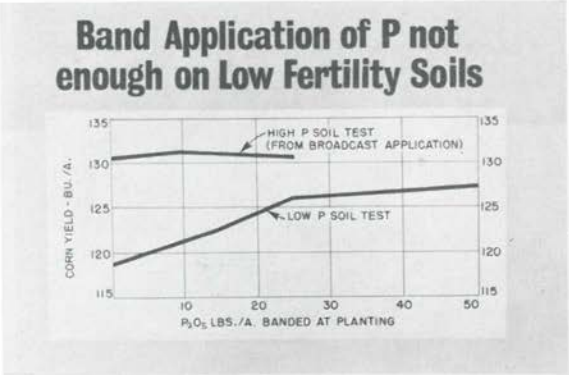


SLIDE 19—Plowdown fertilizer gets nutrients into moist, active root zones. . . vital with limited moisture and on less fertile soils. Roots grow to less than 3% of the nutrients in the soil. So, such nutrients as N, Ca, Mg, etc. must get to the plants through water films drawn by absorbing roots. But P and K move very slowly through water films and higher P-K levels speed movement. Plowdown encourages roots to penetrate deeper for fuller moisture and nutrient uptake . . . often during stress periods. Disking may leave the fertilizer stranded in moisture-stress soil.

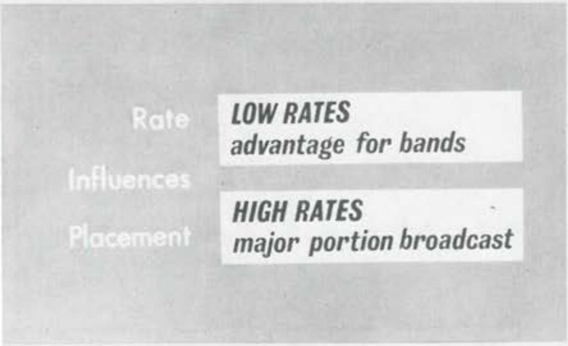


SLIDE 20—No-till or conservation-till puts more fertilizer on the surface. Effectiveness depends on (1) soil test levels, (2) rainfall, (3) surface residues, and (4) soil temperature before seedling emergence. No-till corn culture demands heavy mulch to hold moisture near surface for good root growth and nutrient uptake. Be sure your soil tests medium to high P-K before switching to restricted till. If possible, plow every 3 or 4 years to redistribute P and K through plow layer.





SLIDE 21—Banded P can't do enough for low fertility soils. You must BROADCAST P to build fertility levels for top yields. These tests show why. The same principle apples to K.



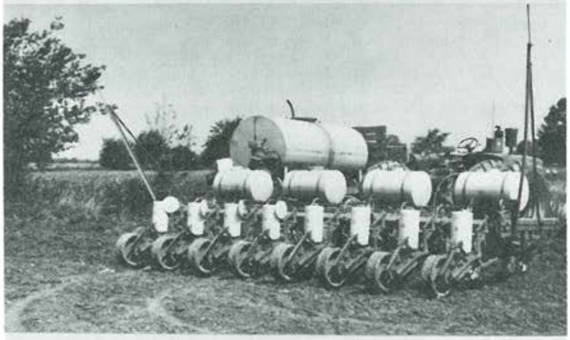
SLIDE 22—How MUCH you apply influences the WAY you apply it. Band low rates beside the row to reduce fixation risk and feed young roots. Broadcast and plowdown high rates to meet the major part of your fertilizer needs.

SLIDE 23—Band + broadcast = fast start and continued supply.

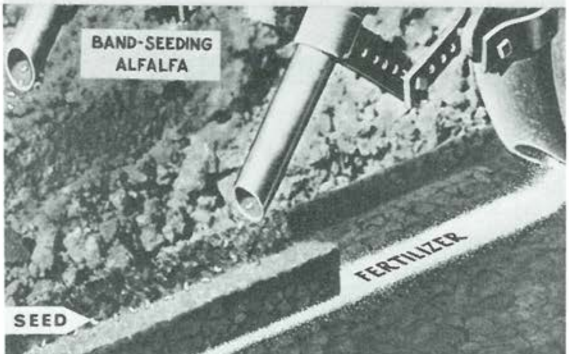
SLIDE 24—Row crops like band placement . . . about 2″ to side and below seed . . . to prevent soluble salts from damaging seed in dry years . . . to help feeder roots reach nutrients soon after seed germination. Good for such crops as corn, sorghum, soybeans. Top growers often save this step by MAINTAINING high fertility through broadcast applications. Plowdown can be teamed with banding to meet later demands after the fast start.

SLIDE 25—Top growers load fast . . . 500 to 1500 lbs or more per minute . . . from wagons with auger conveyors that save labor and time filling hoppers on the planter.

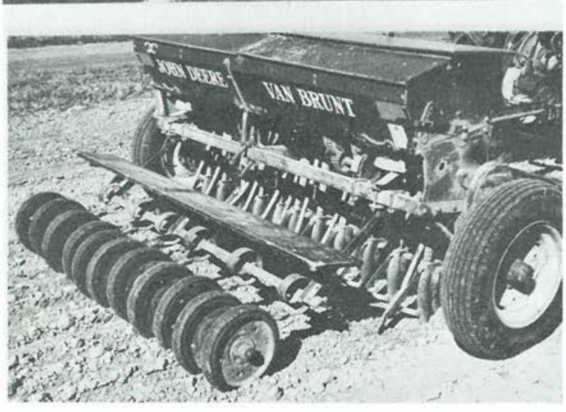
SLIDE 26—Fluid fertilizer pumped into the fertilizer hopper is increasing . . . to save time and labor.

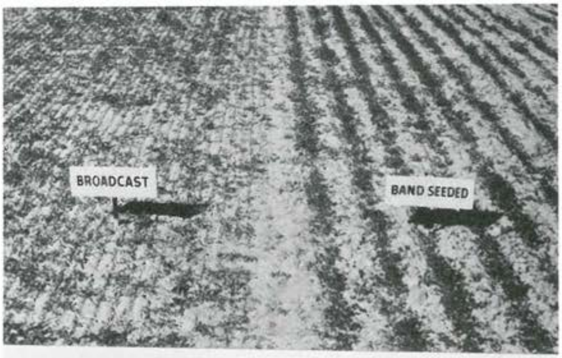


SLIDE 27—For small-seeded legumes and grasses, band fertilizer about 1½ to 2″ deep . . . with seed directly over band . . . to help tap roots reach nutrient quickly for fast start. Many companies offer this equipment. Existing equipment can be converted economically.



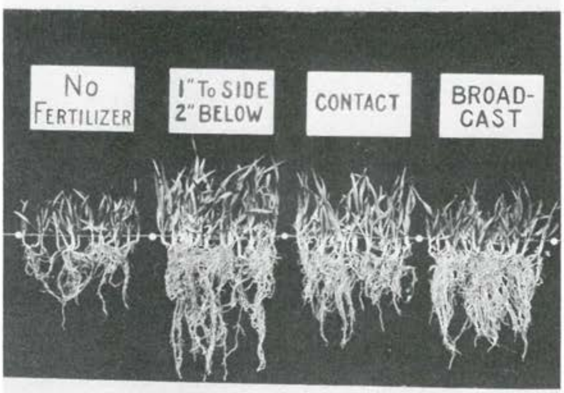
SLIDE 28—Compact seeds with press wheels or other equipment . . . to give them shallow cover and contact with moist soil . . . to improve germination and stand.



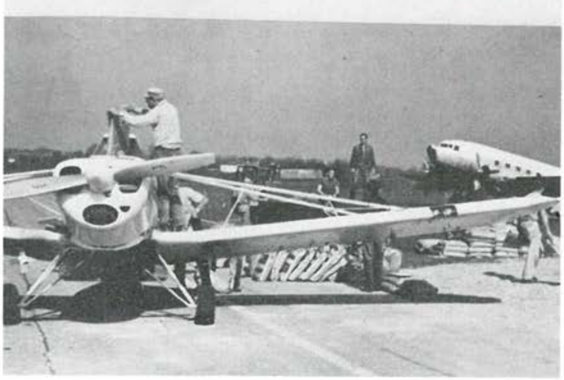


SLIDE 29—Band seeded alfalfa (right) got off to a vigorous start . . . in contrast to broadcast seeding (left).

SLIDE 30—Alfalfa and other forages take up much plant food. Many growers replace this with two topdressings of 0-10-30 or 0-10-40 plus boron . . . one after the first cut, one after the last cut. Roots near or on the surface readily absorb the broadcast fertilizer.



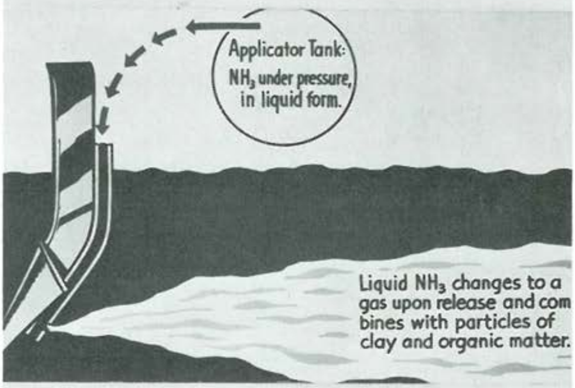
SLIDE 31—Most small grain contacts or comes near fertilizer at planting. But too much down the spout with the seed may injure germination and growth when moisture is low. Broadcast part or all the fertilizer (1) when you need high rates or (2) when the soil is dry.



SLIDE 32—Fertilize by air when ground machinery won't do . . . on rough land or wet soils . . . on pasture, sugar cane, forest, rice, cereals in early spring, etc.

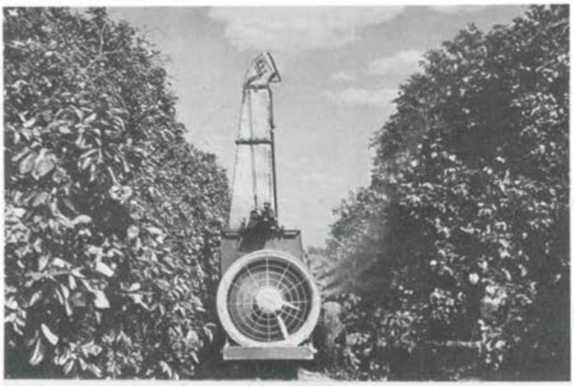
SLIDE 33—Proper soil moisture and applicator closers help retain anhydrous. On good tilth soils, applicators 30″ to 40″ apart are normal. But when you apply more than 125 to 150 lbs anhydrous N per acre before planting, consider closer spacings. Why? Because a given N rate in 20″ spacings releases half as much NH_3 from each knife as the 40″ spacings . . . the same TOTAL amount but less NH_3 per spot for the soil to absorb and young plants to face.

SLIDE 34—Place ammonia at least 6″ to 8″ deep, so the clay and organic matter can hold it.

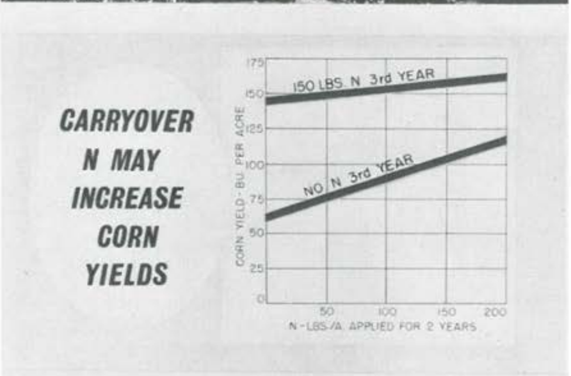


SLIDE 35—Broadcast liquid mixed fertilizers or nonpressure nitrogen solutions directly on the surface. At planting, apply liquid complete fertilizers just like solid fertilizers. Apply nitrogen with compatible pesticides to save time and labor. And always release pressurized nitrogen solutions beneath the soil surface.

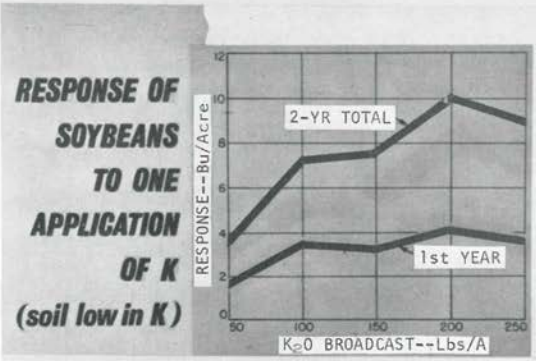
SLIDE 36—Cut costs by feeding nutrients into the irrigation water. This aqua ammonia is applied to the irrigation system for sugar cane.



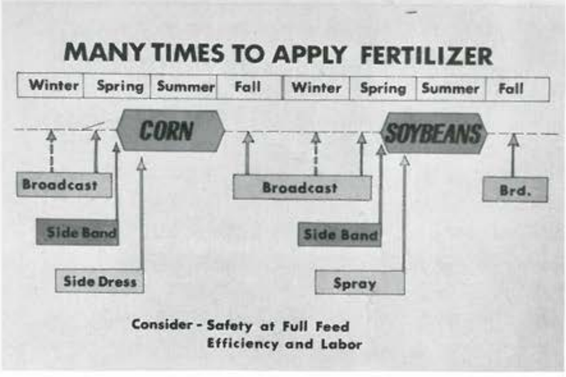
SLIDE 37—You can apply some micronutrients . . . as well as N, K, Mg, etc. and some pesticides . . . directly to the plant through solutions.



SLIDE 38—Residual (carryover) fertility is the best insurance policy you can carry for future crops. Unused fertilizer stays in the soil to make sure plant nutrition doesn't hold back future yields. Corrective or buildup P-K applications insure this. On this Midwest silt loam, carryover N (from high rates the first 2 years) increased yields the 3rd year with no N. Yet, profitable returns came from adding150 lbs N the third year. Rate, soil, rainfall, yield affect carryover. Residual fertility should be considered when calculating the economics of fertilizer use.

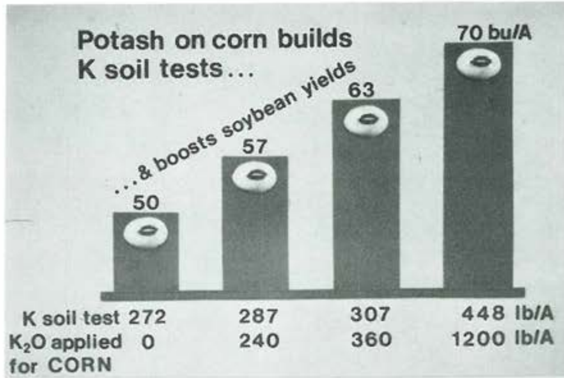


SLIDE 39—Large K applications can increase next year's yields. Up to 250 lbs K_2O per acre not only increased soybean yields in the year of application but continued to boost yields during the following season. Don't expect a carryover effect with heavy K-using crops such as alfalfa and corn silage—unless you are applying very high rates.



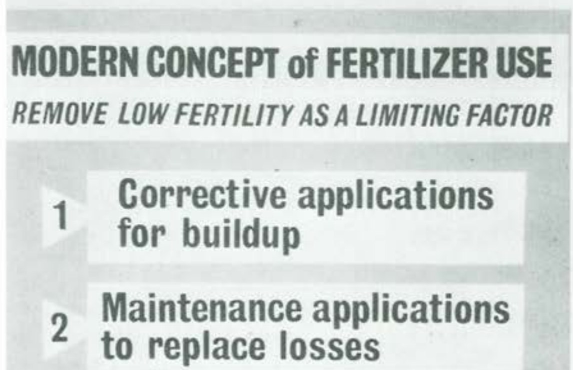
SLIDE 40—The many possibilities for applying fertilizer in a rotation . . . such as corn-soybean, continuous corn or soybeans, corn-small grain . . . can lengthen the fertilizer season. It often pays to band place small amounts and broadcast-plowdown the major part. Be sure to get enough nutrients into the root zone well ahead of peak demand or seed formation time.

SLIDE 41—Potash applied 4 years to corn built up the soil enough to increase soybean yields up to 20 bushels per acre the 5th year. The K soil test was taken Sept. 23 the year the beans were grown on an imperfectly drained, dark, silty clay-loam Midwest soil.

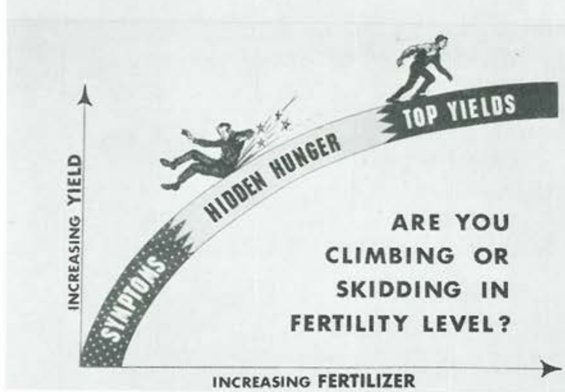


SLIDE 42—Who can wait for this . . . when a farmer's time is worth $100 or more PER HOUR at planting time? Better yields from early planting and unpredictable spring weather are leading to more fall and winter fertilization on level land. If erosion is no problem, P-K loss is no problem. If rainfall is low, N loss will be low. Apply NH_4-N to soils cooler than 50° F.

SLIDE 43—Use fertilizer the MODERN way. Large applications to CORRECT low fertility. Broadcast, plow down and/or band applications to replace losses from removal, fixation, and other factors.



SLIDE 44—Climb . . . don't skid back! Demand facts for top-profit yields. Ask if you are applying ENOUGH fertilizer . . . if you are applying it the right WAY . . . to get the most out of each acre. Remove nutrition as a barrier to success.



ORDER COMPLETE SET on Back Cover

Lest we forget

I WONDER if a single farm show in our coming Bicentennial year will feature—really feature—the greatest friend the American farmer ever had?

It nourishes the human soul just to drive through his native hills. To stand on his lawn and look across the verdant valley unto the hills beyond.

I have chatted with different people there. The most insightful was a school teacher. A tall, pretty blonde in the morning of her career. A true expert on the heritage of America. She really knew the man of Monticello.

Much more than the **things** there, his dwelling and furniture and dumb waiter and pewter and things. She knew the **MAN.**

So, we stood a long time, saying nothing, looking across the valley, lost in our own thoughts of his legacy to us all. Then . . .

"He was much more than a genius," I suggested to the expert.

"Much more," she agreed. "He was such a good and just man. So simple. In manner and clothes, even in his food. A very friendly, tall, plain man."

I laughed, "You really know him."

"Yes," she replied without explaining. "I wonder if anyone here today will stop looking at the finery long enough to feel what went through his heart trying to save his home in his old age. He spent 50 years building a library and less than a year selling it to save his home."

I pointed toward the overfed men and women, like me, waddling around Monticello in their rump-sprung slacks and said, "They don't give a hoot-in-hell about **HIM.** They're curious about his **THINGS.** That's what we've come to in this age."

"You must be in the writing field," she said.

"Of sorts," I replied. "Does it show?"

"Most of you are cynical—some of the time," she explained.

I answered quickly, "Honey, do you know **why** he went broke? He was a **FARMER.** You remember what he said: **'When I first entered on the stage of public life, I came to the resolution never to wear any other character than that of a farmer.'** And he was a great one, a scientific one. Who invented a plow. Introduced new crop rotations and new varieties. Encouraged agricultural societies. But he went broke.

"You're the historian. Doesn't history say the only thing certain about farming is the uncertainty of it?"

She smiled and asked, "Why have farmers gotten the short end of the dollar? So often? Too often?"

I tried to look suddenly wise, into the distance, upward and onward to higher wisdoms. Then I stuttered, "It-t-tt would be easy to say wheeler dealers cheat him. Or the commercially cunning con him out of his fair share . . . or mother nature gets menopause and won't meet him half way. But I just don't know."

She asked, "Did Mr. Jefferson know?"

"Apparently not," I said, "or he wouldn't have gone broke. Yet, I can't believe he was inefficient, although he went on his neighbor's note and that helped drag him down."

She smiled, "He was that kind of man."

"Yeah, I know," I replied. "He got mad one day in Philadelphia and said something that made sense: **'Here in the city the unmoneyed farmer, as he is termed, his cattle and crops, are no more thought of than if they did not feed us."**

Then we both wondered why he kept coming back to the farm? With all his talents in law, architecture, science, literature, engineering, etc. Especially when history is full of farm-bred folks sweating so hard to get off the farm.

Thomas Jefferson was, at heart, a very simple man who feared the king instinct in every man. Who walked the sidewalk to his own inauguration. Who did not care to be called Mr. President or Mr. Governor when he returned to his Virginia farm.

A man who believed down to the end that **"the good sense of our country will see that its greatest prosperity depends on a DUE balance between agriculture, industry, and commerce."**

I still believe those rump-sprung slacks shuffling through Monticello, worshipping his **things,** don't like to think of him as he thought of himself—a farmer.

FIGHT WEATHER STRESS

PLAN NEXT YEAR'S FERTILITY FROM THE WAY THIS YEAR'S CROP FACES WEATHER STRESS

We cannot control weather. But we CAN control fertility enough to help the crop through bad weather stress with respectable yields, many times.

Here are some questions top farmers ask researchers about weather stress and fertility. The answers may help us use this year's experiences to plan a fertilewise program for next year's crops.

One of the best times to apply phosphate and potash is this fall, broadcast and plowed down right in behind harvest, to ''stressure'' your soil against next year's dry or wet spells.

1—How does increased fertility help crops face weather stress?

It's like an insurance policy in the soil. It puts more nutrients in the direct vicinity of the plant roots. Additional potassium for corn added 7 days to grain filling time in Kentucky. Additional phosphorus on alfalfa increased irrigation efficiency 34% in Arizona—nearly 3 tons more hay per acre with 4 inches less water per ton. And additional nitrogen produced 51% more bushels of corn per inch of water in Colorado tests.

2—Does fertility help the crop during wet spells?

Yes. Iowa tested the effect of wet spells at different stages of corn growth. Yields of 6-inch corn declined 30%, silking corn 13% when receiving too much moisture and too little nitrogen (50 lb N). With adequate nitrogen (350 lb N), the silking corn increased up to 11% (16 bushels) under excess moisture. The same thing happened with potassium in Indiana. Adding K to corn increased yields 48 bushels per acre with a wet 25.73-inch rainfall, 39 bushels with a dry 7.61-inch rainfall.

3—Does increased fertility cause the crop to reach for water?

Yes. In Iowa tests, the fertilized corn reached 7 feet for its moisture. The unfertilized corn got its water from less than 5 feet of soil. This soil contained about 2 inches of available water per foot. This means the amount of extra water used was about 4 inches. Adequate fertility really paid off. Illinois had the same expeience—fertilized corn roots reaching at least 5 feet deep, unfertilized roots barely 3 feet.

4—Will I lose much fertilizer if a big rain hits?

Surface runoff is no problem if land is not too sloping and ground cover is good. P and K are safe on most soils because neither leaches. After Minnesota researchers surface-applied high K rates to alfalfa on a sandy loam, they found most of the K remained in the surface—over 600 lbs/A exchangeable K in the top 2 inches of soil, but only 70 lbs/A between 5 and 6 inches. Even after very high rainfall in the application year.

5—When 17 inches of water grew 100 bushels for one farmer and 160 bushels for his neighbor, what happened?
Many things may have happened. But your best bet is to check fertilization first. During a very dry year, Missouri farmers saw well fertilized corn push its roots 4 or more feet through claypan soils for that needed moisture. Then they saw the fertilized corn use 15,400 *less gallons* of water per bushel to produce 61 *more bushels* per acre.

6—Does inadequate fertility increase a crop's thirst?
It seems to. Almost like diabetes in the human. The deficiency of just one plant food element can do it. As the supply of this nutrient runs low, the plant starts slowing down drastically in growth. But its transpiration (exhaling moisture) does not change drastically. So, without the needed nutrient to balance its diet and keep up healthy growth, it demands more and more water to produce less and less crop.

7—Do fertilized crops do more than give extra yields during weather stress?
Yes. Fertilized crops grow fuller foliage to protect the soil from hard falling raindrops. This insures more of the falling rain seeping into the subsoil for future use. Fertilized crops develop more vigorous root systems to keep the soil in good physical condition. Fertilized crops increase plant residues for valuable organic matter and fuller water storage.

8—How does potassium help reduce plant wilting?
It has been said that potassium "turns off the plant faucet". How? By its influence on the cells that open and close the little leaf pores called stomata. Plants lose water through these pores. Many researchers now say the stomata on potassium-deficient plants stay open longer and lose much water.

9—Does potassium increase moisture in the plant?
Tests have shown it does. Leaves of low-K plants lose their muscle to hold firm. They become limp and often fray at the tips in the wind. Potassium moves from older to newer tissues. The older tissues then go limp, dry prematurely, and die from too little potassium.

10—Why do crops respond better to potassium in dry years?
Probably for two reasons. (1) Potassium gets to the plant root only in soil water—the less water the harder for the K to move. So, roots really latch onto *extra K* in their vicinity. (2) Roots feeding in that subsoil usually find a low-K diet down there. So, added K comes as a real buffet bonus.

11—Can acid soil hold back root growth?
It did in Auburn University tests. Cotton seedlings showed little root penetration into the subsoil that remained strongly acid. When lime was in the subsoil, the roots seemed to take off far deeper moisture. Cotton roots apparently are very sensitive to low lime content as they grow toward the subsoil.

A complete set of these tips for fighting weather stress (22 questions and answers to key points) is available in a kit offered on page 31.

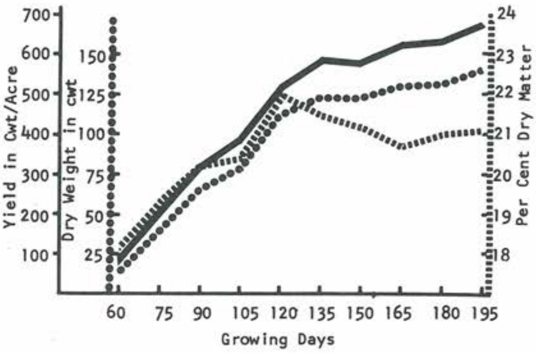


Figure 1—Relationships among yields of potatoes, amount of dry matter produced and percentage dry matter of the tubers.

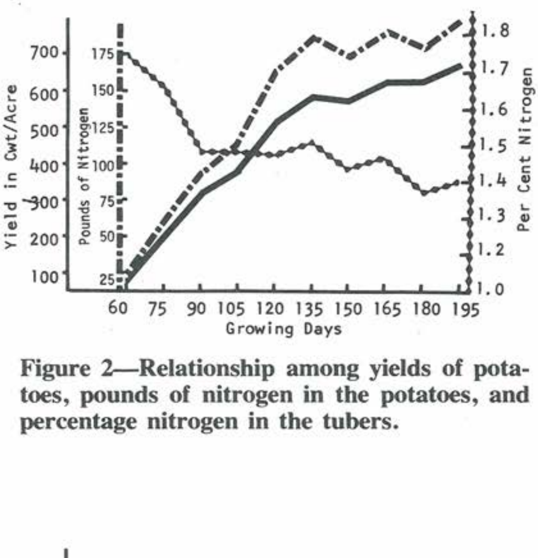


Figure 2—Relationship among yields of potatoes, pounds of nitrogen in the potatoes, and percentage nitrogen in the tubers.

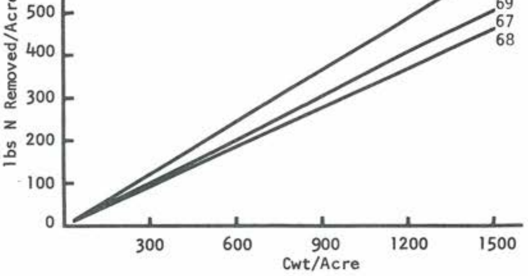


Figure 3—Regression lines showing the relationships between yields of potatoes and pounds of nitrogen contained in Russet Burbank potatoes in each of four years.

Nutrients Potatoes REMOVE Estimated Rapidly

R. KUNKEL
WASHINGTON STATE UNIVERSITY

THE NATION'S HIGHEST POTATO YIELDS per acre are produced under Washington's Columbia Basin conditions—with long, hot days and water provided to the crop as needed.

Potatoes are harvested 100 to 180 days after planting—and 200 growing days are possible in parts of the Basin. Reported commercial yields vary from 300 to 860 cwt per acre. Experimental yields have reached 1385 cwt per acre.

For three years (1966-69), potato tubers were analyzed yearly for major and minor elements. The total plant (except roots) was analyzed in 1967 and 1968. All experiments were conducted on Shano silt loam soils which had never grown potatoes. So, potato root diseases were not a factor.

All fertilizers were applied at planting time in equal bands about two inches to the side and slightly below the bottom of the seed piece. The plants were furrow irrigated. Insects and diseases were controlled as in commercial potato production.

Standard laboratory procedures were used in preparing and chemically analyzing the tuber and plant tissues.

Nitrogen, phosphorus, and potassium rates and ratios were studied, as well as the mineral element make-up of different varieties.

Mineral element composition of the

tubers was surprisingly uniform, regardless of fertilizer rate and ratio or potato variety used. The correlation coefficients relating amount of mineral elements in the tubers to yield were 0.9 or above (a coefficient of 1.0 is the highest possible), while those relating yield to percentage compositions were negligibly low. **Table 1** shows this.

TABLE 1—Total N, P, and K contained in the tuber of Russet Burbank potatoes (sample size 256), 1968 data.

	Percent			lb/acre		
	N	P	K	N	P	K
Yield Cwt	−0.16	−0.12	−0.23	0.93	0.90	0.93
Pounds N		0.39	0.49		0.89	0.91
Pounds P			0.56			0.94

Neither the percentages nor the amount of mineral elements found in the vines were correlated with yield.

Figure 1 shows close relation between yield and total dry matter produced, but not a close relation between percentage dry matter and yield.

Figure 2 shows pounds of nitrogen in the potatoes are positively related to yield, while percentage of nitrogen is inversely related to yield. Similar trends occurred for phosphorus and potassium.

Figure 3 shows the total amount of nitrogen contained in tuber crops of various sizes. As the yield per acre increased, the amount of nitrogen removed from the soil increased in a linear manner. **Figures 4 and 5** show similar removal trend for phosphorus and potassium.

Figure 6 compares nitrogen contained in various yields of Russet Burbank potatoes with the amount in other varieties. The amount of nitrogen for all varieties averaged slightly more than in the Russet Burbank. Phosphorus in other varieties averaged slightly less

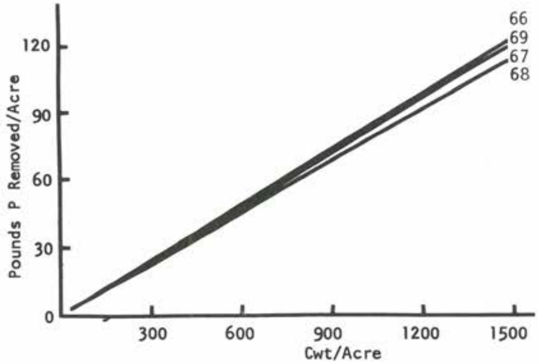


Figure 4—Regression lines showing the relationships between yields of potatoes and pounds of phosphorus contained in Russet Burbank potatoes in each of four years.

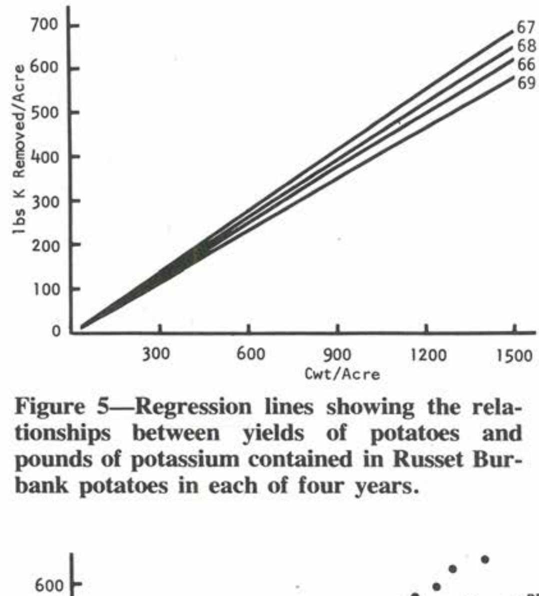


Figure 5—Regression lines showing the relationships between yields of potatoes and pounds of potassium contained in Russet Burbank potatoes in each of four years.

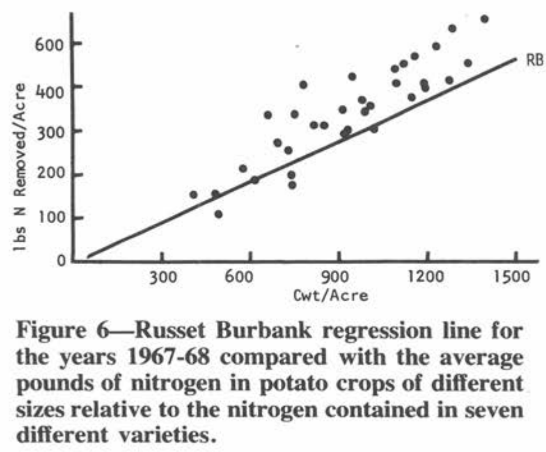


Figure 6—Russet Burbank regression line for the years 1967-68 compared with the average pounds of nitrogen in potato crops of different sizes relative to the nitrogen contained in seven different varieties.

and potassium about the same as in the Russet Burbank potato.

Therefore, data for the Russet Burbank potato can help estimate the amount of mineral elements removed from the soil by potatoes. **Table 2** shows this removal.

TABLE 2—Pounds of mineral nutrients removed from the soil per hundred weight of potato tubers.

Element	lb/100 cwt
Nitrogen	30.0
Phosphorus (P_2O_5)	7.0 (16)
Potassium (K_2O)	**44.0 (52.8)**
Calcium	0.8
Magnesium	2.5
Sulfur	2.4
Zinc	0.02
Copper	0.016
Manganese	0.015
Iron	0.047
Boron	0.007

THE FOLLOWING INFERENCES seem justified:

1. Large yields of potatoes remove large amounts of plant nutrients from the soil. If the soil cannot provide them, these nutrients must be applied.

2. The data agree with the range of yields from 300 to 600 hundred weight per acre which would include most present-day commercial potato yields.

3. Knowledge of soil tests, the amount of nutrients applied to the land, and the amount removed in a given sized crop should help determine fertilizer rates required for different yield levels. **The End**

Send us color chart: **Crops TAKE UP Nutrients ALL Season (Size 12″ x 18″)**

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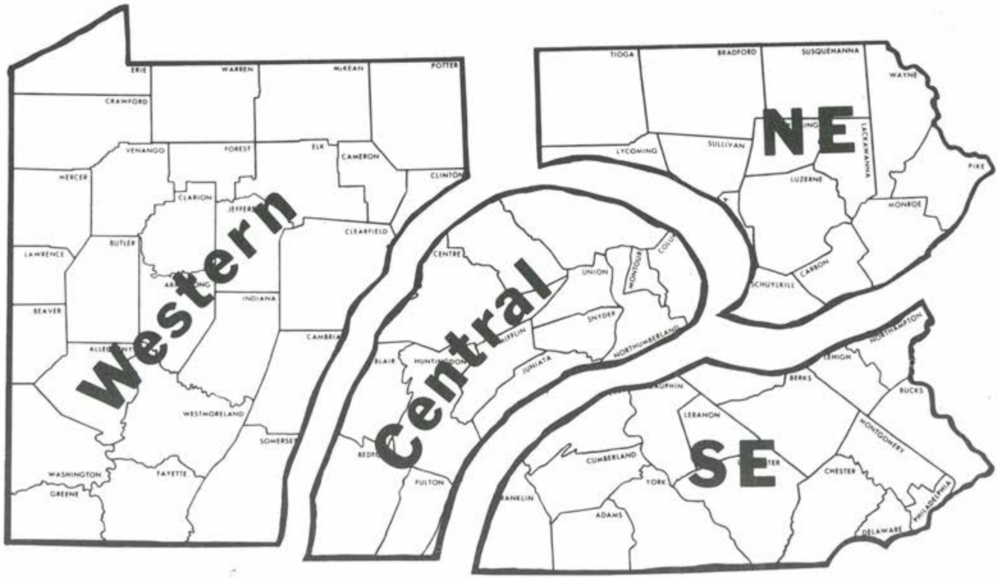

A LOOK AT 4 AREAS helps evaluate the changes. **SOUTHEAST:** Soils primarily of limestones and other calcareous materials. Intensive farming on soils under cultivation well over 200 years. Small farms using liberal limestone, fertilizers, and manures for years. **CENTRAL:** Soils developed in limestone valleys and on shale and sandstone ridges. Intensive dairy farming mostly. **NORTHEAST:** Soils primarily from glaciated shale and sandstone. Dairy and vegetable farming. **WESTERN:** Soils from acid shales and sandstones. Northwest soils similar to Northeast glaciated soils but less intensive farming.

Soil Summaries REVEAL Fertility Changes

A. WAYNE HINISH
PENNSYLVANIA STATE UNIVERSITY

When potassium (K) soil test levels drop this dramatically, applications apparently are not keeping up with plant withdrawal.

FERTILITY LEVELS of Pennsylvania soils are changing, according to data from 260,000 soil samples processed at Penn State's Merkle Soil Test Laboratory from 1968-1972.

In general, soil acidity may be increasing. Phosphorus and magnesium levels are increasing. Potassium levels have dropped and calcium levels have remained about the same.

The changes were not the same throughout the state. They were caused by many inter-acting factors, including materials used, application rates, crop

Table 1. Average Soil pH, 1968-1972

Year	SE	Central	NE	Western	State
1968	6.6	6.5	6.3	6.1	6.4
1969	6.7	6.6	6.5	6.3	6.5
1970	6.6	6.6	6.4	6.2	6.5
1971	6.6	6.5	6.3	6.2	6.4
1972	6.5	6.4	6.2	6.2	6.4

Table 2. Consumption of Limestone and Nitrogen in Pennsylvania 1963-1973

Year	Tons Limestone	Tons Nitrogen
1963	969,193	51,862
1964	972,210	55,574
1965	972,841	58,511
1966	1,087,365	65,489
1967	916,259	70,198
1968	972,257	72,407
1969	923,026	75,293
1970	828,557	82,947
1971	919,125	86,407
1972	827,999	76,061
1973	(935,000) est.	90,968

Table 3. Soil Test Phosphorus (#P/A) Values

Year	NE	Central	SE	West	State
1968	78	50	59	51	57
1969	88	62	70	52	66
1970	97	87	80	72	82
1971	106	92	88	76	88
1972	127	110	100	93	104

yields, and soils.

IN TABLE 1, the average pH of Pennsylvania soils changed very little from 1968 through 1972, though central and eastern Pennsylvania soils have become slightly more acid. But the pH of western Pennsylvania soils has increased slightly over this period.

The western soils, primarily from acid shales and limestones, are the most acid. Soils in this area average about half a pH unit more acid than limestone soils in central and eastern Pennsylvania.

IN TABLE 2, a 10-year comparison of nitrogen and limestone consumption may explain the apparent increase in soil acidity.

Nitrogen consumption has increased 80 percent (40,000 tons) while limestone consumption has tended to decline. This is important because nitrogen fertilizers help cause soil acidity.

It takes about 4 lbs of limestone to neutralize the acidity formed by 1 lb of nitrogen. This means at least 160,000 tons **MORE** lime was needed over the 10 years just to offset the nitrogen effect.

Even more limestone is needed to offset other acidifying effects—such as higher yields per acre and idle land into production.

Table 4. Consumption of P_2O_5 and K_2O per Harvested Acre of Field and Vegetable Crops by Area

Year	SE		Central		NE		West	
	P_2O_5	K_2O	P_2O_5	K_2O	P_2O_5	K_2O	P_2O_5	K_2O
1963	42.7	40.0	31.8	25.9	13.5	13.1	24.2	22.7
64	42.1	37.4	29.0	26.5	16.0	15.0	23.3	20.7
65	40.0	33.5	33.6	30.2	13.6	12.7	21.5	19.5
66	44.1	38.5	35.7	31.4	23.5	21.0	25.5	23.4
67	39.5	33.8	30.8	26.3	22.0	19.3	28.3	24.6
68	41.6	34.4	31.3	26.8	23.0	20.8	25.3	22.4
69	46.5	38.4	34.4	28.6	22.6	21.0	25.9	22.2
70	48.6	37.8	37.2	29.3	23.3	21.1	28.1	24.9
71	43.9	35.7	33.0	27.8	23.0	21.3	28.4	25.7

Table 5. Soil Test Potassium Values Expressed as #K/Acre and as %Saturation of the CEC

Year	NE		Central		SE		West		State	
	#/A	%K	#/A	%K	#/A	%K	#/A	%K	#/A	%K
1968	255	3.2	270	3.4	305	3.9	250	2.9	275	3.4
1969	280	3.3	305	3.6	350	4.3	290	3.0	315	3.7
1970	365	3.2	360	3.6	380	4.1	400	3.2	380	3.6
1971	195	2.8	240	3.1	260	3.6	225	2.7	235	3.1
1972	200	2.8	240	3.1	255	3.6	220	2.6	235	3.1

IN TABLE 3, the precipitous increase in soil phosphorus levels is a striking revelation.

The average level increased 80 percent—from 57 to 104 lbs P per acre. The Pennsylvania Soil Test Program interprets these soil test values for phosphorus:

Lb P/Acre	Soil level
0-60	Low
61-100	Medium
101+	High

Therefore, **TABLE 3** indicates the average P levels for Pennsylvania soils moved from a low-medium to a low-high range in five years.

Although an increase occurred throughout the state, the highest P levels came in the Northeast where vegetable acres are heavily concentrated.

But, fertilizer consumption figures do not explain the increase in soil test P values over these past five years.

IN TABLE 4, the slight increase in phosphate fertilizer usage is not as dramatic as the increase in soil test value for P.

But it seems farmers are following the soil test recommendations. In the Northeast where test values are highest, the lowest phosphate fertilizer is used.

One possible explanation for the increasing soil P levels is the trend toward high phosphate fertilizers and the tendency to concentrate most of the applied phosphate in a band rather than broadcasting it.

IN TABLE 5, dramatic changes also occurred in the potassium soil test values—increasing from 1968 to 1970, then decreasing about 150 lbs per acre since 1970.

Expressed in terms of percent saturation of the CEC, this was 0.5 percent decrease throughout the state.

The Pennsylvania Soil Test Program

Table 6. Soil Test Magnesium Values

Year	SE		Central		NE		Western		State	
	#/A	%Mg	#/A	%Mg	#/A	%Mg	#/A	%Mg	#/A	%Mg
1968	265	11.0	150	6.2	215	8.7	175	6.3	205	8.2
1969	285	12.1	180	7.2	215	8.9	200	7.3	230	9.3
1970	315	12.9	195	7.5	205	8.7	225	7.8	245	9.6
1971	320	12.7	205	7.7	225	9.0	235	7.9	260	9.7
1972	320	12.8	210	8.0	225	8.8	235	7.8	260	9.8

uses these interpretation levels for potassium:

% K	Soil level
0-2.0	Low
2.1-3.5	Medium
3.6	High

Therefore, average test values are in the medium range throughout the state.

Fertilizer consumption figures in **TABLE 4** do not explain the drop in soil K levels. In fact, K_2O consumption per harvested acreage has changed little.

But the consumption data does seem to indicate a positive influence of soil test recommendations, because the areas where soil test values are lowest are using more K_2O per acre.

IN TABLE 6, the soil testing program has influenced magnesium soil levels, because the average state level increased 55 lbs Mg per acre or 1.6% in percent saturation of the CEC.

The Pennsylvania Soil Test Program first included the Mg test as part of the standard test in 1967 and developed recommendations for all crops.

The amount of Mg recommended is that required to raise the soil test value to 10 percent saturation of the CEC. When K soil test values exceed 5% K, sufficient Mg is recommended to increase the soil %Mg to twice the %K value.

Early studies had keyed problem areas—low Mg soil levels and excessive K levels. Low Mg soils were found in west-central and central counties. Excessive or very high K levels were found in the Southeast.

So, if soil test recommendations were followed, we should find an increase in soil Mg levels in the Southeast, Central, and Western areas. The data indicates this did occur.

IN TABLE 7, Pennsylvania corn

Table 7. Corn Yields Per Acre 1963-1972

Year	Grains Bu/A	Silage T/A
1963	53.0	10.5
1964	58.0	11.0
1965	65.0	11.0
1966	49.0	8.0
1967	88.0	16.0
1968	70.0	12.0
1969	84.0	15.0
1970	85.0	15.5
1971	75.0	14.0

yields increased rather dramatically in 1967, 1969, 1970, and 1971. We would expect such rising yields to remove greater amounts of plant nutrients and increase soil acidity.

The effect on soil test values would be delayed. For example, the current year's test value reflects what has happened over the past year or two, not what will happen this year.

During these high yields, especially for the three years in a row (1969-1972), fertilizer consumption changed little.

Whether soil test values would reflect this situation is the next question.

Experience has shown that changes in potassium levels are picked up more quickly through phosphorus, so look back at what happened to soil test values.

The decline in K value coincides real well with the demand high yields put on soil levels in 1969 and 1970. Simply put, applications were apparently not keeping up with plant withdrawal. The End.

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