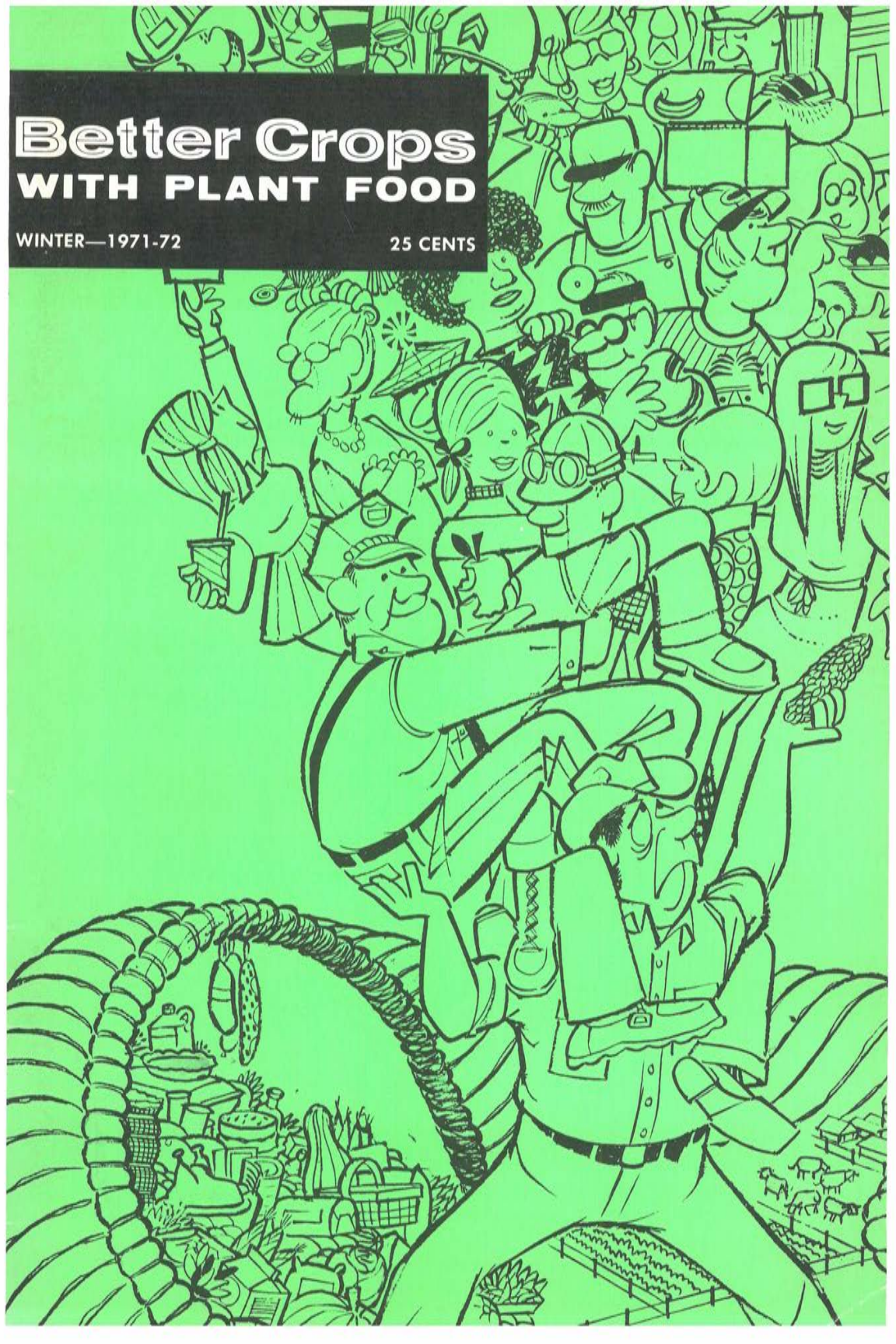
Better Crops
WITH PLANT FOOD

WINTER—1971-72

25 CENTS



"We cut ourselves off from an acknowledgement of the values of rural life, agriculture and outdoor living only at our peril. There is the obvious fact that city man depends upon rural products, food, clothing, etc., for his very life. But we fail to adopt social policies that strengthen rural life, make viable a real choice of a continuing and satisfactory rural life for many in our population."

Richard L. Means, THE ETHICAL IMPERATIVE, Doubleday, 1969, Pages 238-239.

"What is agribusiness? It is the world's biggest business, and the most essential. Everyone everywhere depends on agribusiness—all who eat, all who wear clothes, and all who live in houses."

Archie A. Stone, CAREERS IN AGRIBUSINESS AND INDUSTRY, Interstate Printers and Publishers, 1965, Page 3.

". . . the great cities rest upon our broad (plains) and prairies. Burn down your cities and leave our farms, and your cities will spring up again as if by magic. But destroy our farms and the grass will grow in the streets of every city in the country."

Wm. Jennings Bryan, 1896.

"History . . . celebrates the battle fields whereon we meet our death, but scorns to speak of plowed fields whereby we thrive; it knows the names of the king's bastards, but cannot tell us the origin of wheat. That is the way of human folly."

J. Henri Fabre.

"Not all Americans live in big cities or densely packed suburbs. In fact, one-third of our Nation is still living in small towns and open country areas. For a highly developed Nation, this fact is extremely significant."

James H. Copp in CONTOURS OF CHANGE, The Yearbook of Agriculture 1970, page 143.

"One has only to look at an ignorant disease-ridden . . . Bedouin seated among the marble ruins of the once great Roman cities of North Africa to see and to understand what happens to countries and nations when their agriculture fades, their soil becomes worn out and their peoples lose their economic independence, their health, their vigor and their intelligence."

Louis Bromfield, MALABAR FARM, Harper and Row, 1947, page 375.

"One might look for a moment upon modern agriculture as a young lady of many talents and moods. She is obviously very influential politically. When courted by government her tastes are expensive, but she cannot be won by force, as is clear from the Soviet experience. She is unabashed in giving her favors to the consumers of food yet heartless in her treatment of her own people—in the stresses and strains she imposes on many farm people."

Theodore W. Schultz, ECONOMIC CRISES IN WORLD AGRICULTURE, University of Michigan Press, 1966, Page 69.

ON THE COVER . . .

We get an idea of the load the American farmer carries. This cover was loaned to us by FARM PROFIT magazine, published by Massey Ferguson Company, a name long known for quality equipment and service in agriculture. On page 2, FARM PROFIT Managing Editor Wes Ritchie lets America know who's supporting who.

Better Crops
WITH PLANT FOOD

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CONTENTS

WHO'S Supporting WHO?

Note how the farmer's production load has increased—he's added 20 since 1960.

1850
He fed 4

1900
He fed 7

WES RITCHIE in FARM PROFIT Magazine

WHETHER WE Americans realize it or not (and most of us don't), we owe a great deal of our luxurious living to the man producing our food.

The farmer and the abundant supply of food he produces is the basis on which we have been able to build the world's highest standard of living.

Stop and think of the progress this country has made in the past 25 years—or even the last 10 years. Fabulous!

Twenty-five years ago we had very few dishwashers or clothes dryers in our homes. Jet airplanes, antibiotics, atomic energy, Salk vaccine, electronic computers and electric can openers were hardly heard of. Two-car families and air conditioned homes (let alone air conditioned cars) were few and far between . . . and the list could go on.

WHO'S MADE IT POSSIBLE? Ask that question of the average man on the street and you're sure to get a multitude of answers. Our scientists, inventors and industrialists are sure to be mentioned, as they rightly should. But the farmer, as an important force behind this country's progress, would most likely be overlooked.

And there's probably a reason for that, too. Farmers have become so efficient at producing great quantities of wholesome food at low cost that most of us take a full stomach for granted.

But even though farmers are taken for granted, their business is still the nation's most basic industry. And food is man's most basic material need.

Agriculture is this nation's biggest single industry, in fact employs more persons than transportation, public utilities, automobile manufacturing, and the steel industry combined. The current investment per farm worker of $50,000 is nearly double the average for nonfarm industries.

Even more significant is the rate of increase in output per farm worker since 1950—almost double that of nonfarm workers. This is one of the basic reasons for the high and rising American standard of living.

HOW HAVE FARMERS DONE IT!

- **Farmers have freed manpower.** At the time of the American Revolution, this was a nation of farmers. Even 50 years ago, over ¼ of all Americans were farmers. If farmers were no more efficient now than in 1920, this country would need

1940
He fed 11

1960
He fed 26

1970
He fed 46

20 million people in agriculture to meet her current needs. In 50 years, more than 15 million workers have been "freed" to produce other things.

• **Farmers have freed income.** Fifty years ago, the average American had to spend about 80% of his income on the basic requirements of life—food, clothing and shelter. Today these essentials take less than 65%. So the average family can spend over 35% of its take home pay—instead of 20%—for travel, recreation, education, health, and the other luxuries that add to life's quality.

A major part of this gain in extra spendable income has come from a decline in the relative cost of food. Americans last year had to spend only 16½% of their income on food. That compares with over 20% just 10 years ago and over 50% and more in eastern Europe and many developing countries. Any way you look at it, Americans are buying food at bargain prices.

• **Farmers have also freed time.** The average work week was 51 hours in 1920, compared to 40 now. And paid vacations 50 years ago were few and far between.

Many things have helped, but you can be sure that if food, fiber and shelter were still costing 80% of consumer spending, workers could not have reduced their work week.

• **Farmers have freed space.** When we were a nation of 107 million people, 350 million acres were needed to grow our food and fiber. In recent years we have harvested fewer than 300 million acres and our population has nearly doubled.

If farmers hadn't improved their efficiency, we would now need to harvest 500 to 550 million acres—even if we stopped exporting. The acres spared by farm efficiency add greatly to soil and water protection, wildlife, and recreation. And more land is available for towns and open space, too.

These benefits—income, time, space, and better use of manpower—have all been vital to improving the quality of life for every member of our society.

TREMENDOUS FARM PROGRESS. What has happened in the past few years overshadows the progress of many, many previous generations. In Christ's time, it's thought that one full-time worker was producing enough food and fiber for him-

self and less than one other person.

By 1850, the food and fiber produced by one American farm worker was enough for 4 persons. Just 50 years later the figure had nearly doubled—it was up to 7.

Between 1900 and 1940, farmers made tremendous progress and the output of food and fiber per farm worker had risen to enough for 11 other people.

By 1960, the production of one farm worker was enough to meet the food and fiber needs of himself, plus 26 other people. Last year, each farmer produced enough to feed nearly 46 people. In 1971, it could equal, or possibly exceed 50!

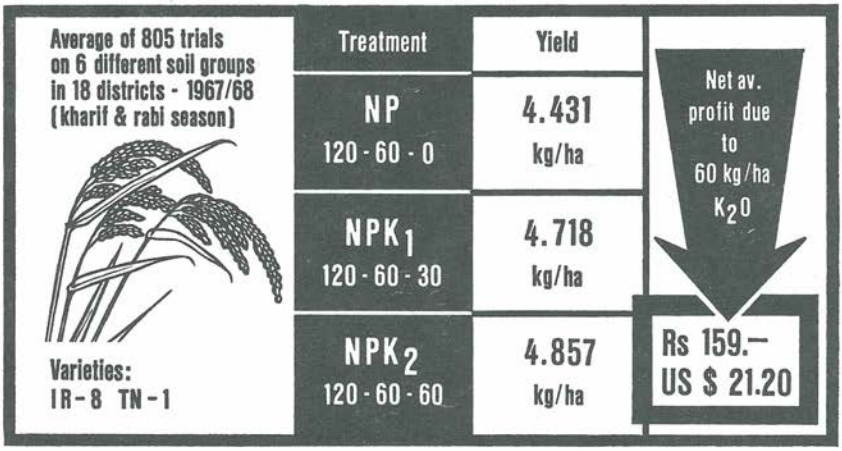
Farmers have made as much change in their productivity in the past 11 years as was made between Christ's time and 1960.

WHO BENEFITS MOST? Generally, we in America feel that he who makes progress possible should be rewarded for it. But the farmer, the man who has really made our improved level of living possible, often does not share proportionately in the profits.

The real beneficiary of our great agricultural progress is the American consumer. The average American who feeds himself on only 16½% of his after-tax income could not do it without the farmer's basic support—an abundant supply of food.

THE END

Response of HYV rice to potash

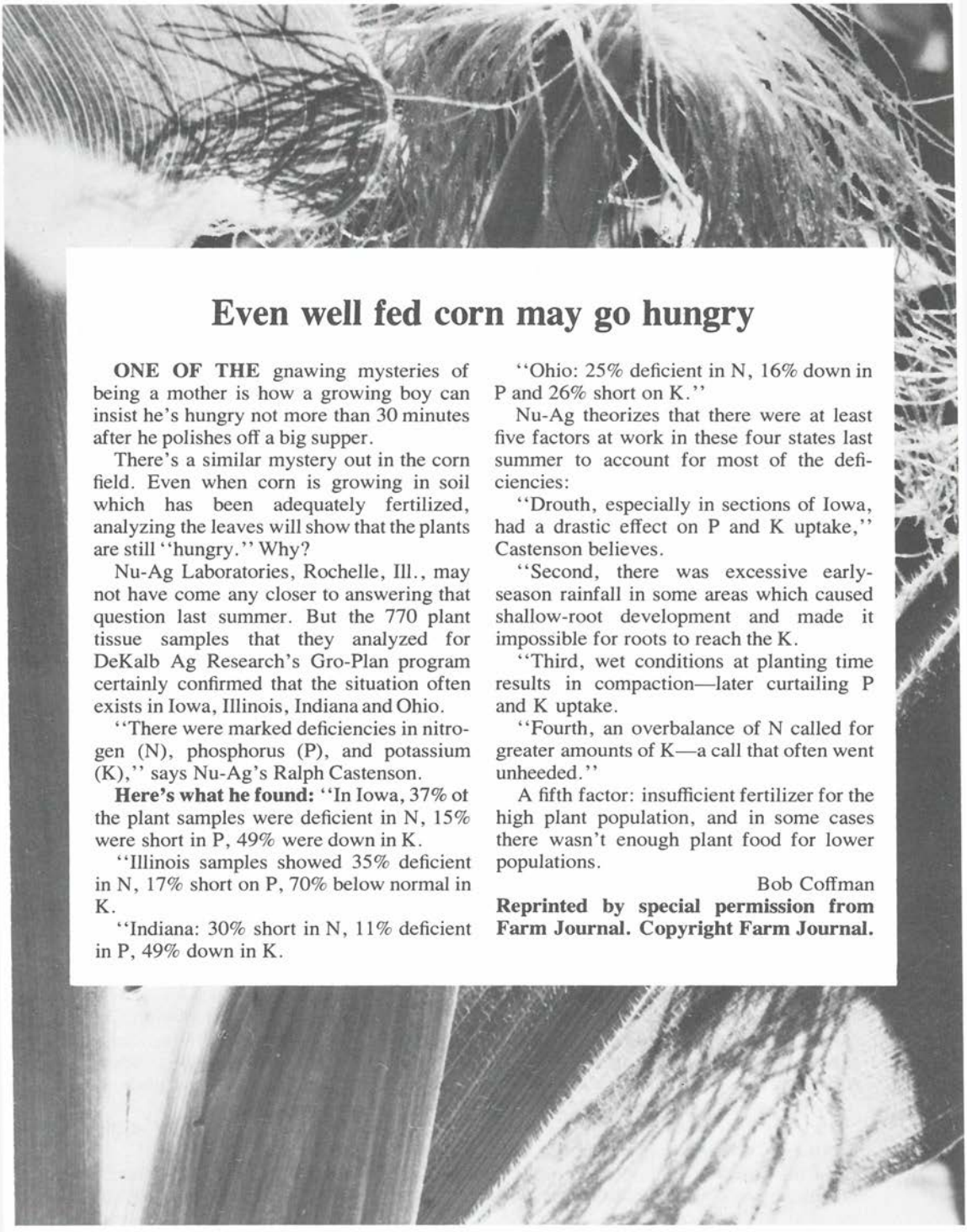


THE NEW HIGH YIELDING varieties of rice are very responsive to fertilizer, particularly to nitrogen. But as they remove large amounts of K_2O yields reached with the rather expensive nitrogen dressings can still be increased significantly by the addition of potash.

The results of 805 fertilizer trials carried out on farmers' fields by the Indian Council of Agricultural Research in 1967/68 on 6 soil types in 18 regions with different climatic conditions show, on average, a linear response to increasing rates of potash and a marked net profit due to 60 kg K_2O given in addition to 120 kg N and 60 kg P_2O_5 per hectare.

Recent investigations in Japan, Taiwan and Ceylon furthermore show that additional topdressing of K, together with N, can result in still higher earnings with the same expense on mineral fertilizers and labour costs.

—From International Fertilizer Correspondent



Even well fed corn may go hungry

ONE OF THE gnawing mysteries of being a mother is how a growing boy can insist he's hungry not more than 30 minutes after he polishes off a big supper.

There's a similar mystery out in the corn field. Even when corn is growing in soil which has been adequately fertilized, analyzing the leaves will show that the plants are still "hungry." Why?

Nu-Ag Laboratories, Rochelle, Ill., may not have come any closer to answering that question last summer. But the 770 plant tissue samples that they analyzed for DeKalb Ag Research's Gro-Plan program certainly confirmed that the situation often exists in Iowa, Illinois, Indiana and Ohio.

"There were marked deficiencies in nitrogen (N), phosphorus (P), and potassium (K)," says Nu-Ag's Ralph Castenson.

Here's what he found: "In Iowa, 37% of the plant samples were deficient in N, 15% were short in P, 49% were down in K.

"Illinois samples showed 35% deficient in N, 17% short on P, 70% below normal in K.

"Indiana: 30% short in N, 11% deficient in P, 49% down in K.

"Ohio: 25% deficient in N, 16% down in P and 26% short on K."

Nu-Ag theorizes that there were at least five factors at work in these four states last summer to account for most of the deficiencies:

"Drouth, especially in sections of Iowa, had a drastic effect on P and K uptake," Castenson believes.

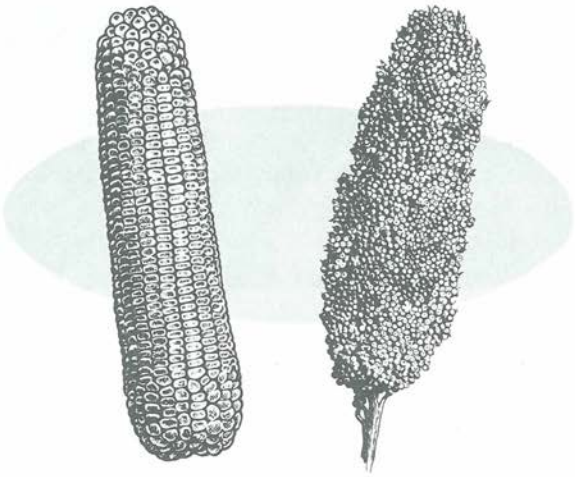
"Second, there was excessive early-season rainfall in some areas which caused shallow-root development and made it impossible for roots to reach the K.

"Third, wet conditions at planting time results in compaction—later curtailing P and K uptake.

"Fourth, an overbalance of N called for greater amounts of K—a call that often went unheeded."

A fifth factor: insufficient fertilizer for the high plant population, and in some cases there wasn't enough plant food for lower populations.

Bob Coffman



From the University of EXPERIENCE

THROUGH THE YEARS, this magazine has featured many items on alfalfa as the Queen of Forages . . . citing its palatability and high protein content . . . its suitability for hay or silage . . . its work as a soil improver and drought fighter . . . and hailing 10-tons hay from some trials.

One of the world's best known corn breeders and producers, Roswell Garst, has raised some challenging questions about alfalfa and all legumes. Mr. Garst is no ordinary man. He is a remarkable farmer, known about as well abroad as in America. He has pioneered questions and practices since the early days of hybrid corn and tractors and high analysis fertilizers.

His points are worth our attention:

- **When one speaks of 10 tons per acre of alfalfa, remember such yields are usually limited to the very long-season areas of the USA, places like southern Arizona and California and under irrigation. 10-ton returns are rare in the alfalfa production areas of the East and Midwest.**

- **When one speaks of alfalfa as a "low cost source of protein" for high-producing dairy cows, remember dairy cows need nearly 15% of their total intake to be protein. That takes a whale of a lot of alfalfa to produce.**

- **When one values protein of alfalfa at 10¢ per pound, or about the cost of a pound of protein in soybean meal, you should remember cattle are ruminants which can use urea for their protein requirements if the urea is fed in combination with fast carbohydrates—sugar or starch. This means a pound of protein equivalent through urea costs less than 1.5 cents—not 10 cents.**

"With nitrogen for plant food selling at present prices and with urea for the protein of ruminants available, alfalfa is like horses," Mr. Garst believes, "beautiful, interesting, a fine tribute to the past, but no longer a very economic crop—certainly not economic in the heavy grain producing areas where frequent summer rains greatly lower the quality of a great deal of it."

Roswell Garst has long been a straight-A student in the most important university on earth—EXPERIENCE. There is no need nor space to go into his record. But two very readable booklets, issued by the Garst & Thomas Hybrid Corn Company at Coon Rapids, Iowa, explain how a farmer can use the cellulose products he usually wastes—the corn cobs, corn stalks, and grain sorghum stubble—for cattle feed.

In a nutshell, these bulletins explain several important things:

THAT the farmer who uses only his shelled corn and throws away the cobs and stalks loses ⅓ the feed units he has raised.

THAT the farmer who uses only the grain from grain sorghum and throws away the stubble loses ⅓ the feed units he has raised.

THAT grain sorghum stubble makes a very inexpensive source of palatable silage cattle prefer over hay when properly supplemented with protein and minerals.

THAT anyone feeding ruminants corn cobs, corn stalks, grain sorghum stubble, dry grass, sorghum silage—anything low in protein—should balance them with the cheapest effective protein. This is urea which only works with ruminants—the cattle, sheep, and goats of American agriculture.

THAT all celluloses—such as corn cobs, stalks, grain sorghum stubble, etc.—are low not only in protein, but also in minerals and Vitamin A. They can be added at negligible cost—but neglecting them can be very costly.

THAT economical nitrogen in fertilizer has eliminated the need for legumes in soil building—certainly in the heavy grain producing areas—as corn yields have almost doubled and sorghum yields almost tripled just since 1954.

THAT legumes may well be too costly for building soil nitrogen—about 75¢ lb when you consider loss in income between oats and soybeans and the cost of clover seed. Today nitrogen can be bought (in fertilizer) for 10¢ lb or less in most areas.

THAT hay is too expensive in time, labor, and machinery. It must be cut 2 or 3 times . . . raked more than it is cut, because it gets rained on and must be "turned over." Then it must be baled . . . then lifted by each bale onto a wagon . . . then farther up on the wagon . . . then off the wagon into an elevator . . . then stacked . . . then handled out of the stack onto a wagon . . . perhaps every ton handled by human muscle 6 or 7 times before it gets down the cow's throat. Other feeds can be much more automated.

THAT a farmer who makes grain sorghum **silage** on the same 50 acres he used to get grain sorghum **grain** will ADD 50 acres to his farm without cost or taxes.

"To me the day of crop rotations is over because through new technology we can raise corn continuously on the same land. Your experiences and our research at Purdue have indicated for many years that you could produce more beef per acre from the corn plant than by any other crop. For example, we can produce 2000 lb. of beef per acre from corn silage and only 500-600 lbs. of beef per acre from the best legume hay crops made either in the form of silage or hay.

"With our present knowledge of feeding cattle, hay is not an essential item in beef cattle rations. The corn plant contains all essential nutrients for ruminants excepting protein, minerals and vitamin A. We are obtaining excellent results by fortifying our rations with 20,000-30,000 I. U. of synthetic vitamin A per head daily. Many cattle feeders are even going to higher levels—40,000-50,000 I. U. per day.

"Indiana is rapidly becoming a cow and calf state, and many counties in the southern region have increased their cow and calf herds 50 to 100 percent in the past few years.

"The thing that puzzles me is that with the introduction of picker shellers, we are leaving from ⅓ to ½ of the nutritional value of the crop in the field. We need a machine that will simultaneously shell the corn and also grind the cobs and stalks which could be stored in a silo or even dried.

"Best wishes and kindest personal regards.

To Garst & Thomas

Very truly yours,
W. M. Beeson
Lynn Professor"
Purdue University

THAT a farmer can add 50% more cows to his operation if he will quit putting up hay and add those hay acres to his pasturing acres. And if he **fertilizes** the pasture, he can carry TWICE the cows he did before—and sometimes more than twice!

The Garst ideas will not be accepted everywhere. They may not be workable everywhere. But they will be read and thought about and debated—because he is one of the master farmers of this planet. If you are interested in his bulletins and more of his ideas, you can reach him at Coon Rapids, Iowa. **THE END**

These tips can be ordered as kits of FERTILEGRAMS for distribution to farmers, advisers, and fertilizer outlets. The rate is 4¢ per kit. Order on next page.

From NEW soybean kit: (20 questions & answers)

Is it practical to fertilize soybeans?

Yes. "The notion that soybeans do not respond to fertilizer is a myth," Purdue scientist M. L. Swearingin says. We know soybeans remove much NPK in the grain. We know soybeans are sold off the farm, so no return in manure. We know fertile soils mean higher soybean yields. We know relatively few soybean acres are NOW fertilized and then very sparingly. Fertilization is a good investment.

How much plant food does each bushel of soybeans remove?

About 4 lb N, 0.8 lb P_2O_5, and 1.4 lb K_2O. This means 50 bushels remove 200 lb N, 40 lb P_2O_5 and 70 lb K_2O. Don't forget TOTAL uptake. North Carolina scientists found 50 bushels take up 257 lb N, 48 lb P_2O_5, and 187 lbs K_2O PER ACRE in the beans and plants. All nutrients totaled 560 lbs. An 80-bushel crop took up 780 lbs.

What about fertilizing soybeans with nitrogen?

Soybeans have a great N fixation factory in the nodule bacteria. They fix most of their N from the air or get it from the soil. But added nitrogen may give the crop a boost under cool conditions, drouth, acid soil or poor inoculation. Most soybean fertilizers contain some N because farmers feel it helps the soybean get a jump on the weeds.

What does research say about phosphate and potash for soybeans?

All states say fertilize on low fertility soils. Most states, especially east of the Mississippi, say fertilize to replace the P and K soybeans remove. Some states, such as Ohio and Missouri, say fertilize on high fertility soils.

How about including soybeans when fertilizing other crops in the rotation?

Fine, IF you apply enough fertilizer to take care of the soybeans. Remember what just the grain of a corn-soybean rotation removes. The 150 bu corn and 50 bu soybeans remove 90 lbs P_2O_5 per acre—50 lb in the corn, 40 lb in the soybeans. The same 150 bu corn and 50 bu soybeans remove 115 lbs K_2O per acre—42 lb in the corn, 73 lb in the soybeans. Don't forget some fixation of fertilizer nutrients in the soil, plant inability to absorb all the fertilizer, and soil loss.

Do farmers generally apply enough fertilizer in the rotation?

No. Soybeans remove much phosphate and very much potash. The problem may be creeping up on us. Through limited corn leaf samples in 1970, Missouri researchers may have found a warning. With corn 1969 and corn 1970, 37% of the samples tested K deficient. With soybeans 1969 and corn 1970, 55% tested K deficient. Never forget the soybean's high fertility demand.

From NEW disease kit: (16 questions & answers)

I've heard fertilizer can help control disease in my crop. Any truth to this?

A nutrient is not a direct agent of control. Illinois plant pathologist, Dr. E. E. Burns, says it augments the natural resistance mechanisms of the plant. An IMBALANCE of nutrients, rather than the absolute amounts of each nutrient, usually favors disease development.

What do you mean by IMBALANCE? How does it favor disease, as you say?

Most diseases have a sweet tooth for lush, soft crops, the kind that come from pouring on plenty of nitrogen but forgetting to add enough of the other nutrients to keep normal balance in the plant. For example, potash-hungry plants accumulate too much sugars and nitrates that can't be converted to proteins. Such plants run down early—cells die, tissues deteriorate, inviting open house to disease.

Is any one nutrient the key to this apparent resistance building?

NO, though USDA Yearbook on Plant Disease says, "More plant diseases have been retarded by use of potash fertilizers than any other substance, perhaps because potassium is so essential for catalyzing cell activities."

But right balance was the key in most reports. For example, on turf-grasses, bringing sulfur into right balance with other elements seemed to help reduce Patch disease . . . keeping nitrogen level up during active growing season did most to control red thread disease . . . bringing sulfur and potash more into balance with the other elements seemed to help reduce dollarspot?

In potatoes, late blight increased as nitrogen was increased and declined as P and K were increased or brought "into right balance." Corn stalk rot and lodging usually hit harder when potash was "out of balance" with nitrogen and phosphorus.

What do you mean when you say "out of balance" or "in right balance?"

Right balanced fertility, of course, does not mean equal amounts of all elements. It means ENOUGH of EACH nutrient to satisfy a high-yield crop's need. Nitrogen is usually the lead horse, so to speak—the vigorous booster. The more it boosts growth the more the crop takes up (or WOULD take up) OTHER nutrients, if they are there. Recent reports from such varied places as Florida, Michigan, Nebraska, and Illinois indicate corn takes up about the same amounts of nitrogen and potassium—with six hybrids containing an average of 24.2 lb N and 26.2 lb K per ton of dry matter produced.

Then, is plant health a matter of nutrient balance?

Let's put it this way—you can't expect too much health without it. Illinois plant pathologist Burns cited some cases where nutrients in balance and out of balance affected disease development: (1) Corn ear rot hitting some very fertile fields the worst . . . (2) Stewart's wilt of corn aggravated by nitrate nitrogen . . . (3) Potassium helping reduce leaf spot infestation on corn when brought into right balance . . . (4) Calcium helping increase resistance to certain wilt fungi by stabilizing pectic wall substances, making them more resistant to enzymes that decompose cell walls.

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SECOND IN A SERIES

Is environmental pollution a new peril to man?

No—though it has been made to appear so. **Dr. Robert White-Stevens, eminent Rutgers University environmental scientist,** cites some of the new vocabulary that has grown up to confuse and defy definition: "ecosystems" . . . "bionomics" . . . "territorial integrity" . . . "behaviorism" . . . and "biotype."

Dr. White-Stevens makes three striking contentions, based on a lifetime of study respected around the world:

- THAT life everywhere has always been threatened by pollution and the hazard of contamination.
- THAT reduction of one form of pollution, be it animate or inanimate, in one place generally creates another, hopefully less injurious or annoying contamination elsewhere.
- THAT pollution is a relative matter, the hazard of which depends entirely on the biochemical activity of the substance involved, its rate of decay or conversion, the nature of the degradation products, the route, degree and frequency of exposure to humans, domestic livestock, wildlife and crop plants and their relative capacity to metabolize such compounds.

Which is right: the "furnace" theory or the "ice box" theory?

Glib but unscientific prophets throw doomsday rhetoric at us these days, **Dr. Roy Kottman, Ohio State University Dean of Agriculture,** warns.

One side says carbon dioxide produced by oxidation of fossil fuels is building up in

the biosphere . . . creating a "greenhouse effect" to heat up the earth and melt the ice at the Poles and drown the major coastal cities.

Another side says increased particulate matter released into the atmosphere will reflect (or haze out) enough sun energy to cool the earth and build glaciers toward another ice age.

Who's right? No one knows. And only scientific study, worldwide over a long period of time, will tell. But **Dr. Kottman** warns against rhetoric that avoids reality.

"The reality of our environmental status is this: More has been done to alleviate human suffering . . . more done to eliminate hunger and famine . . . more done to eliminate pestilence and disease . . . more done to make life pleasant and comfortable during the past 50 years than in all recorded history," he says.

Why isn't potassium fertilizer ever mentioned with environmental problems?

Because it is no potential hazard to water quality. Iowa State University Extension Agronomist, E. R. Duncan, says there is no apparent environmental concern about fertilizer potassium as a pollutant.

What is the purpose of conservation?

Dr. White-Stevens puts it very plainly, "The purpose of conservation is to conserve man and all those animate creatures and inanimate creatures which contribute to his conservation of mind, body, and soul . . . anything else is not conservation but merely conversation."

Do fertilizers contribute anything to food quality?

They are key elements in food and feed quality, **Dr. George Smith** (Mo.) told a U.S. Senate Committee. The higher minerals and proteins fertilizer puts in our crops, for example, have made rickets in children and milk fever in cows a rarity.

Fertilizers were once used largely to "perk up" poor soils. Today states with some of the richest soils use the most nitrogen. Why? So they can grow highest protein species (crops) possible . . . in the yearly output of grains and meat.

I've heard it said fertilizer helps improve animal efficiency. Is this so?

Yes, sir! Modern fertilizer grew up with improved genetics in plants and animals. **Dr. Smith** cites the work of plant and animal breeders who produced:

(1) **Plants** that could use greater quantities of properly balanced fertilizers to boost yields sharply.

(2) **Animals** that could convert these more nutritious grains and forages into much more meat, milk, and eggs.

He cites how Missouri's corn and wheat yields are now double those of 1940. Look at commercial **laying hens:** 25% more eggs than in 1940, about 250 a year!

Broilers: now 1 lb live weight on less than 3 lbs of feed.

Swine: 1 lb of live weight on 4 lbs of feed.

A dairy cow: now more than twice the milk of her 1940 ancestor.

Such gains could not have happened on the "mining" soil habits of 30 years ago, **Dr. Smith** said.

Does fertilizer use affect a nation's economic condition?

Yes. It improves it. **Dr. White-Stevens** cites an interesting study by **Dr. Tanner** showing "a direct correlation between the Fertilizer Nitrogen Equivalent Diet (FNED) and income for 19 countries. As income rises the relation to FNED becomes flattened to a steady state around 80 lbs/cap/annum."

How much land does it take to provide the nitrogen ONE person needs?

From 2 to 2.5 acres on favorable arable soils in humid temperature latitudes . . . to provide about 38 lbs of nitrogen from natural sources. **Dr. White-Stevens** reports.

Or under ideal crop and livestock conditions, some 500 million acres of top-yield arable land to sustain our U.S. population "at a bare subsistence level of protein intake . . . allowing nothing to be lost to flood, drought, frost, insects, disease or weeds . . . providing no carryover for future crop or livestock failures . . . and leaving nothing for export to hungrier countries."

Where nitrate has increased in waterways, what are the causes?

Localized and isolated instances point to three sources: (1) Municipal-industrial wastes, (2) Septic tank and animal effluents, (3) Soil erosion. **Dr. White-Stevens** says, "There is little secure evidence that recommended levels of field applied fertilizer nitrogen are responsible for significant or serious levels of nitrates in aquifers."

Is nitrate seriously polluting our rivers?

- Let's look at Indiana's famous Wabash near Lafayette. **USDA scientist G. H. Enfield** found yearly levels over one 6-year period ranging from 4.9 to 6.9 ppm —little different from the 1906 reading of 6.4 ppm.
- A Kentucky town of 13,000 contributed far more nitrates and phosphates to the Clark River than two rural watersheds flowing into the river above the town, **Murray State University scientist J. D. Mikculcik** reported. Nitrates never reached toxic level for humans, but phosphates tested excessive at times, averaging 30 times greater below than above the town. Only small amounts of nitrates and phosphates came from rural drainage above town, even though half the watershed was cropped, **Dr. Mikculcik** said.

Is soil erosion and runoff all bad?

No. Not all soil erosion and runoff is pollution, **Dr. Harold E. Jones of Kansas State University** says. It has been going on since the world began—furnishing mineral nutrients to our streams, lakes, and mighty oceans . . . forming soils and sometimes shifting them . . . always continuing the ecological system.

Man will never control it all. He never should. But he has learned to control some of this process for the finest food production the world has yet seen. And he will continue to try to prevent the silting of his flood-plains, the filling in of his waters, and the excess aging and deterioration of his water bodies.

Can irrigation water be managed to prevent nitrate leaching below the root zone?

Yes, even on sandy soils that need careful management. **Dr. Jones** says the key is "to know how deep plants feed for water and how much moisture any given soil can hold to that depth." County soil survey reports will give moisture holding capacity in inches per foot of soil.

How do nitrogen and phosphates move? Are they different?

Soil particles do not generally bind or absorb nitrate. Rain or irrigation can move nitrate out of a plant's root zone.

But soil particles absorb or bind phosphate tightly to their outside surface where it reverts quickly to an insoluble, poorly available form not subject to leaching.

Ohio State University agronomist, Terry Logan, found most phosphates get to our water on the erosion express—riding on soil particles. Once in the water, the particles don't always release the phosphates. The P often stays trapped in the sediment unavailable to algae. If the water has more phosphate than the soil particles, the sediment may even absorb phosphates from the water rather than release them into it.

Will winter cover crops help prevent nitrates leaching?

Apparently so. **Dr. Jones (Kan)** reports sandy soil receiving both manure and nitrogen under irrigation accumulated "significant" nitrate-nitrogen down to 4 feet. But two fields with fall-planted rye showed much lower nitrate-nitrogen levels down to 2 feet the next spring.

Illinois agronomists D. W. Miller and David Schertz found alfalfa actually reducing nitrate N level in the soil profile. Even 600 lb N split application on alfalfa did not cause nitrate buildup—no more than 1 ppm at 35 to 50 inches for any treatment. Perhaps alfalfa in the rotation helps reduce nitrates that might accumulate under continuous corn.

Are chemical fertilizers slowing the decline in soil fertility?

On a national scale, **Dr. Smith** contends, our crop and livestock farming is STILL removing more nitrogen and minerals (phosphorus, potassium, etc.) than we are adding.

In Missouri's famed Sanborn Field, 80 years of soil fertility tests have watched organic matter decline about 50% in those soils fed only by legumes and farm manures. Legumes removed for hay drain hardest on essential mineral elements, **Dr. Smith** explains.

Illinois, Kansas, and Iowa report similar results. Higher temperatures and more moisture increase losses. When a soil loses 1% of its organic matter in the top 6 or 7 inches, you can deduct about 1,000 lbs of nitrogen, **Dr. Smith** warns.

Then if this be so, are we using too much nitrogen?

A little INput and UPtake arithmetic helps answer this. We apply about 7 million tons N a year on cultivated fields, lawns, and golf courses, **Dr. C. H. Wadleigh, science advisor to the Administrator of the USDA Agricultural Research Service,** reports.

But the food we Americans eat in one year "accounts for 8,200,000 tons of nitrogen." A little subtracting shows 1,200,000 more tons going OUT than going IN the soil.

We've used only 90,000,000 tons of chemical nitrogen since such chemicals were first offered around the turn of the century—not much progress counteracting the 1.5 BILLION TONS of nitrogen lost by mineralization of soil organic matter over the years. **Dr. Wadleigh** warns "we are still robbing the soil nitrogen bank."

They tell me to fertilize my ponds for fish but to keep nitrogen-phosphorus runoff out of ponds. What's up, doc?

Fish biologists say the main drawback to fish production in surface waters the world over is phosphorus deficiency in the water, **Dr. Wadleigh** reports. Your pond needs phosphorus to grow plankton for fish food. Fish biologists generally advise 800 to 1,200 lbs of 8-8-4 fertilizer per acre of pond surface per year, **Dr. Wadleigh** says. Yet, we are urged to keep phosphorus runoff out of ponds. **Dr. Wadleigh** says conservation farming is our best bet for managing everything right and even beautifying it.

A neighbor heard we had lost more mineral nutrients from erosion than from crop removal in the past 50 years. Is he right?

Yes, according to **Dr. Smith.**

Then why haven't more farmers practiced conservation farming?

Because some of the grass and rotation programs would not bring enough income to pay mortgages, **Dr. Smith** explains. Also because large row crop machinery is not adapted to many mechanical erosion control practices promoted in the past.

Do developing urban and suburban areas erode as much as rural or agricultural areas?

Much more so, generally. **Dr. Jones** cites a study by **SCS Geologist J. R. Thompson** . . . showing tons of erosion from building and construction activity in metropolitan Detroit: 1,111,252 tons of soil eroded from about 1,094.5 acres in a 4-county area . . . averaging 69 tons lost per acre per year. This compared with 3 tons/A/year for the total metropolitan area and 2.6 tons/A/year for all southeast Michigan. He warns urban areas under active construction can suffer up to 25 times the erosion of comparable protected areas.

I've heard folks say Lake Erie is being murdered. What about that?

If it is, agriculture is not doing it. Just 13% of the phosphate-P entering the lake is from agricultural sources, the **Lake Erie Enforcement Conference Technical Committee** reports. Lake Huron contributes that much phosphate-P to Erie.

Do fowl pollute our waters?

They surely do. They carry on their biologic functions, as **Dr. Wadleigh** explains. At just one lake in Illinois—Lake Chautaugua—the duck population adds 5.6 lbs of phosphorus, 12.8 lbs of nitrogen **per acre of lake per year** . . . enough to induce eutrophication. **Dr. Borlaug** said, "If I have to choose between birds and man, I'll vote for man every time."

Can We Depend On NATURE'S ACRES To Feed Us?

	Bu Yield	Moisture	Test Weight	Broken Kernels Foreign Matter
Today's Acre →	121.9	22%	56 lb	0.8%
Nature's Acre →	37.74	18%	54 lb	5%
DIFFERENCE →	84 Bu Less Food	4% Less Moisture	2 lb Less Test Wt.	4.2% More Breakage, etc.

Condensed from NEBRASKA FARMER Magazine

MUCH HAS BEEN said about food shortages we would face if we listened too carefully to the "ecologists."

The Geneva Young Farmers Association in Fillmore County (Nebr.) decided to show what the results would be. So in 1971 they grew a **"Nature's Acre"** of corn. Beside it, they put **"Today's Acre."**

"Nature's Acre" got **NO** fertilizer, **NO** herbicide, **NO** irrigation, **NO** insecticide. **"Today's Acre"** got recommended amounts of each.

In all other things, the two "acres" were treated exactly alike—**SAME** cropping history, **SAME** cultivation, **SAME** seed (N-cytoplasm). All planting was done on May 4.

NO fertilizer, NO herbicide, NO irrigation, NO pesticide: NATURE'S ACRE

"Today's Acre" was seeded for 24,000 plants per acre. The aim for **"Nature's Acre"** was 18,000 plants, since it was not to be irrigated. But Dennis Kimbrough figured he probably got it on a little heavier than that, closer to 20,000.

On Aug. 10 when the picture was taken, **"Nature's Acre"** corn was in the milk stage, **"Today's Acre"** in late dough stage. The **"Nature's Acre"** ears were nubbins, **"Today's Acre"** ears long, plump and well filled.

At harvest, the contrast in the two systems spoke for itself: 37.74 bushels from **"Nature's Acre,"** 121.9 bushels from **"Today's Acre."**

The plots were on the farm operated by Dennis Kimbrough. He and Mike Johnson, both members of the Geneva Young Farmers, told Nebraska Farmer the **"Nature's Acre"** corn had been 5 days behind tasseling, 12 days behind in ear shoot and silking—even though corn on both plots emerged at the same time, reached the 4-leaf stage at the same time.

Dennis was concerned with adjusting his co·ıbine to get all the low-to-the-ground ·ars on the Nature's plot. They plan to repeat the demonstration on the same acreage next year. It is believed even more difference will be shown.

The **"Nature's Acre"** corn undoubtedly derived some benefit in 1971 from modern farming techniques used on this ground in 1970. The 1970 corn here had been well fertilized and treated for weed control and rootworm control. Corn on the plot field had been cut for silage the year before. **THE END**

TODAY'S ACRE: Adequate Rates Fertilizer, Herbicide, Irrigation, Pesticide

Some talk a lot about the balance of nature. What is it?

Dr. Norman Borlaug, winner of the Nobel Peace Prize for developing highly productive wheat, told **FARM PROFIT** magazine this balance of nature talk makes him "sick to his stomach." Why? Perhaps because he was originally a forest ecologist . . . working in Central Idaho's largest primitive area in 1936 . . . along the middle fork of the Salmon River, an area essentially untouched by man. But even there he found things not in balance with nature. Instead he found big bark beetle epidemics ravaging the forests and summer fires started by lightning. Those precious forestlands were getting the worst of that "balance" and man had come to try to help them.

What does Dr. Borlaug believe would happen if the U.S. suddenly had no fertilizer?

He told **FARM PROFIT Associate Editor Bill Brantley** the people wouldn't starve for 3 or 4 years . . . but they would have to pay huge prices for food they got or go hungry. He wonders if the "ecology fanatics" would be around then to take care of the starving people who couldn't afford to buy what food there was. **Editor Brantley** reports "an exhaustive" Texas A & M study showed Texas crop yields would decline 36 to 47% if all fertilizers and pesticides were banned . . . increasing food costs nearly 300%. Other estimates range downward, he reports, with one showing 40% LESS food costing consumers 75% MORE money.

Is there a magic seed that doesn't need growth boosters and protectors?

No, sir. **Dr. Borlaug** and a small staff of scientists worked 25 years to come up with the remarkable wheat varieties they recently gave to the world—especially less developed nations. But the seed is "just the catalyst," **Dr. Borlaug** reminded **FARM PROFIT** readers. He emphasized how it takes "the fertilizer, chemicals, power, and management to put it all together." Most of the "popular press" did not capture this when talking about the so-called Green Revolution.

What does the Nobel winner think of organic farming?

Organic farmers aren't really farmers at all, **Dr. Borlaug** contends—"they're gardeners and they're on Cloud 9." Even if organic plant foods could produce enough food to feed today's population, we would have to use every available acre to get that food. The environmentalists could forget wildlife and recreation. **Dr. Borlaug** concluded, "There'd be no land left for this because then it becomes a struggle for survival.

What does Dr. Borlaug think of future food prospects?

A lost game UNLESS the "Food deficit countries" can continue to use fertilizer—not at present rates—but doubled, tripled, and quadrupled in the next 20 to 30 years. He told **FARM PROFIT Editor Brantley,** "Environmental alarmists are out peddling their philosophy to developing countries where there is human hunger already. As far as I'm concerned, this is immoral."

What army of pests will attack our cultivated crops this season?

Over 3,000 "economically important species of insects"—PLUS as many plant disease agents, and "unestimated numbers of nematodes, rodents, weeds, and other competitors," according to **Ohio State University agronomist Edward Stroube.**

What do pests cost the U.S. today?

About $20 billion a year, estimated, in total losses of crop plants and livestock—**even with our intensive pest control measure and efficient pesticides, Dr. White-Stevens** reports. This represents a 25% pest tax—or 25¢ on every dollar spent for food.

What would pests cost us if we didn't have pesticides?

It's anyone's guess, **Dr. White-Stevens** contends. He believes yields would drop to less than 50% . . . food costs would jump 4 to 5 fold . . . and the 18¢ per take-home dollar now spent for food would rise to 75 or 80¢ perhaps. And all this for quality "totally unacceptable to the modern American housewife."

Why should food costs soar that much?

Because of losses **in more than yield! Dr. White-Stevens** cites India—using very little or no pest control—where insects, decay, and vermin get over 50% of the harvested food before it reaches the consumer's mouth.

He concludes, "Simple protective pesticide measures between harvest and consumer could virtually double effective food production in a land where upwards of 300 million people are continually on the verge of starvation."

Why introduce new improved plant and animal stocks, why pour on fertilizers, why provide irrigation facilities, if the EXTRA yields are to be devoured by pests? **Dr. White-Stevens** urges pesticides in all agricultural inprovement programs for developing nations.

What about America? Are pests a problem here AFTER the food is produced?

A big problem, according to **Dr. Stroube.** The FDA seizes thousands of tons of food "unfit for human consumption"—about 75% attributed to filth or decomposition, including insects, insect fragments, molds, fungi, bacteria, and other undesirable organisms. **Dr. Stroube** quotes the National Research Council: "Plant and animal pests rank among the foremost causes of food destruction, deterioration, and contamination."

How were pests controlled before chemical pesticides?

Through limited biological and cultural methods. Insects and disease once caused wide fluctuations in yields and quality from season to season. And the housewife had to "trim away" a third or more of her fresh produce ruined by insects or disease. **Dr. White-Stevens** says advances are being made in biological control methods. But he believes the most we can anticipate is "integrated programs where both chemicals and biological controls are combined."

Dr. Stroube reports producers now use cultural controls where practical—right tillage, crop sanitation, planting dates unfavorable to specific pests, varieties resistant to certain insects and disease. They also try certain parasites, predators, and disease organisms to control a few specific pests. But he says such methods have "definite limitations."

Is DDT a villain or a hero?

You be the judge. **Dr. White-Stevens** gives some scientific facts in the brief history of this workhorse chemical;

- DDT alone has saved more human lives than all the wonder drugs combined—especially in the malaria battle.
- No evidence of injury, cancer, or death after 25 years of DDT use, exposing at least 1 billion humans, has ever been "medically established"—though "invidious claims" have been made.
- Workers in DDT plants, exposed daily up to 19 years to at least 200 times the level reaching the general public, revealed "no significant clinical effects at all."
- Cancer among these DDT plant workers averaged less than the general public . . . while the numbers of children they sired averaged above the U.S. population average.
- Insurance companies underwriting workers in pesticide plants or in pest control operator companies do not demand higher risk premium for such coverage.

The acute effects of DDT may not be serious in man. But what about long term effects?

"All drugs exhibit a dose-response effect," **Dr. White-Stevens** explains, "and if DDT does not, it is the first drug discovered that doesn't." He then cites the DDT plant workers . . . exposed for nearly 20 years to at least 200 times the DDT the average person gets. This exceeds "a **normal** continuous exposure of 4,000 years." Who wants experimental proof that "extends for longer than 4 millenia?"

Do weed and pest-control chemicals persist and accumulate in our soil and water and food supply?

"Long term monitoring surveys of major river and estuarine waters and their benthic deposits reveal no significant trends of accumulation or toxicities for any group of pesticidal compounds or for any one pesticide," **Dr. White-Stevens** reports. He cites 7 studies supporting this statement—including general assays of DDT and related analogues on such major rivers as Mississippi, Missouri, Ohio, and Columbia draining millions of acres of pesticide-treated lands.

He also says there is "no evidence from extensive market basket surveys nor from surveys of blood analyses or fat and tissue biopsies that any pesticide or group of pesticides is escalating in the food or the bodies of the people." He cites 17 studies here, reaching back to 1958.

He says herbicides have effectively reduced undesirable underbrush and stream bank-clogging weed growth "without inducing injurious or deleterious contamination of flowing or storage aquifers." He cited 6 studies showing top concentrations of applied herbicides to be below 0.1 ppm, which rapidly dissipated and degraded.

What do pesticide critics invariably overlook?

Three mitigating factors, according to **Dr. White-Stevens:** (1) There is tremendous **dilution** as the compound courses the gathering waters. (2) The most persistent pesticides are exceedingly **insoluble** in water. (3) Even the most persistent pesticides undergo varying degrees of **decay** into less toxic derivatives.

Then how can pesticides contaminate waterways?

Where it happens, it can usually be traced to one of three conditions, **Dr. White-Stevens** explains:

1—To accidental or irresponsible dumping of residual pesticides into streams.

2—To an unexpected severe wash-off by torrential rains immediately after a dust or granular application of a persistent insecticide to control soil insects.

3—To the ill-advised application of an unrecommended persistent pesticide directly to a lake or stream.

The last condition occurred at Clear Lake in California, now a well known case. But few headlines appeared when CORRECT insecticides enabled the fish to repopulate rapidly, the grebes to return, and the legions of eye gnats to decline enough for humans to enjoy the Clear Lake area for recreation.

Do agricultural pesticides cause unnatural fish kills in the U.S.?

Public Health Service and Interior Department reports have shown for many years that all agricultural chemicals combined account for LESS than 3% of all fish kills reported. Industrial and municipal sewage effluents kill over 75% of the total reported each year.

How do pesticides rank as a form of agricultural investment?

"They rank second only to fertilizer in terms of their dollar return per dollar invested," **Dr. Kottman** explains. He cites a 1968 study by **Dr. J. C. Headley** showing these average returns: Fertilizer returns $4.50 . . . pesticides $4.16 . . . machinery $2.43 for each dollar invested in them.

What is the maximum number of people this old planet can take?

No one knows. But **Dr. Kottman** points out a striking paradox in the warnings of the alarmists. We are told India is "one of the areas where over-population prevents people from enjoying the good life."

But we are not told the POPULATION DENSITY of India is 200 FEWER people per square mile than West Germany . . . 478 FEWER people per square mile than Holland . . . 578 FEWER people per square mile than New Jersey.

Dr. Kottman says he doesn't hear "too many people talking about how deprived the people in West Germany are today."

Do you have any idea . . .

. . . how many reprints of this magazine's current series on **FACTS from OUR ENVIRONMENT** can be used by your school or company or state at a cost not to exceed 7¢ per booklet?

If demand warrants, the Potash Institute will compress the 4-part series into a multi-purpose brochure—for local mailings, meeting handouts, teaching and talk plans, radio and press use, and as a handy guide when facing alarmed urban friends. **Let us hear from you. We will appreciate your advice.**

Make bermudagrass WINTER-TOUGH

W. B. Gilbert
N. C. State University

- **Turfgrasses with high tissue-N were less resistant to winter injury than those from low-N plots.**
- **Heavy and late nitrogen applications increased total N content in bluegrass.**
- **Nitrate concentration was high before wheat hardening, decreased during hardening, and remained low during maximum hardiness.**
- **Frost resistance was maintained in potato tissue with N fertilization IF high P and K were present.**
- **Applying P and K with normal N levels increased hardiness of winter wheat.**
- **Alfalfa's cold resistance was influenced by amounts of phosphorus and potassium—with a 2:5 ratio fertilizer giving best results.**
- **At high nitrogen levels, winter injury to coastal bermudagrass declined as potash rates went up.**

WINTER IS HARD on golf greens in the Piedmont area of the Southeast. Winter loss of bermudagrass (Cynodon spp.) is causing much concern. When grass fails to regrow in spring, you can often trace the reason directly or indirectly to winter temperatures.

Can plant food help fight this problem? Science has long known correctly balanced fertility—(N) nitrogen, (P) phosphorus, (K) potassium—influences the hardening process in plants. Work in many areas has shown:

How much or how little do DIFFERENT ratios of nitrogen, phosphorus, and potassium aid the cold tolerance of golf green grass? We studied two golf green bermudagrass cultivars to answer this question.

Samples from field-produced turf were depleted of soil nutrients before different fertility ratios were applied, as shown in **Table 1.** Then the samples were cold-hardened in a growth chamber before being subjected to a standard freezing test.

Regrowth after freezing differed greatly among several ratios, as shown in **Table 2.** As temperatures declined differences among treatments became greater.

Most regrowth came from ratios in which nitrogen and potassium were about equal and about 4 to 5 times greater than P. The 4-1-6 ratio gave greatest yield in dry matter, followed closely by 4-1-3 and 4-0-4.

Least regrowth occurred when nitrogen was much higher or out of balance or proportion to the other two nutrients. Poorest regrowth came from 4-0-0 and 1-1-3 ratios. The 4-0-0 treatment, carrying plenty of nitrogen but no phosphorus and potassium, produced very dark green, succulent leaf tissue, an open house to disease organisms. The 1-1-3 ratio, low in nitrogen, led to poor leaf and stem growth.

Plants receiving only high nitrogen (4-0-0 ratio) showed least resistance to low temperatures, as shown in **Table 3.** This material was hardened very little by exposure to normal hardening conditions. But by increasing the level of nitrogen at a given level of phosphorus and potassium, hardiness increased.

Adding phosphorus OR potassium (4-0-0 vs 4-1-0 or 4-0-3) improved cold tolerance slightly. But adding both (4-0-0 vs 4-1-3) improved cold tolerance substantially. A balanced fertility program certainly seems advisable to condition the bermudagrass for the processes of hardening.

With straight N, Tifgreen bermuda suffered 50% winterkill of the stand at 26° F. Increments of K reduced the percent killed

Table 1. Nutrient ratios applied to two bermudagrass cultivars for winter hardiness evaluation.

Treatment	Nutrient, g/100m² on elemental basis			Ratio approximate
	N	P	K	
1	1,000	244	1,230	4-1-6
2	1,000	244	615	4-1-3
3	1,000	0	615	4-0-3
4	1,000	0	0	4-0-0
5	500	244	615	2-1-3
6	1,000	244	0	4-1-0
7	1,000	1,220	205	4-5-1
8	250	244	615	1-1-3

with RIGHT BALANCED fertility

D. L. Davis
University of Kentucky

Table 2. Top regrowth produced by Tifdwarf and Tifgreen bermudagrass following exposure to low temperature test.

Treatment	N-P-K ratio	Mean values*, dry weight in g			
		Check	-2.2 c	-5.0 c	-7.8 c
1	4-1-6	2.36 a	2.34 a	1.99 a	1.29 a
2	4-1-3	2.24 ab	2.45 a	1.84 a	1.03 ab
3	4-0-3	2.17 ab	2.26 a	1.42 ab	0.00 d
4	4-0-0	2.16 ab	2.03 a	0.88 b	0.00 d
5	2-1-3	1.75 bc	1.81 ab	1.45 ab	0.87 abc
6	4-1-0	1.70 bc	1.82 ab	1.32 ab	0.57 bcd
7	4-5-1	1.70 bc	1.79 ab	1.55 ab	0.56 bcd
8	1-1-3	1.40 c	1.21 b	1.01 b	0.24 cd

* Means within a given temperature treatment not followed by a common letter differ significantly at the 5% level according to Duncan's multiple range test.

Table 3. Low temperature points (LT_{50}) which caused a 50% reduction in top growth of bermudagrass after a freezing test.

Treatment	N-P-K ratio	LT_{50} in C		
		Tifdwarf	Tifgreen	Avg
1	4-1-6	-8.3	-8.3	-8.3
2	4-1-3	-8.3	-7.8	-8.1
5	2-1-3	-7.8	-7.2	-7.5
7	4-5-1	-6.1	-7.2	-6.7
8	1-1-3	-6.1	-6.1	-6.1
3	4-0-3	-5.0	-6.1	-5.6
6	4-1-0	-5.6	-5.6	-5.6
4	4-0-0	-4.5	-5.0	-4.8

by cold temperatures. And at optimum treatment (4N-6K ratio) 50% kill did not occur until 18° F. That seems to say potassium helped add 8 vital degrees to the life of the grass stand.

Other scientists have found similar trends —for example, a 2P-5K ratio increasing cold resistance in alfalfa . . . excess nitrogen and/or inadequate potassium possibly aiding winter damage to bermudagrass greens.

Such results strongly suggest three steps for turf growers confronting winter damage:

1—When using NPK to build cold tolerance, always maintain adequate levels of "the other two."

2—Right balanced fertility is the key, with emphasis on adequate potassium in late summer.

3—A 4-1-6 NPK ratio produced best cold tolerance in these tests. THE END

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Can fertilizers BALANCE OUT crop disease?

Good teaching and telling aids from scientific research and experience.

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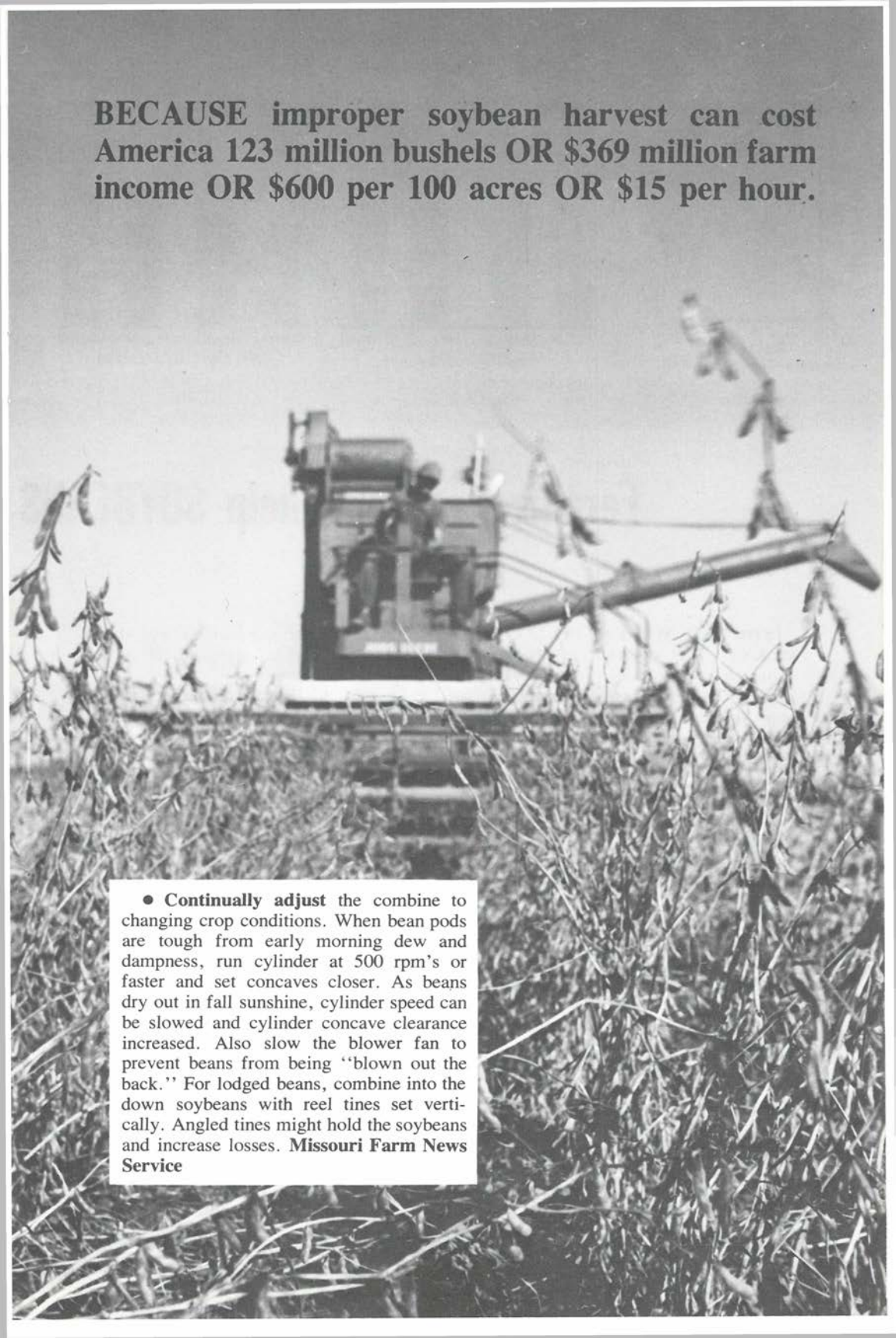
Cut LOSSES . . .

FEWER SOYBEANS will be left in the field—and more money in the pocketbook—if farmers will follow the advice of Missouri agricultural engineer, Richard Phillips:

- **Begin harvesting** when moisture content reaches 13 percent. Shatter losses increase greatly when moisture levels drop below 11.5 percent. A sure way to check moisture content is to have field samples tested with a moisture tester. Local elevators can do this.
- **Harvest at an** average combine 8 round speed between 2.5 and 4 miles per hour. Combines operate most efficiently at that range—and the cutter bar is allowed to ride down for maximum cut. Figure miles per hour by dividing 10 into the number of three-foot strides covered by the combine in 20 seconds.
- **Count beans on** the ground before harvest so they won't be charged against combining. After the combine has passed, again count beans on the ground to determine number lost in harvest. Four beans per square foot indicate a bushel of beans lost per acre.
- **Match ground speed** to combine reel speed. Best speed ratio is a reel speed 1.5 times the combine ground speed. Another good guideline is 12 rpm's of reel speed for each mph of combine ground speed. A low reel speed reduces shattering and cuts loss of bean pods that "pop out" of the combine after cutting.
- **Cut soybeans** as close to the ground as possible. A 3.5 to 4-inch stubble height is not good. Tests show a 10 percent reduction in harvest losses when soybeans were cut off at 2½ inches. A low stubble height is possible by harvesting slowly and using an automatic header control.
- **Measure soybean** losses from cutting, gathering, and threshing operations to pinpoint necessary adjustments. Follow instructions in the combine operator's manual. Check losses resulting from each area of operation, then readjust individually to best operating conditions.

BECAUSE improper soybean harvest can cost America 123 million bushels OR $369 million farm income OR $600 per 100 acres OR $15 per hour.



• **Continually adjust** the combine to changing crop conditions. When bean pods are tough from early morning dew and dampness, run cylinder at 500 rpm's or faster and set concaves closer. As beans dry out in fall sunshine, cylinder speed can be slowed and cylinder concave clearance increased. Also slow the blower fan to prevent beans from being "blown out the back." For lodged beans, combine into the down soybeans with reel tines set vertically. Angled tines might hold the soybeans and increase losses. **Missouri Farm News Service**

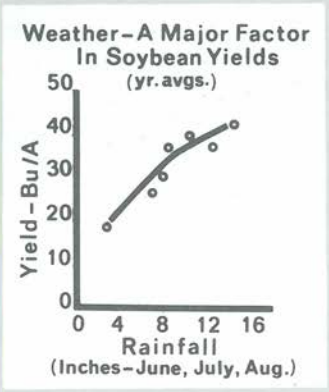


FIGURE 1

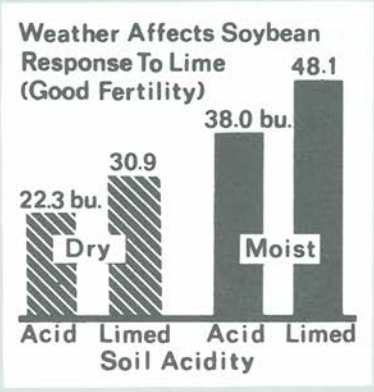


FIGURE 2

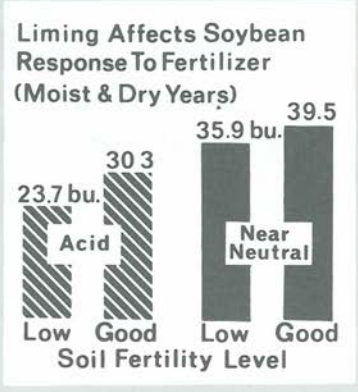


FIGURE 3

Fertilizer + lime help SOYBEANS

SHOULD WE FERTILIZE SOYBEANS? This question is often asked. Researchers seem convinced soybeans will respond to fertilizers—but statistics say many farmers are not convinced.

Soybeans—like corn—have a big appetite. North Carolina State University reports a 50-bushel soybean crop produces 9,100 lbs. of dry matter per acre (beans and tops). Such a crop requires about 257 lbs. N; 48 lbs. P_2O_5; 187 lbs. K_2O; 49 lbs. calcium; 19 lbs. magnesium; 20 lbs. sulfur, and small quantities of various micronutrients.

Yet, USDA shows many farmers still do not fertilize their soybeans. In Indiana, 61% were fertilized, but only 13% in Iowa in 1970. Even soybeans being fertilized receive low quantities. Average application in the 14 major soybean states was 14 lb N–37 lb P_2O_5–50 lb K_2O in 1970.

Why do so many farmers fail to fertilize their soybeans? Many say they tried it and it didn't pay. But did they really measure yield responses closely enough to tell?

A $10 per acre increase in corn yield (10 bu) is easily seen in the hopper when harvesting the fertilizer test rows. But the same $10 per acre increase in soybeans (about 3 bu) may go unnoticed unless careful weights are taken.

Perhaps this is part of the answer, but there are other reasons.

In trials at their Washington Court House, Ohio, test plots, Agrico agronomists have shown how rainfall, liming, and fertilizers affect soybean yields. Poor weather conditions or excess soil acidity can reduce or even prevent soybean responses to fertilizers. But if conditions were good otherwise, fertilizers increased yields most years.

The study was conducted on four main plots for seven years. **Table 1** shows the ranges of soil test values.

Plots included: (1) "Acid, low P-K soil"; (2) "Near-neutral, low P-K soil"; (3) "Acid, good P-K soil"; (4) "Near-neutral, good P-K soil".

Each year two to ten soybean varieties were grown on all plots. Plant samples were taken at different stages. Rainfall was recorded. In the seventh year row fertilizers were evaluated.

Did soybeans respond to fertilizers? Yes—under most conditions. Three factors

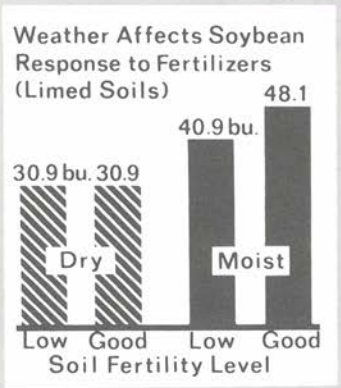


FIGURE 4

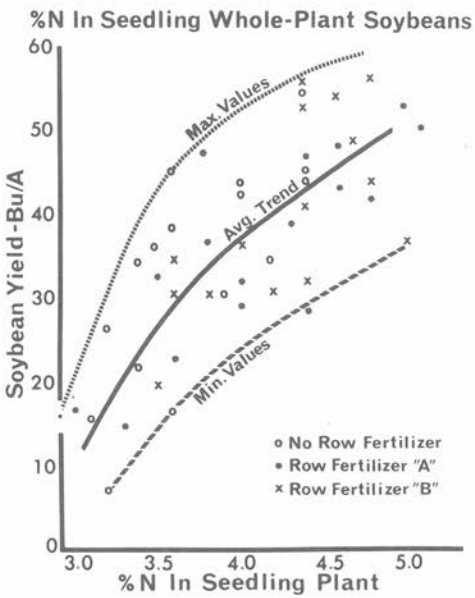


FIGURE 5

meet ALL weather

R. B. LOCKMAN
AGRICO CHEMICAL COMPANY

were shown to influence yields:

(1) **Moisture:** Soybeans may have relatively short roots concentrated in the top few inches of soil. **Figure 1** shows the big influence of moisture on soybean yields. The greatest increase from good moisture (+17.2 bu/A) was found on the near-neutral, good fertility plot. **Moisture response was only 10 bu/A on low fertility plots. Good fertility prepares the soybean to take advantage of good moisture.**

(2) **Liming:** Soil acidity partly governs nutrient uptake and nitrogen fixation. Liming played a big role in determining soybean yields. Proper liming (pH in the 6.0's vs. in the 5.0's) averaged 10.8 bu/acre yield increase.

Moisture and fertility did not greatly affect response to liming. **Figure 2** shows liming was slightly more profitable on moist years (+10.1 bu/A) than on dry years (+8.6 bu/A). **Figure 3** shows fertilizers slightly reduced degree of lime response (+12.2 bu on low vs. +9.2 bu on good fertility soils), apparently since both can increase supply of available nutrients.

(3) **Soil Fertility:** Good soil fertility plays two roles in soybean production—to feed the plant and to feed the nitrogen fixing bacteria which in turn supply the large N requirement for the plant.

Figure 3 shows good fertility increased yields 6.6 bu on acid soils and 3.6 bu on near-neutral soils. **Figure 4** shows good fertility increased yields 7.2 bu under moist conditions but had no effect in dry years. Top yield (48.1 bu) came from a combination of good moisture and good fertility on limed soils.

THROUGH PLANT TESTS, Table 2 shows how moisture, soil acidity, and soil fertility affected the soybean's mineral composition. Important differences also occurred in seedling and vegetative samples. In fact, earlier N and K levels were more closely related to bean yields than the traditional "bloom-stage" samples. Nitrogen and calcium levels increase with increasing yields. Phosphorus and potassium levels increased with yields in moist years, but not in dry years. Other element

Table 1: Soil Test Ranges in Agrico Standard Plots (1964-1969)

	Plot Numbers			
	1	2	3	4
pH	5.2-6.1	6.4-7.0	4.8-5.6	6.5-7.3
P (1b/A)	6-15	7-18	31 → 148*	25 → 135
K (1b/A)	130-150	190-260	170 → 330	170 → 338

* Arrow indicates a soil test trend with time.

Table 2: Factors Affecting Mineral Composition of Upper Leaves at Bloom Stage

Factor	Changes in Upper-Leaf Analysis				
	Major Decrease	Minor Decrease	None	Minor Increase	Major Increase
Good Moisture	—	B,Fe,Mn,An,Al	K,Mg	P,Ca,Cu	N
Liming	Mn,Al	K,Fe,Zn	Mg,Cu	N,Ca,B	P
Good Soil Fertility	—	N,Mg,B,Cu,Zn	—	Ca,Fe,Al	P,K,Mn

Table 3: Soybeans Respond to Row Fertilizers (1970)

	Plot				
	1 Acid Low Fert.	2 Near-neutral Low Fert.	3 Acid Good Fert.	4 Near-neutral Good Fert.	Row-Trt. Averages
No Row Fertilizer	15.9	39.2	33.4	47.8	34.0
Row Fertilizer "A"	21.2	43.9	32.7	48.4	36.5
Row Fertilizer "B"	24.5	47.5	34.0	50.0	39.0
Plot Averages	**20.6**	**43.5**	**33.3**	**48.6**	**36.5**

Table 4: Row Fertilizers Affect Early Soybean Growth, Nitrogen Levels, and Yield

	Avg. Seedling Plant N (%)*	Avg. Seedling Plant Ht. (inches)*	Avg. Seedling Plant Wt. (gm/plant)*	Avg. Bean Yield (bu/A)
No Row Fertilizer	3.7	5.6	.66	34.0
Row Fertilizer "A"	4.1	5.9	.72	36.5
Row Fertilizer "B"	4.2	5.8	.74	39.0

* Whole plant samples taken June 11, 33 days after planting.

levels tended to be lower with increasing yields.

WHAT ABOUT ROW FERTILIZER? **Table 3** shows how soybeans responded to row fertilizers—on both "low" and "good" fertility soils in 1970, a good moisture year. But on acid, good-fertility soils, row fertilizers failed to produce further yield responses.

The type of row fertilizer applied made a difference. Fertilizer "A" was a regular 8-32-16. Fertilizer "B" was a 4-20-12, containing micronutrients especially formulated for soybeans.

WHAT ABOUT N IN SEEDLINGS? A study of early soybean growth and plant nutrient content shows row fertilizer increased plant N level which was in turn related to early growth and finally bean yields. See **Table 4.**

Figure 5 shows seedling nitrogen levels from the 48 plots were definitely related to final yields. Plots yielding less than 20 bu/A produced seedling plants containing from 2.9 to 3.6% N, while plots exceeding 50 bu/A produced seedling plants containing from 4.5 to 5.1% N.

Complete starter fertilizers with low N levels consistently increased seedling N levels. **The extra N and other nutrients seemed to get the plant and nitrogen-fixing bacteria off to a good start—but did not interfere with the essential nitrogen fixation process in later growth.**

Row fertilizers can help increase soybean yields, but apparently they cannot completely substitute for good soil fertility levels and liming practices.

OVER A PERIOD OF YEARS soybean fertilization increases yields. There are extreme conditions under which response will not occur. These factors (except moisture) should be corrected by a good program. The farmer who puts the program "all together" will realize top yields and profits.

Factors not discussed in this report—proper inoculation, weed control, variety selection, date of planting, etc.—must be considered in any successful soybean program. But proper applications of lime and fertilizers are vital. The farmer can do something about his soybean yield.

THE END

Get HIGHER soybean yields

...with moisture control and other key factors

CECIL D. NICKELL
KANSAS STATE UNIVERSITY

MANY COMPONENTS of the environment influence soybean yields. Moisture is a big one. And we are learning just how important the amount and the timing of irrigation can be in soybean production.

Regulating other production practices—such as planting date and rate and row-width—can also influence seed production. Regulating irrigation and production practices helps produce an optimum environment for top yields.

VARIETY IS IMPORTANT. Genetics determines what the plant can do, but the environment determines what the plant WILL do. Like corn, sorghum, and wheat, **full season** soybean varieties produce more per acre, if water or some other environmental component does not limit them.

Full season varieties, **Groups III and IV maturity,** have produced highest yields under irrigation in Kansas.

Earlier varieties, **Groups I and II maturity,** have not produced as well in Kansas, even when planted in late June or early July.

Late varieties, in **Groups V and VI,** have generally produced less per acre than **Groups III or IV.** But when frost or cool temperatures are later than normal in fall, **Groups V and VI** produce yields similar to those from **Groups III or IV.**

WATCH PLANT population and row width. Plant populations can vary from three plants to twelve plants per linear foot of row in 36-inch rows with no change in yield. Lodging increases as plant population increases. To minimize lodging without significantly changing yield, a rule of thumb is used as a planting rate: "4 viable seeds per square foot."

If germination and emergency are assumed to be 80%, 8 plants will be produced in 30-inch rows; 10 in 36-inch rows. Soil crusting after a hard rain reduces emergence. The "4 seeds per square foot" rule provides the margin normally needed to reduce this problem.

Row-width studies have indicated 10- and 20-inch rows produce higher yields than 30- or 40-inch rows. Again lodging will be a problem if seeding rate (seeds per linear foot of row) is not reduced in the narrower rows.

No variety x row-width interaction has been measured for three years in our irrigation studies. Varieties used in the study were from maturity **Groups III, IV, and V.**

BACKGROUND ON MOISTURE CONTROL. Missouri, Nebraska, and Illinois studies indicated water applied during POD AND SEED DEVELOPMENT produced the greatest yield increase. Irrigation before or after that stage produced small yield increases.

Irrigated soybeans lodged in the Ohio studies. In most cases, yield responses have occurred when water was applied during pod and seed development and when the soil was unable to hold water for an extended period.

Drouth stress during pod and seed development reduced yields more than drouth during other periods in Iowa studies.

Photosynthesis is highest during pod and seed development, Illinois studies indicated. Additional carbon dioxide during this stage increased seed yield more than at any other period of development.

Mineral uptake increases through the growing season until seed development —then movement of N, P, and K, and other nutrients starts from the leaves to the beans, as pointed out in Iowa, Illinois, and North Carolina research.

Because of such information from various sources, we irrigated soybeans during moisture stress pod-seed development. When water was required early in the season, before pod development started, only 2 inches per acre was used to avoid excessive early plant growth.

WHAT HAVE WE LEARNED about irrigating soybeans? Variety trials were conducted at Manhattan, Kansas, with furrow irrigation in 1968, 1969, and 1970. Nitrogen (16# N) and phosphorus (48# P_2O_5) were applied to meet soil test requirements (pH 7.7, organic matter 1.1%).

Varieties representing five maturity groups were planted each year on land that had produced wheat the preceding year. **Table 1** shows the conditions.

In 1968 irrigation water was applied at four inches per acre and rain added 3.85 inches one week later. As a result, weather forecasts were watched in 1969 and 1970 to avoid over-irrigating.

Group III and IV varieties produced higher yields all three years. **Table 2** shows the performance. Water applied early in 1968 along with the excess rainfall caused lodging. Stem internodes were long, slender, and weak. The excess water caused **Group III and IV** varieties to revert to vegetative growth at the expense of flowering. Pod set was reduced by leaf shading. Lodging reduced movement of nutrients to the seed during filling.

In 1969, water was applied when plants began to show signs of wilting. Only two applications were required. And over 70 bushels per acre were produced with little lodging. Water applied late in the season favored the later maturing **Group IV** variety, Columbus.

Rainfall during 1970 was below average —1.48 inches during the growing season from June 20 to August 20. Water was applied four times during the season. Flowering started earlier than in the first two years. Irrigation was needed earlier in the season, but later by bloom dates.

Group III varieties were favored, because they were in early pod development stage when water was added. Late **Group IV and V** varieties, which were blooming, lodged because the additional water pro-

Table 1: Conditions under which irrigated soybean variety tests were conducted.

Year	Date planted	Date 1st bloom		Row width	Planting rate seeds/ foot	Date Irrigated
		Wayne	Clark 63			
1968	5/9	6/28	7/5	36″	9	7/1, 7/10, 7/17*
1969	5/20	6/25	7/8	36″	9	8/1, 9/4
1970	5/11	6/16	6/21	30″	9	7/3, 7/20, 8/10, 8/28

*3.85″ precipitation occurred July 24.

Table 2: Agronomic performance of soybean varieties in three years.

Variety	Maturity Group	Maturity*	Yield			Bloom date 1970
			1968	1969	1970	
Hark	I	−25		48.9	57.6	6/14
Amsoy	II	−18	34.2	51.5	63.9	6/16
Wayne	III	−8	52.7	64.0	67.3	6/16
Calland	III	−8	56.4	68.0	**80.3**	6/18
Clark 63	IV	0	48.9	60.4	67.7	6/21
Cutler	IV	+2	50.5	61.7	65.3	6/23
Columbus	IV	+11	**62.1**	**74.0**	60.7	7/4
Dare	V	+22	39.4	53.7	43.7	7/15

*Maturity is measured as the days earlier (−) or later (+) than Clark 63.

duced taller, weaker, and more slender stems.

If water had been applied later to Columbus, its relative yield likely would have been similar to its 1968 and 1969 yields. Seeds of Columbus were 20% smaller, further indicating the need for moisture later, not earlier, in the season. Dryland yields of the same varieties in adjacent plots averaged 40 bushels per acre in 1968 and 1969, but only 10-15 bushels per acre in 1970.

Based on information collected from the past three years with furrow irrigation, water should be applied before pod and seed development when the plants show initial signs of wilt.

Enough water must be applied to maintain growth, but not to stimulate excess plant growth. The amount of water depends upon the water holding capacity of the soil and the water requirement of the soybean plant.

The most critical period is during seed and pod development when the plant's water requirement is highest. Stress must be avoided to produce maximum yields.

With the knowledge of how each soybean variety grows, controlled irrigation can produce high soybean yields.

WHAT ABOUT THE FUTURE? Irrigation has consistently increased yields, indicating the potential on soybeans. Varieties we used were developed for dryland production in the humid Midwest.

It is conceivable that specific genotypes that will respond to irrigation exist or will be developed. They may have an extremely short flowering period, be short stemmed, and respond to high levels of fertility—contrary in some respects to present ideas about soybeans.

Soybean varieties now bloom for about four weeks, are tall, and are traditionally thought to be rather unresponsive to fertilizers. But some lines have proved much more responsive to one or more elements than others.

Dryland soybeans have an extended bloom period, necessary to avoid dry periods and complete loss of seed set. Tall plants were needed because deficient moisture shortens them. Short plants produce pods closer to the ground, causing harvest problems.

Fertility responses in soybeans could be tied to moisture supply. If a water deficit exists during pod and seed development, mineral responses that could otherwise be apparent may not occur.

"...you can raise fatter

DEEP CONCERN etched his face. He was an old friend of an up-and-comer just discredited by a columnist for rapid advancement at a major university . . . laced with phrases like "poor administration . . . mediocre leadership . . . internal dissension."

"Why be concerned about that?" I asked. "It'll be used to throw out fish head tomorrow, just as this column is. But today it does exactly what human nature eats up, then vomits up, then goes looking for more to eat up."

There is a sad tendency in man to accept anything as truth so long as it reflects a negative light on the "other fellow" or the "other cause." A current fad is the doomsday theme.

A Missouri farm editor, Frank Farmer of the Springfield NEWS AND LEADER, tells the sad tale of a biology professor at a large university. Some years ago he foresaw the future of ecology and started some courses for his students.

They covered a wide range: From birth control to land management, from new foodstuffs to reforestation of cutover areas. He pushed the positive. He did not preach doom. He believed—and taught—that pollution was not out of hand and would never get out of hand with honest planning.

Then the first Earth Day was announced. The old professor who had forseen the trend to ecology was invited to speak, along with more recent experts. He came. He spoke. He did not terrify the assembly. And he got a cool reception.

He was not invited to the next Earth Day. His class attendance started slipping. And then, one morning, one of the few students left in his course asked him to name the last day man would be alive on this planet so he could plan for it.

Man doesn't seem to want good news. I believe it was Drew Pearson's brother, Leon, who once dreamed of a "good news" program to originate out of Washington—NBC, I believe—in the darkest days of the Great Depression. They believed the people were starving for tidbits of good news available in that era of mass failures.

The idea never got off the ground. Who wanted **good** news about their fellowman? Maybe that explains why the first settlement on the river at Jamestown, Va. posted GOSSIP as one of the top "crimes" for a jail sentence around 1607.

What does gossip have to do with ecology? Plenty if a man can create one dramatic lecture on a few isolated problems and fill a high school auditorium with housewives and their overweight husbands much more eager to learn about their extinction than their distinction.

Is doomsday promotion becoming big business? Big publishing, lecturing, crusading business? I wonder how many trees furnish the paper for all those newsletters, magazines, books, and fund-raising kits? How much oxygen to get the lecturers to that next date by plane? How much pollution to power the air conditioning for their headquarters . . . to transport that prime beef to their comfortable homes.

They are lucky to have the paper to spread their word. Just 30 years ago this nation harvested 20% more trees than it grew each year. Today we grow 61% more wood than we harvest or lose to fire, insects, and disease. How? At least 5,000 timberland owners operate on a sustained yield basis, planting and growing more than they harvest.

And their plans point a century ahead—hardly a greedy mining attitude. But how many headlines does it get? How many mentions in that lecture on MAN'S LAST DAYS at Primrose High?

For that matter, has anyone seen a major documentary mention . . .

THAT the population of robins and many other bird species has actually increased in recent years. **(It has!)**

THAT the king of England had to issue pollution laws to keep London from suffocating

budgets with witches . . ."

600 years ago. **(He did!)**

THAT correct insecticides (after unrecommended insecticides had damaged Clear Lake, Calif.) enabled the fish to repopulate rapidly, the grebes to return, and the legions of eye gnats to decline so humans could enjoy the lake. **(They did!)**

THAT Martha Washington wrote her niece, Fanny, about Philadelphia air causing sore eyes in many people, including her husband, George. **(She did!)**

THAT our air contains the same amount of oxygen today as it did in 1910, 29.5% in tested samples. **(It does!)**

THAT the year before Mrs. Washington complained about Philadelphia air, one out of every 5 residents of that city died from an epidemic out of the rivers . . . typhoid, yellow fever, cholera rarely heard of today. **(They did!)**

THAT workers in DDT plants, exposed daily for 19 years to at least 200 times more than the general public, averaged less cancer and sired more children than the U.S. average—and at the same insurance rate as you and I. **(They did!)**

THAT drug addiction was much greater per capita after the Civil War than it is today . . . and by 1900 the federal government figured one in 400 Americans hooked, compared to one in 3,000 today. **(It was!)**

THAT many American streams once ran yellow from Buffalo manure, as well as dead horses and cattle, and the air grew black from burning strawstacks after threshing. **(It did!)**

These are tidbits of isolated facts. But no more isolated, I submit, than some of the alarms set off to scare the human race and to make a name for some of the more articulate alarmists.

Most scientists are not glib—indeed, are downright inarticulate. They do not have an easy way with words. Rhetoric is not their business.

Truth is their business. And the discovery of it is rarely as stimulating as the search for it . . . never as exciting as the dragons and witches the human mind conjures up in the search. Most truth is usually very simple and undramatic when it is found . . . in any field . . . as the little talk Lincoln made at Gettysburg and the little sermon Jesus preached on a small mountainside.

You can raise much fatter annual budgets with witches, if you know how to shake them at the people and dramatize their dangers with words that flow as slick as maple syrup over hot buckwheats on a cold winter morning.

My boss has missionary belief in agricultural industry's capacity to CONTINUE to feed the world. Known widely for this zeal, he was once invited to appear with a world-known biologist and author on the prospects of feeding a hungry world.

In a nutshell, he told the huge assembly that well trained agricultural scientists are kept under wraps much of the time in developed nations because they unleash overwhelming surpluses every time they are given free rein.

He then cited the new high-yield wheat and rice varieties, including a 6-million ton rice surplus in one nation . . . the vegetable protein potential in new high-protein soybeans and high-lysine corn . . . the 19% jump in poultry production by one nation seeking faster meat protein than beef . . . etc., etc. etc.

But the audience did not applaud these facts. They applauded the prophecies of possible famine. The boss came home and filed his talk "for the future." It'll stay filed a long time because people like to worry much more than they like to hope.

Sadly our natures are more stimulated by the negative than by the positive. I've never known a hopeful gossip. I've known some nervous-tongued men, but never one with the courage to claim authorship of the accusations he peddles. They are mere crumb carriers.

Mankind usually insists on tasting more than crumbs—indeed, a respectable piece of the cake—before buying it. Maybe that's why nature, which has evolved and discarded countless species without the slightest explanation, has not discarded man. Maybe she hasn't been able to.

Will farm fertilizer use be regulated in the future?

Farm fertilizer is already regulated—**by the farmer.** You won't find a handful of farmers who use more fertilizer than their crops need. They can't afford to in the cost-price squeeze that has pinched them since the beginning of time, it seems—although fertilizer is the biggest bargain in their package of practices.

Most farmers use **less** fertilizer than their crops need. Look at Illinois, one of the nation's great corn producing states. They applied 112 lbs fertilizer nitrogen per acre average on their cornland in 1970—63 lbs **LESS** than the University of Illinois suggests for efficient corn production and below that required for significant leaching.

The American farmer is not going to waste money or equipment or fertilizer—you can bet your pension fund on that. And what he uses in the future **MUST** go into his crop or be stored in his soil for tomorrow, not the water table below or the creek over the fence. That is the only way he can stay in business.

(The second part of the Potash Institute's new series on FACTS FROM OUR ENVIRONMENT is featured in this issue.)

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