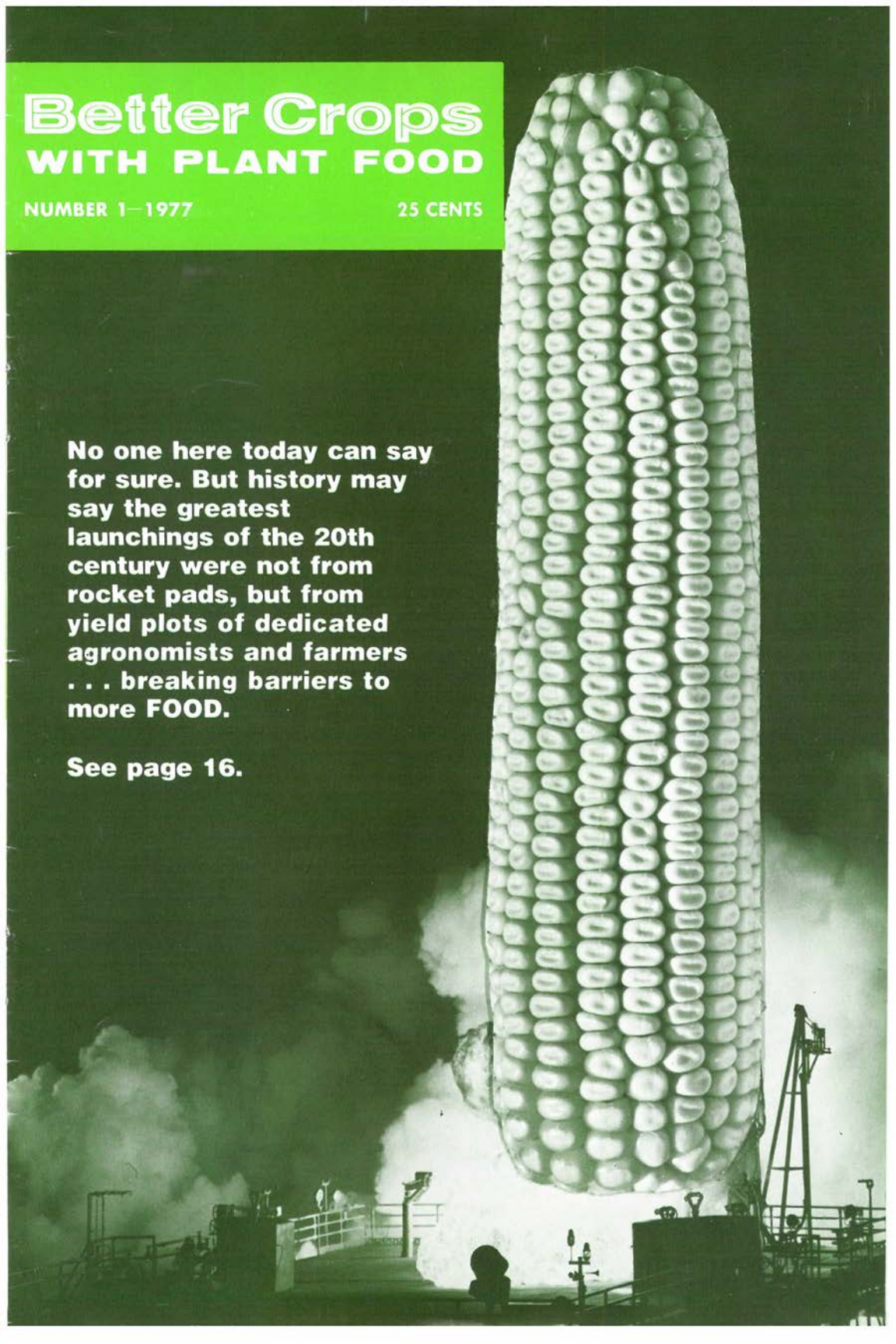
Better Crops WITH PLANT FOOD

NUMBER 1—1977 25 CENTS



No one here today can say for sure. But history may say the greatest launchings of the 20th century were not from rocket pads, but from yield plots of dedicated agronomists and farmers . . . breaking barriers to more FOOD.

See page 16.

Better Crops
WITH PLANT FOOD

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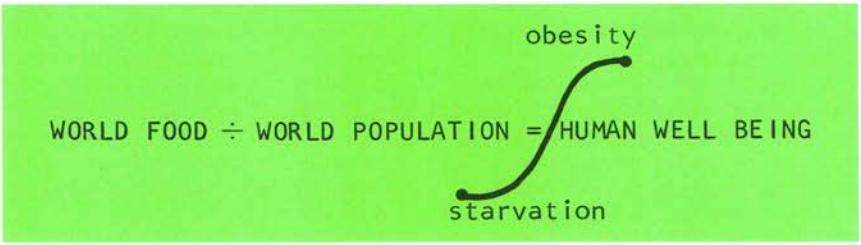

DATE	Time Span (years)	World Population
8000 BC	—	5,000,000
6500 BC	1500	10,000,000
Time of Christ	6500	250,000,000
1650 AD	1650	500,000,000
1850 AD	200	1 billion
1930 AD	80	2 billion
1975 AD	45	4 billion
Borgstrom: 2000 AD	25	7 billion
(2) 2020 AD	20	12 billion

B. RODNEY BERTRAMSON
WASHINGTON STATE UNIVERSITY

THE ENERGY CRISIS of the 1972-73 winter shocked the nation—became front page news. It soon became apparent food is energy of the most precious kind.

Food became the major concern as the seven-year, Sub-Saharan Desert drought climaxed at the same time Russia had a poor crop and sought millions of tons of wheat in the world market.

World grain reserves quickly shrank to an alarming level. This provided a frightening preview of the catastrophe portrayed by the Paddock brothers in the book, Famine in 1975, published a decade before (12).

Thus, the precarious balance of a world food supply—barely above starvation level—was brutally impressed upon the well-fed people of the world. Strohm (14) said fewer than 700 million people could be fed on the present world's food supply at the American standard of living.

About 2 billion people could be fed now at the present level of people in Western Europe. And today, world population is about 4 billion people! Hence, more than two-thirds of the people on this planet are ever painfully aware of the food shortage.

"The history of man is the record of a hungry creature in search of

food," said Hendrick Willen van Loon (16) in his book, The Story of Mankind.

The table on page 3 shows how man has prevailed.

Present world population increase is about 80 to 90 million per year (2, 7, 14).

As world citizens—**responsible** citizens of a small planet—we must study the problems of human survival, get the facts, ponder solutions, and launch a plan to counter the impending catastrophe of famine.

THE PURPOSE of this presentation is to set forth some facts and studied comments to assist concerned citizens who accept this challenge.

Food consumed by U.S. pets (cats, dogs, horses) could feed 122 million people.

In this day of rapid mass communication, we are flooded with information and quotations, ranging from sound facts to half-truths and downright untruths.

Crisis hysteria and instant experts are commonplace. An exercise of common sense requires adherence to the scientific method:

1. Cultivate a passion for facts. (Be sure they are facts.)

2. Exercise a cautiousness of statement. (Stick to the facts.)

3. Develop a sense of the interrelatedness of things and phenomena.

My title was selected to suggest the interrelatedness of food supply (production) and population (reproduction). The differences between the developed and the less developed countries have sharply contrasted during the past 4 or 5 decades.

The developed countries have greatly enhanced yield increases while population growth has declined to about 1.3% per year.

In the less developed countries, yield increases have lagged and population growth has been approximately double the rate of developed countries, 2.4% per year.

In other words, the countries in trouble have had vast increases in people—and only limited increases in crops. So the rich get richer—and the poor get poorer.

Borgstrom (2) indicated population stress on the land is the sum of people—and livestock—indeed of all animal life on the land

THE PRESENT WORLD people population weighs about 180 million metric tons and the livestock population weighs 925 million tons. With its great livestock numbers, the U.S. has the equivalent of 2 billion people.

Wittwer (17) said the U.S. has 100 million cats and dogs—maintained by a birth rate of 3000 per hour in contrast to a human U.S. birth rate of 450 per hour. The food consumed by these pets and horses could feed 122 million people.

How many of us stop to remember—or even know—14,000 Indian children go blind annually for lack of food.

Borgstrom (4) cited India as the extreme of biological overdevelopment—too many people, cows, crows, monkeys, antelope, wild boars, elephants and rats!

Stronck (15) said, "Voluntary birth control has failed in India, the world's largest democracy. Only 7% of the married couples in the reproductive age practice any form of birth control."

The population is increasing at the annual rate of 3%. The 500 million population in 1950 increased to 600 million in ten years and will reach one billion by the year 2000.

THE WORLD FISH catch would provide only one small herring per person daily to the people of India.

If such a developing country were able to reduce its birth rate to replacement level by 2000, it would still reach a population 2½ times its present level before it stops growing.

James P. Grant (6), President of the Overseas Development Council, said "Population programs alone do not lower birth rates very much. It is not until there is a general improvement in the way of life through improved diets, health, education and employment of the bottom two-thirds of the population that they have the motivation for smaller families."

A. J. Mair (8), Deputy Assistant Secretary of U.S.D.A., said, "There is no solution to the world's food problems unless there is a solution to the population problem."

Paddock (11) discussed the Malthus (Dismal Theorem), "If the only check on growth of population is starvation and misery, no matter how favorable the environment or how advanced the technology, the population will grow until it is miserable and starves."

Complexity of the population problem is well illustrated by India. This nation, a great civilization when Western Europe was inhabited by "savages," has a high rate of illiteracy and its communications are further exacerbated by the use of 800 languages, or dialects, among its people. There are 16 languages assigned official status in various areas (2).

Strohm (14) pointed out that India spent 2 billion to develop the atomic bomb. This is 100 times India's annual expenditure on family planning, 200 times the annual expenditure on agricultural research.

(Margaret Meade (9) stated 30% of the U.S. federal budget is for military which is 300 times what the U.S. spends on population activities.)

Keith Barrons (1) said there are 3 groups of the world's people:

1. **Highly affluent heavy meat-consuming, e.g. USA, Canada, Australia, and Germany.**
2. **Intermediate, e.g. Russia, Eastern Europe, North Africa, and the Near East.**
3. **Very hungry, e.g. India, China, Asia, Tropical Africa, and parts of Latin America.**

FOOD PRODUCTION—AGRICULTURE. "You are never farther from agriculture than your next meal," said Keith Barrons (1). A world food deficit of about 20 million tons prevailed in the early 70's and may increase to 85 million tons by 1985 (5).

Before World War II, Asia, Africa, and Latin America were food exporters. Now they are importers (14). Areas of greatest stress today are the Sub-Sahara, Northeastern Brazil, parts of India, and Bangladesch.

84% of all food aid in the world over the past 25 years has come from the U.S.A.

Strohm (14) said each U.S. farmer supplies food for 60. Each USSR farmer supplies food for 7. Today, in the U.S. we have twice the food production from one-third of the farm units of a generation ago.

By applying science and technology to agriculture, the U.S. is today undisputed leader in agricultural production efficiency.

The U.S. has applied mechanical power, fertilizer, pesticides, irrigation, improved crop varieties and animal breeds to develop the world's most productive agriculture.

Here are a few recent benchmarks or yield achievements of the U.S.A.:

Wheat (Gaines)—209 bushels per acre, Ellensburg, Wash., 1965.

Corn—338 bushels per acre, Saybrook, Ill., 1975.

Milk—Mowry Prince Corinne, a registered 9½-year-old Holstein cow at Roaring Springs, Pa., produced in 1975 a 365-day world record of 50,759 pounds of milk or 23,609 quarts—enough milk to supply 64 U.S. families for the year (18).

Lester Brown (3) cited the political power of U.S. food production. The U.S. controls more of the exportable food than the vaunted OPEC (oil exporting nations) controls exportable oil.

Congressman Tom Foley (2) said, "The power of food is a potent instrument of foreign policy. Perhaps 50 or 75 years from now, our major contributions may well be judged by how effectively we have carried out our leadership in food. Our agricultural and food aid policies may be more important than our military policies." (Commercial Review, June 10, 1975, p. 9)

Food itself has become the most powerful weapon for peace in the world today.

Former USDA Secretary, Earl Butz (4), said, "Food itself has become the most powerful weapon for peace in the world today. The actual and potential exports of agricultural commodities and know-how to Russia, to China, and to the Middle East are providing vastly more effective deterrents to hostility and war than all the military might we could muster."

The $20 billion foreign exchange gained from the USA farm produce exported in 1974 just paid for the oil imported (1). Does anyone know of a better way to pay for the oil we insist on importing to satisfy our affluent appetites?

EIGHTY-FOUR PERCENT of all food aid in the world over the past 25 years has come from the U.S.A. (14) The only cushion, or food reserve, of the world during the last 20 years has been the extra production (often called "surplus") of the U.S.A.

The person who seeks to understand U.S. agriculture and how it works today should read the 1975 book by Keith C. Barrons: The Food in Your Future. (1).

Lest our well-intentioned but poorly informed instant ecologists, environmentalists, and city farmers kill the goose that lays the golden eggs, or bite the hand that feeds them, we should seriously consider Barrons' perturbing question:

"Can representatives of our vast urban majority, so far removed from the farm and the finely tuned systems that transform and transport farm produce to products on the supermarket shelf, make wise policy decisions at the national and international level?"

In our democratic system of government there can only be an affirmative answer. But we must inform and educate the public so the right decisions will be made.

Reviewing Barrons' book, William B. Seward (13) described especially well those who pose threats or deterrents to maximum sustained agricultural production and who are labeled by Barrons the "Hunger Mongers."

His review dealing with the "Hunger Mongers" is excerpted as follows:

1. The Land Gobblers. Cities continue their sprawl, often in the direction of our most productive land. Developers like the economy of level terrain.

Shopping centers and single-story industrial buildings, all with their tremendous parking lot requirements, are more cheaply built on level land, often the land that is best adapted to food production.

2. The Soil Despoilers. You see fields that should be terraced or contour-farmed still running rows up and down the slope. There are farmers still using the moldboard plow in areas where stubble mulching would give good protection against wind erosion in the event of a long drought. Fall plowing is economically sound for the farmer but on some soils it is ecologically unwise.

(The South Fork of the Palouse River carries annually through Pullman, Washington, a silt load equivalent to a field of 160 acres one inch deep. And the main Palouse River dumps over Palouse Falls annually a silt load equivalent to a field of 160 acres eighty feet deep! B.R.B.)

3. The Organic Farming Promoters. If much of the world adopted the system of farming they recommend, we would soon have a serious food shortage. This is not to say manure should not be applied to the soil whenever available—that is the most ecologically sound way to handle it.

But if all the manure generated by our livestock was divided among the acres tilled, we would still have a crisis in plant nutrition if fertilizer was not used. Indeed we would have a food disaster, a horrendous famine.

4. The Safety-at-Any-Cost People. There are forces stalking legislative halls and the offices of regulatory agencies who would ban the use of any and all crop and livestock protection chemicals—the anti-chemical cult.

They may not realize it but the cost is nothing short of less food, higher prices and eventual hunger. What does it profit people to eliminate all substances that someone thinks might present a hazard when grossly misused only to later find empty shelves at the supermarket?

5. The Far-Out Environmentalists. Barry Commoner in "The Closing Circle" refers to the "addiction" of soil to fertilizer nitrogen. Apparently mimicking Commoner's views, "Time" magazine for February 2, 1970 stated, "Just as people get hooked on drugs, so the soil seems to be addicted to Chemical additives and loses its ability to fix its own nitrogen."

The most charitable thing a soil specialist could say about these statements is that they are grossly misleading.

6. The Anti-Malthusians. There is absolutely nothing on the horizon to suggest food can keep pace for long with present rates of population growth now being recorded in much of the world.

Right now, and hopefully for a few years more, technology is buying us some time, but opportunities for yield increases are finite just as is land available for agriculture.

Pest control must use modern technology. There is no other way to feed today's population.

TO THOSE DEEPLY CONCERNED about the world population-food problem and the welfare of fellow inhabitants everywhere on this small planet, Barrons (1) offers 17 suggestions to help solve the problem:

1. Support and practice population control.
2. Adopt a sensible, non-gluttonous diet.
3. Extend moderation to non-food demands, e.g. beer, liquors, tobacco, tea, coffee, food for pets, paper products, etc.
4. Refrain from panic buying of food items rumored in short

supply or that are out of season.

5. Don't join the Hunger Mongers!
6. Recognize pest management and control must utilize modern technology if the people are to be fed. There is no other way to feed the present population nor to cope with increasing food needs.
7. Encourage and suggest sensible regulations. Over regulation reduces production, increases costs of production, and increases prices at the supermarket. Have an appreciation of tolerances. (For instance, Ivory Soap 99 and $^{44}/_{100}$% pure actually contains 0.56% "residue" or 5,600 ppm (parts per million), or 5,600,000 ppb. (parts per billion), or 5,600,000,000 ppt. (parts per trillion) of impurities! B.R.B.)
8. Recognize the wide range of inputs essential to modern farming, maximum production, and top quality of product.
9. Support policies needed to ensure further increases in productivity and sustained production.
10. Think through food policies. Do they serve these four aims?
    (1) To stimulate food production by America's farmers, recognizing a fair return, economic incentive is essential.
    (2) To keep food prices reasonable for consumers through a production of abundance.
    (3) To help starving people overseas.
    (4) To help sustain a favorable balance of payments for us in world trade.
11. **Study** agricultural legislation and **then** express opinions.
12. Participate in foreign aid decisions. (The U.S.A. has spent $150 to $200 billion on foreign aid.)
13. Study subsidy programs—know what is good or bad about them. Get the interrelatedness. Does the subsidy help the farmer or the consumer or both?
14. Support land use planning concepts that take future food needs into consideration.
15. Raise a garden. Be an "organic farmer"—if you like.
16. Don't waste food or related inputs.
17. Farmers, you must be good stewards—save the soil. "They stopped making land some time ago."

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BUREAUCRACY is not a state of government. It is a state of mind.

My morning paper convinces me. It reports a certain Housing Authority can't pay some bills because of a budget crunch, yet **"23 agency officials are packing for their biggest convention at what is described as a 'deluxe resort.'"**

Size—of government agency or private enterprise—has nothing to do with a bureaucracy. We can create a bureaucracy out of the corner grocery store.

First, build a private office for the Produce Manager. And eliminate the title, **Manager,** from this store forevermore.

Now—no self-respecting Meat **Manager** is gonna slice along happily with a Produce **Director** ensconced in his own private office.

So, our Store Chairman creates an equal office for the Meat Director—then for the Packaged Goods Director, Bookkeeping Director, and Loading Dock Director.

Any ambitious Meat Director will find need for a good quality table to butt against his desk, into a T-shaped conference setting.

But no table is conference caliber without chairs. Sooo, the store (stockholder) coughs up quality chairs. Such an investment must be used. So, the Meat Director closes his door to conceive some problems worth calling his cutters into their first staff conference.

They are busy serving popular cuts to a steady flow of customers. But surely there are problems to discuss, proposals to make—THAT'S IT, **proposals** to make.

He enthusiastically announces their first staff meeting "next Monday morning at 9 sharp." The dam is open.

Cutters, who first gripe about being pulled away from their talent, learn to like meetings. **They find it easier to talk about cutting than to cut—and much less lonely.** Good cutting is a lonely art. Rump roasts, loins, ribs, shoulders don't talk. They just lie there. Waiting for a creative cutter to shape them into attractive pieces hungry homemakers can't resist.

The Meat Director starts receiving notes suggesting topics for "the next meeting." Notes soon become elaborate agendas of multiple proposals.

One day he closes his door and stares at 6 pages. A sudden sense of physics overwhelms him. He remembers Miss Anna Lula in high school. She said every action has a reaction.

He uncrumples the sheets and sees the word, **disposal,** in his mind's eye. For every **pro**posal there must be a **dis**posal.

The Meat Director is depressed. The little bell at his counter window seems to ring less but more loudly by impatient customers waiting for cutters to come out of their popular staff meetings.

He is staring at the crumpled pages of proposals when the Store Chairman pops in with a new idea from the Produce Director—the **first** Forward-Thrust meeting of Produce, Meat, Packaged Goods, Bookkeeping, and Loading Dock.

The Meat Director almost slumps over his conference table in relief. He spins the crumpled proposals into the wastebasket and grins. Great idea! But where? No office will hold such a combined meeting.

The Chairman says the Meat Director can serve as a committee of one to look around Meat and Loading Dock for space to build a first class conference room. We humans, like chickens, have our pecking order. The Loading Dock is in the rear, so at the bottom of the pecking order.

As they slice a conference room out of the Dock, their aging truck driver says, "You ain't gonna leave room for us to get the food in there if you keep this up."

No one hears him but the Meat Director. The thought chills him. **No food, no money. No money, no departments. No departments, no jobs.** So, they leave a dock wide enough for a medium van.

The Meat Director is dog tired at the first Forward-Thrust meeting. He needs an Assistant Director. The Chairman says it is long overdue.

Now—no self-respecting Produce Director is—well—soon all departments need more offices for Assistant Directors. The conference room is converted into several cubicles. The Loading Dock gives up one more chunk. And future Forward-Thrust meetings are scheduled for resorts.

Colleagues notice the Loading Dock Director smiling at these resort meetings. Maybe because his tiny entrance requires twice as many small vans and driving STAFF.

No one notices that twice the small vans bring in only half the food the old driver brought before the Produce Manager became the Produce Director.

R. S. ROMINGER, DALE SMITH,
AND L. A. PETERSON
UNIVERSITY OF WISCONSIN

The Influence of KCl and K_2SO_4 As Potash Sources for Alfalfa

HIGH POTASH RATES are vital to a fertilization program for top alfalfa production in Wisconsin.

In spite of much potash use on crops over the years, about 80% of Wisconsin soils still test medium or less in available K and are below the level needed for profitable alfalfa production.

To bring soil K tests up to top production levels, very high potash rates are needed. Earlier studies show this.

The current study compared different rates of KC1 and K_2SO_4 as sources of potash for Vernal alfalfa grown at the Hill Farm Experimental site at Madison.

Potash was applied each spring and four cuttings were harvested each year. **Figure 1** shows the tons of dry matter from different rates and sources of K_2O in both years.

THE FIRST POTASH LEVEL (480 lb K_2O/A) increased yields significantly both years—.5 and 1.83 tons/A. And, at this 480 lb rate, there was no apparent difference from potash source on yield—5.58 vs. 5.50 tons/A first year, 4.17 vs 4.17 tons/A second year.

This potash rate well exceeds what most Wisconsin farmers apply. So, from a practical standpoint, we might conclude no immediate problem from potassium source exists for current yield levels.

Recent reports also show only 15 to 20% of Wisconsin farmers topdress alfalfa regularly—a surprising fact when 80% of the soils still test medium or less in available K and when well-managed, topdressed alfalfa is such a profitable feed and protein for our state's dairy ration.

POTASH MAINTENANCE requirement is between 50 to 60 lb K_2O per ton of hay. For 5 tons, between 250 and 300 lb of K_2O would be needed if all the potassium were supplied by potash fertilizer.

The question remains from a scientific standpoint: "What source of potash is best if alfalfa yield levels are boosted to 7 or 8 tons and maintenance rates have to be in the 350 to 480 lb K_2O/A range?"

Our data indicates either source is probably all right for annual rates up

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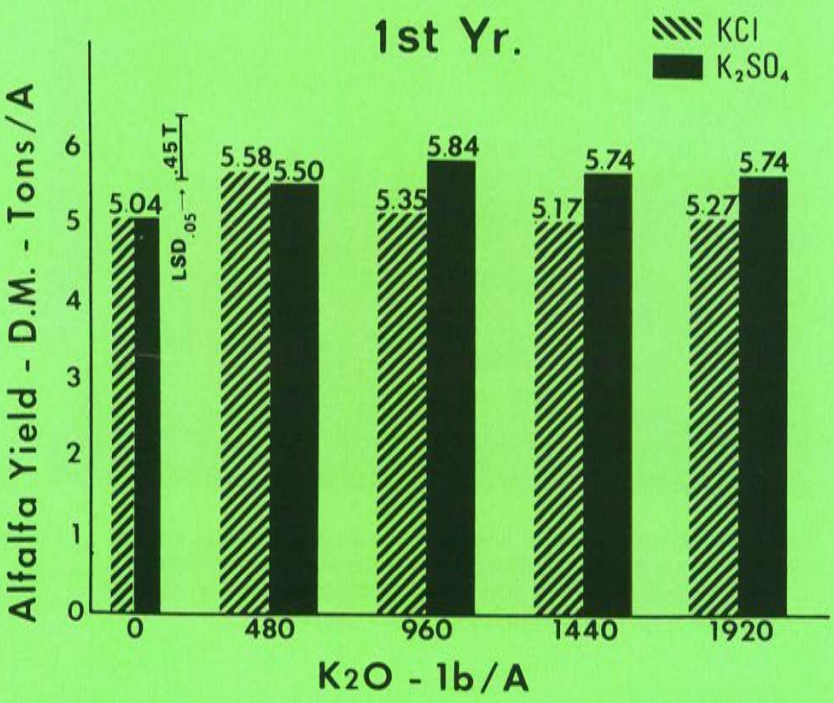
Effect of Two Potash Sources on Alfalfa Yields



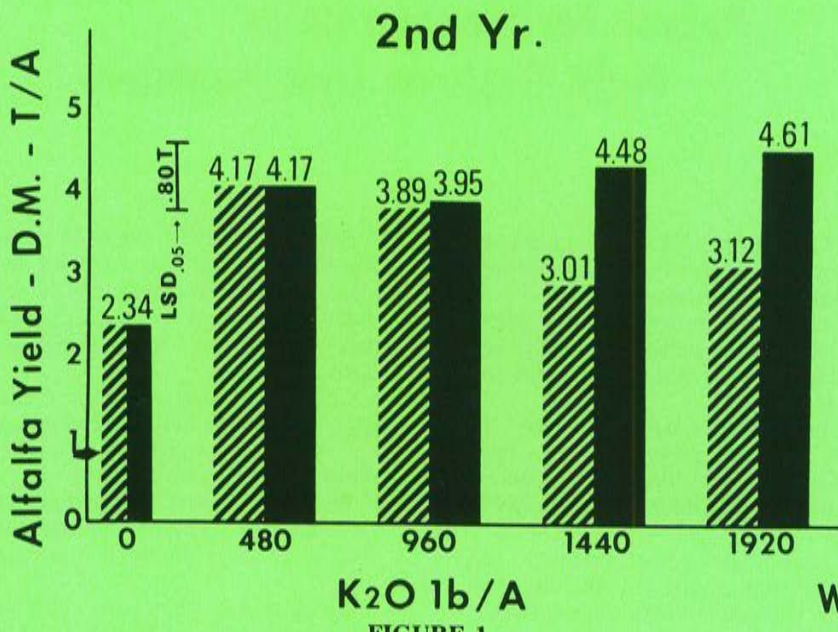
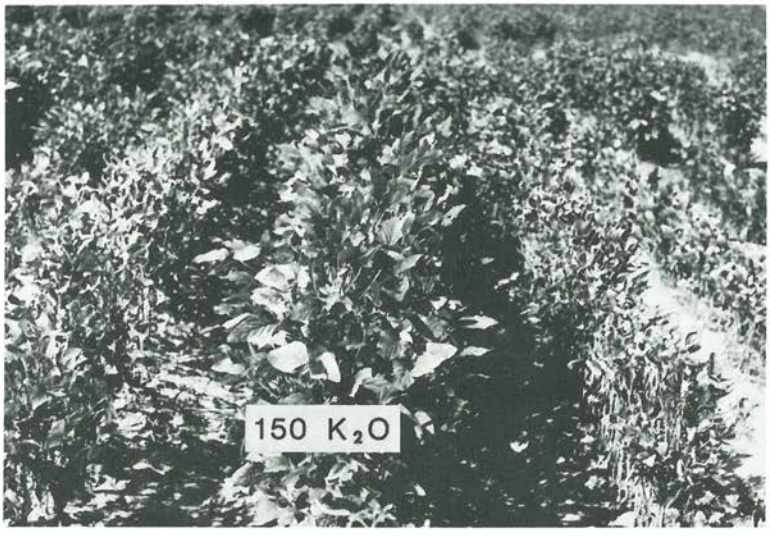


FIGURE 1



A single row of soybeans on a sandy, nematode-infested, low-K soil responded sharply to 150 lb K_2O. Potash deficiency can seriously limit soybean yields on soils where nematodes are a problem.

Potash Fertilization Helps Fight Soybean Cyst Nematode

GOOD FERTILITY is a must for soybeans, especially where cyst nematode is a problem.

Our research shows potash deficiency can seriously limit soybean yields on soils where nematodes are a problem.

Soybeans are big potash users. If the crop can't get enough where cyst nematodes are present, it produces low yields returning little or no profits.

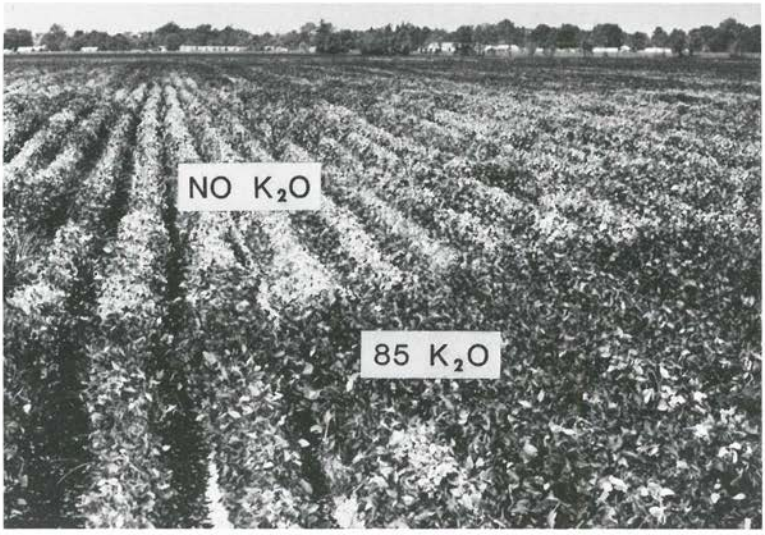
And wherever cyst nematode severely limits root growth, the crop may need more potash than soil tests suggest.

SOYBEAN-CYST NEMATODE attacks the soybean root, feeds off the plant, reduces nodulation, and limits water and nutrient uptake. This pest damages soybeans from Florida to Central Illinois.

Losses from cyst nematode range from total failure to none, depending on nematode population, variety, moisture supply, and fertility.

Races 3 and 4 of this pest cause most damage. Varieties resistant to Race 3 are available, but not to Race 4.

Breeders will soon have varieties resistant to Race 4. If Race 4 is a



The K-treated soybeans received 85 lb K_2O, according to soil test—but deficient areas still showed up. When cyst nematode severely limits root growth, the crop may need more potash than soil tests suggest. (This picture was made in Obion County, Tennessee by E. E. Hartwig.)

J. GROVER SHANNON, C. H. BALDWIN, JR., GARY W. COLLIVER, UNIVERSITY OF MISSOURI DELTA CENTER, PORTAGEVILLE, MO. E. E. HARTWIG, USDA, DELTA BRANCH EXPERIMENT STATION, STONEVILLE, MISSISSIPPI

problem, nematicides may be needed to make profitable yields.

Much of the cyst damage occurs on soils low in fertility and water holding capacity.

Soybeans grown on soils with marginal potassium (K) levels tend to show deficiency more readily if cyst nematode is present. Yields on many of these soils may be only 3 to 10 bu/A.

MANY OF THE sandy soils in the southeast Missouri Delta are low in available K and infested with soybean cyst nematode. These soils are low producers and should be irrigated and properly fertilized to make profitable soybean yields.

A two-year experiment studied how nematicide treatment and potash and nitrogen fertilization affected the yield of soybean varieties differing in resistance to cyst nematode.

The field was near East Prairie, Missouri. The soil type was a Bertrand sand with a pH of 6.1 and testing high P but very low K (48 lbs/A). This field was infested with Race 4 cyst nematode.

THE EXPERIMENT is outlined as follows:

Two Nematicide Levels: (1)

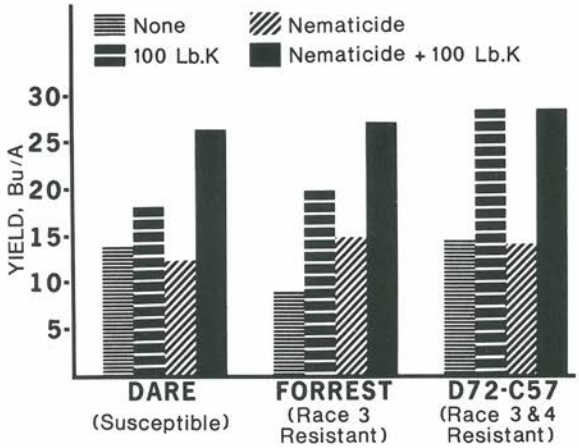


Figure 1—Yield of soybean varieties as affected by nematicide treatment and potash fertility, East Prairie, Missouri 1975-76.

None. (2) 3 qt./A DBCP (Dichlorobromopropane).

Three Varieties: (1) Dare (Susceptible to cyst nematode). (2) Forrest (Resistant to Race 3 cyst nematode). (3) D72-C57 (Resistant to Race 3 & 4 cyst nematode).

Four Fertility Treatments: (Sidedressed 3 weeks after planting). (1) None. (2) 100 lbs K/A. (3) 150 lbs N/A. (4) 100 lbs K/A + 150 lbs N/A.

INFLUENCE OF POTASH. **Figure 1** shows how all varieties responded to potash fertilization, regardless of susceptibility to soybean-cyst nematode—Dare Variety (susceptible), 6 bu/A increase; Forrest (Race 3 resistant) 10 bu/A; and D72-C57 (Race 3 and 4 resistant), 14 bu/A.

The most resistant variety responded better than the more susceptible strains Dare and Forrest. The resistant variety was limited by potash only, while the susceptible strains were limited by both nematodes and potash.

Yields of unfertilized plots were about the same for all varieties. Only when K deficiency was corrected did the benefits of a resistant variety over the Race 4 susceptible varieties show up.

Applying nematicide alone did not increase yield as much as adding potash alone. This shows yield may be limited more from potash deficiency than cyst-nematode.

The K and nematicide team produced highest yield for the susceptible strains—Dare, 13 bu/A; Forrest, 18 bu/A more than the untreated plots.

Nematicide plus K on the Race 4 resistant strain increased yield no more than K alone.

The K-nematicide team gave susceptible varieties a good yield boost.

Nematicide benefited little when K deficiency was not corrected.

INFLUENCE OF N & N + K. **Figure 2** shows soybean yield (averaged over two nematicide levels

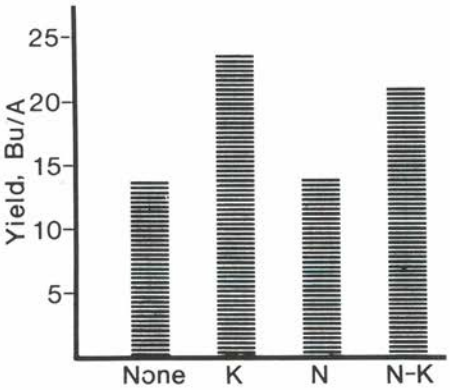


Figure 2—Yield of soybeans as affected by nitrogen and potash fertility, East Prairie, Missouri 1975-76.

and the three varieties) for unfertilized, 100 lbs K, 150 lbs N, and 100 lbs K + 150 lbs of N.

In this case, N did not help K boost yield more than K alone—though previous work has shown positive response to N fertilization on soybeans grown in soil infested with cyst nematode.

This would be expected since nematodes limit nodulation. Lack of response probably came from "burn" by the high N rate we used. We sidedressed at least four-six inches from the row but still got burn.

Plants of susceptible strains, already damaged by cyst nematode, were shocked even more from the high N rate. The nitrogen may have had a positive effect if we had applied lower rates sidedress or broadcast.

IN SUMMARY. More research is needed to study mode of application, time of application and rates of potassium required on soils infested with cyst nematode with marginal K levels.

But one fact seems clear: Neither resistant varieties, nematicides, nor crop rotation will help soybean yield unless good fertility practices are used on cyst nematode infested soil.

The End

FROM PAGE 10

to 960 lb K_2O/A. (Sources differed significantly for the 960 lb/A rate the first year, yet the yields were not different from those obtained with the 480 lb/A rate).

IF ANNUAL K_2O RATES should have to be increased above 960 lbs/A, then source could make a difference. Yields were maintained by K_2SO_4 rates applied above the 960 lb K_2O/A rate, but yields were decreased by the KC1 source. This difference is probably due to the chloride ion.

Production problems could be possible where extremely high K rates are required in one application, where soil profiles do not have water moving through them naturally, or where chloride or sulfate salts accumulate in arid areas.

If high KC1 rates are added, it may be wise to split the application between fall and spring or substitute K_2SO_4 for part of the KC1 fertilizer.

OUR PROBLEM like most states, is not to choose between potash sources for alfalfa, but to get farmers to apply the potash rates our results show profitable.

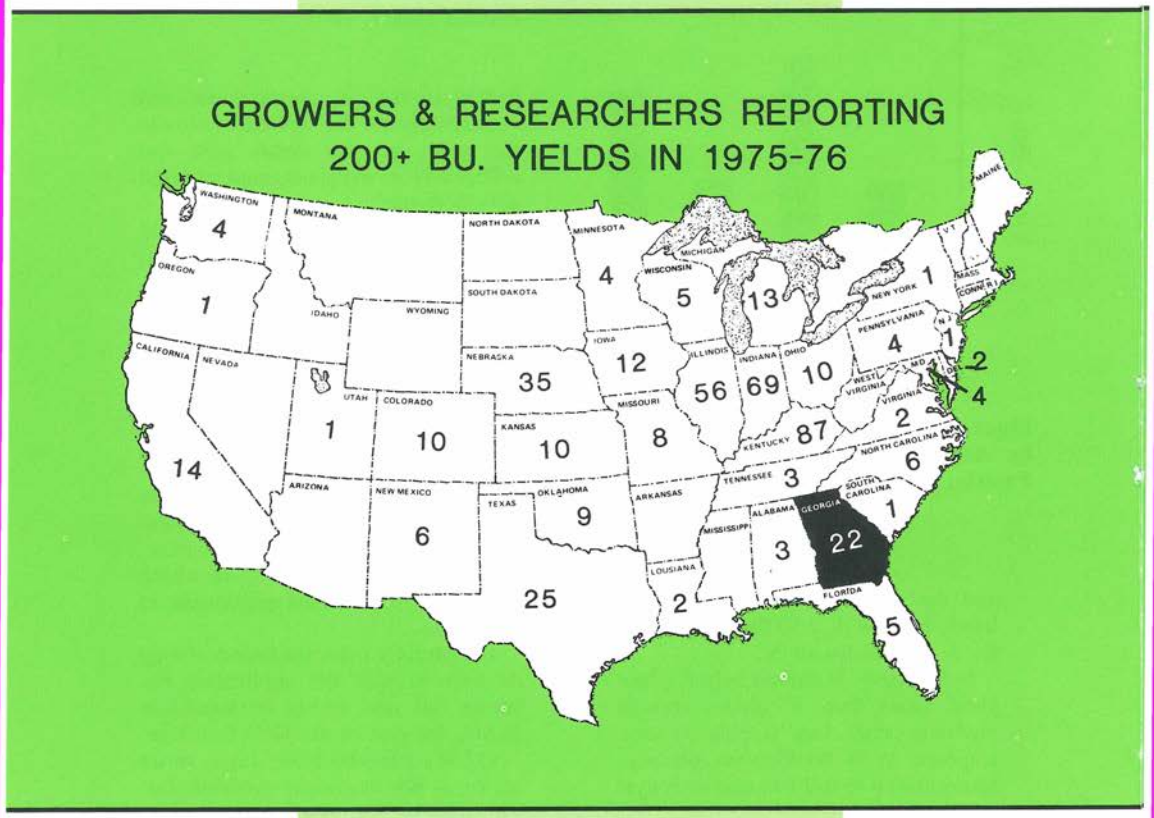
On a soil testing 127 lb exchangeable K, our data indicates the most profitable K_2O rate is about 420 lb/A when alfalfa hay is $50/ton and K_2O is 8.3¢/lb.

But if farmers cut early and achieve a high feed value ($60/ton), they can profitably apply about 520 lbs K_2O/A.

We hope such results will ultimately lead to a better understanding of alfalfa nutrition and improved production for the dairy farmers of Wisconsin and the nation. **The End.**

NEXT ISSUE

SPECIAL SECTION ON NEW SLIDE SETS & SCRIPTS



THIS MAP SHOWS more than 430 corn yields breaking the 200-bushel barrier in 32 states over the past two years.

The Potash Institute is summarizing steps taken to produce these yields. Dr. David Dibb will appreciate hearing from

The BARRIER Breakers

FORGET IT! So said the old-timers when Dr. Harold Gurley started talking 100-bushel corn in South Georgia in the early 50's.

Maybe in the rich mountain valleys of North Georgia. But 100-bushel corn in the coastal plain? "Forget it!"

A few years before, in 1946, a Union County farmer named Grady Satterfield had hit 100 bushels per acre in those mountain valleys. He and two other farmers met a year later in a University of Georgia cafeteria for the first meeting of a new group called the 100-Bushel Corn Club—in 1947.

The 1977 annual meeting of the Georgia Plant Food Educational So-

200+ BU/A CORN GROWERS

In 1976 . . .

By 22 growers
In 17 counties
On 31 fields ranging from 5 to 190 acres

Averaging . . .

264 Lb/A Nitrogen
98 Lb/A Phosphate
165 Lb/A Potash

you: 1367 Pecos Ave., Columbia, MO 65201. Phone: 314-442-0907.

Georgia's story was told through a 9-page press release by its talented writer, Virgil Adams. We compress some facts here.

This story is happening many places. If food is the ultimate weapon, then what better defense than agronomic research?

ciety honored 22 Georgia farmers for breaking the 200-bushel barrier last year in 17 counties, on 31 fields ranging from 5 to 190 acres.

Twelve of these 200-bushel growers did this in SOUTHeast Georgia, 8 in SOUTHwest Georgia. The other two are from what oldtimers, laughing at Gurley in the early 50's, had called "those rich mountain valleys of North Georgia."

When 100-bushel yields became commonplace by 1957, the Extension Service launched an idea they called **The Intensified Corn Program** . . . followed by **The Master Corn Program** . . . followed by **The Full-Feed Corn Program.**

The Champions

IN NORTH GEORGIA	TOP YIELD	COUNTY
Gene Warren	216.7	Gilmer
Ben Overstreet	205.5	Dawson
IN SOUTHEAST GEORGIA		
B. D. Whitfield	237.2	Emanuel
Franklin Burch	224.4	Wayne
Ray & Terry Gerald	224.2	Bullock
Ray Merritt	220.8	Coffee
Lamar Black	217.3	Jenkins
Frank Flanders	212.2	Emanuel
Revis Clary	209.6	Wayne
Gene Moore	208.3	Ware
Herbert Jacobs	207	Screven
Virgil Black	206.6	Jenkins
Marvis Driggers	205.8	Tattnall
W. M. Silas	201.3	Jeff Davis
IN SOUTHWEST GEORGIA		
Douglas Dean	246.4	Decatur
James Adams	244	Mitchell
Mitchell Suber	215.4	Colquitt
Donald Shirah	215.2	Mitchell
Spence Pryor	206.5	Sumter
Charles Barnes	205.8	Sumter
Will Trawich	205.8	Seminole
Hal & Henry Haddock	204	Baker

"When Dr. Harold Gurley, University of Georgia Extension Service agronomist, started talking up 100-bushel corn in South Georgia in the early 50's, the oldtimers laughed at him, said it might be possible in those rich mountain valleys of North Georgia, but as for 100-bushel corn in the coastal plain, 'Forget It!'"

University of Georgia Extension Service Press Release

Each designed to help Georgia farmers find and remove all limitations to high, economical yields. Each with new research, new facts, new technology, AND HIGHER YIELD GOALS.

So 200 bushels seemed like a good goal for the next step up. To help encourage this goal, the Potash Institute created a special award around 1966 for the grower who could top 200 bushels.

When Gurley accepted the trophy from Dr. S. E. Younts, then Vice President of the Potash Institute and now Vice President of the University of Georgia, he said it would be some years before anyone could claim it.

He was right. Appling County farmer L. W. Hutchinson collected the trophy in 1974. A year later he was joined by three other 200-bushel growers: fellow Appling Countian A. D. Garner, Ben Overstreet of Dawson County, and B. D. Whitfield of Emanuel.

Overstreet and Whitfield are repeaters on the 1976 list.

WHAT CAUSED this explosion of 200-bushel barrier breakers? Leaders and farmers with much know-how—and belief.

Dr. Gurley was joined by his colleague, Dr. Keith Wesley, in creating a 1974 Guidelines for 200-Bushel Corn Production.

District Agent Larry Torrance joined the team, stimulating county agents to encourage Southeast Georgia farmers to shoot for 200 bushels through a Bicentennial Corn Club in 1976.

Then District Agent Charles Roland believed his Southwest Georgia area could do it "if they can do it over there."

And, most important, 22 farmers had the faith to commit ENOUGH resources for 200 bushels—15 of them on more than the 5-acre minimum for their "experiment."

James Adams said if it's good enough for 5 acres, it's good enough for 200 acres. So, he shot the works on five 40-acre plots in Mitchell County, each with a different hybrid. He ranged from 210 to 244 bu/A. His experience AND FAITH paid off.

WHAT GUIDELINES did Gurley and Wesley lay down? From past corn programs of their own Extension Service and facts all over the world, they offered these 11 suggestions:

1. Select the most productive well-drained soil, preferably a silt loam.

2. Soil test and apply enough dolomitic lime at least three months before planting to adjust pH to 6.3 to 6.5.

3. If soil tests below 60 lb magnesium per acre, apply a minimum of 50 lb elemental Mg. Apply 5 lb elemental Zn if soil tests less than eight pounds zinc per acre.

4. Plant early—as soon as soil temperature warms to 55 degrees F. and moisture conditions are favorable.

5. Control all weeds.

6. Use 10 to 20 lb Furadan in-furrow or in 12-inch bands as a general insecticide-nematicide.

7. Use highest plant population recommended by the breeder of your hybrid—and overplant the final desired population by 15 percent. Plant slowly enough to get a uniform seed drop—and use 30-inch rows if possible.

8. Apply 260 lb nitrogen per acre in at least two applications: 80 to 100 lb at planting, 160 to 180 lb four to five weeks later as sidedressing. Bring phosphorus soil test levels to 125 lb/A, potassium to 260 lb/A.

9. Disc previous crop residue as soon as possible. A winter plow down rye crop may be helpful, especially in the coastal plain. Break hardpans by in-row sub-soiling.

10. Check field at least twice a week for fertilizer deficiency signs, weeds, insects, and diseases. These problems can often be remedied if detected soon enough.

11. Harvest the corn at high moisture (25 to 28 percent) and dry before storing.

A STRONG FERTILIZER program was one of the keys those 22 Georgia farmers used to average 216 bushels per acre corn last season in their corn club "experiments." Among the steps they took to break the 200-bushel corn barrier were these averages:

Nitrogen 264 lb/A. Phosphate 98 lb/A. Potash 165 lbs/A. Row width 34.5 inches. Plant population 24,952 plants per acre. Eight growers irrigated. Eighteen used zinc. Eleven applied magnesium. Four applied sulfur. Fourteen applied Ag-lime.

The fertilization **GAP** between Georgia's 200-bushel corn club average and the U.S. average last year is striking:

POUNDS PER ACRE

	GA.	GAP	U.S.
N	264	**141**	123
P_2O_5	98	**38**	60
K_2O	165	**98**	67

In a sentence, the U.S. applied an average of 141 lb **LESS** nitrogen, 38 lb **LESS** phosphate, and 98 lb **LESS** potash per acre to produce 129 bushels **LESS** corn/A average than the Georgia champs in 1976.

For details on the practices of individual growers—hybrid, row spacing, plant population. planting date, fertilizer applied, liming, land preparation, insecticide-nematicide, herbicide, irrigation, and previous crop—contact Dr. Harold Gurley, Extension Agronomist, University of Georgia Cooperative Extension Service, Athens, Georgia. **The End**

In 1977 . . .

The Time Is RIGHT

JOHN DOUGLAS

TENNESSEE VALLEY AUTHORITY

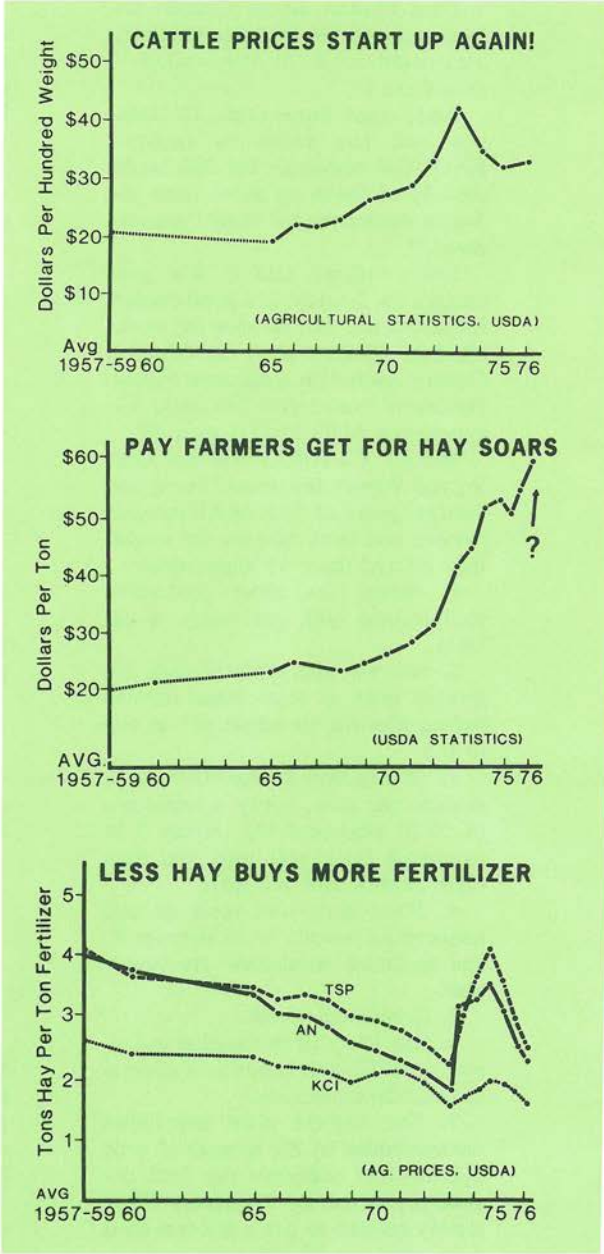
THIS YEAR is a great time to fertilize hay, silage, and pasture lands. Hay and pasture supplies are 30 to 50% below normal in many areas.

In key dairy states like Wisconsin, Minnesota, New York, and Pennsylvania, forage and feed supplies are well below normal. Many beef producing areas are critically short in feed. The reason seems clear.

For two decades, farmers were told of "The Great Potential"—fertilizing forages to get more economical home-grown feed.

Very slowly pasture fertilization increased until fertilizer prices hit those 1974-75 highs while cattle prices tumbled. Suddenly forages started getting little, if any, fertilizer.

So, today—in 1977—most forage lands are ready for a good full-feed fertilizer program. Farmers will probably use "up to 1 million tons more plant nutrients on hay and pasture crops this year than last."



PRICES for cattle are higher than in any of the past 15 years, except 1972-74. Moderate increases are promising for the near future.

The big question is how to feed the

cattle we have most economically—to get best returns from even moderate price increases.

Too many pastures are limping badly. From being grazed to the roots. From long droughts. From reduced fertilization since 1974.

We seem to face two choices. Restore these pastures OR slaughter massive numbers of cattle. Pasture restoration takes plenty of fertilizer.

PRICES for hay have hit an all-time high. Good alfalfa hay now sells higher than corn per pound—$100 per ton or 5¢ per pound. And good grade grass hay reportedly brings $60 to $80 a ton.

Hay has become a $6-7 billion business, topped only by corn and wheat in dollar volume.

But supplies are short—our January 1977 inventory the lowest for that time of year since 1960. Cold weather, over 6% increased farm use of hay from May to January, and decreased production have caused this.

This makes fertility a blue chip investment.

RATIO MAY "almost certainly show the best hay/fertilizer price ratio of all time," TVA specialist John Douglas predicts.

With hay prices up and fertilizer costs relatively stable, farmers may have the best chance in history to make money fertilizing hay & pastures.

A ton of triple superphosphate (TSP) or ammonium nitrate (AN) cost about 1.3 tons less hay in 1976 than in 1960. A ton of potash (KCl) about 1 ton less hay.

Since 1976, hay prices have soared more. This is the year to fertilize for real profits.

FACTS FAVOR forage fertilization. Both research and farm records are full of evidence.

We know home-grown forages are the cheapest feed for all ruminant livestock. Many dairymen use more manufactured feeds than are economically wise. And dairy feeds are 20% higher today than a year ago.

We know fertilizer builds forage quality as well as quantity. And quality forages—higher in protein, carotene, and digestible energy—help reduce feed bills with better herd production and health.

We know fertilizer adds able age to legume stands and keeps the legume strong in a legume-grass mixture. A big point in 1977, with seed supplies tight, prices high, and establishment costs steep. A longer-living forage stand is a better-paying forage stand—two ways.

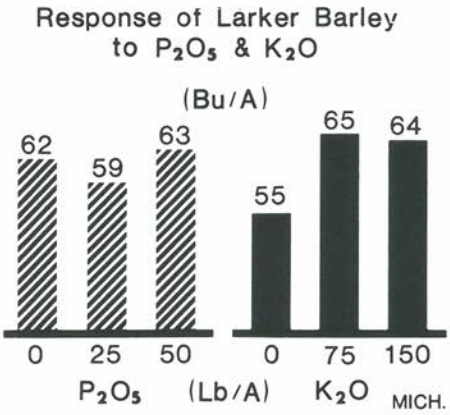
We know fertilizer unlocks the productive potential of forages. It adds 40 to 50% to the yield while taking less than 20% out of the cost pie.

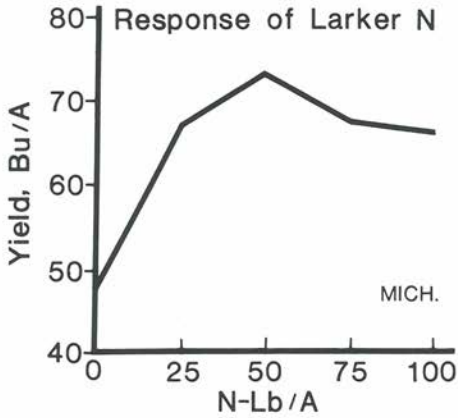
FORAGE PRODUCTION removes the whole crop. This takes much more plant food from the soil than any cash grain crop.

But the yield principle is the same—as yields go up, cost per ton produced declines and chances for profits increase. Top yields demand top fertility.

This table gives the N, P_2O_5, and K_2O contained in ONE TON of key forages. A grower can multiply these nutrient needs by yield goal to get how much maintenance fertilizer he should apply.

	Lbs/Ton FORAGE					YIELD GOAL		For MAINTENANCE Pounds/Acre			
	N	P_2O_5	K_2O	S		Tons/Acre		N	P_2O_5	K_2O	S
Corn Silage	8	3	9	0.9	×	_____	=	_____			
Alfalfa Hay	...	15	60	6.0	×	_____	=	_____			
Leg-Grass Hay	...	12	55	4.8	×	_____	=	_____			
Orchardgrass	50	16	60	5.8	×	_____	=	_____			
Coastal Bermuda	50	14	42	4.5	×	_____	=	_____			





How NPK Influenced Barley

DONALD R. CHRISTENSON
MICHIGAN STATE UNIVERSITY

SMALL GRAINS have usually not received enough fertilizer for optimum growth in the Northern Great Lakes region.

Studies have provided data on the nutrient needs of two barley varieties—Larker and Coho—widely grown in Michigan.

Nitrogen experiments were conducted at three different locations on three different years. The barley was planted in late April or early May in Michigan's Upper Peninsula and harvested in the first two weeks of August. The soils were generally loam texture.

The three-year phosphorus and potassium study was conducted at the Michigan Upper Peninsula Experiment Station on a Chatham stoney loam soil. The treatments were applied each year to the same plot.

Before planting, 75 lb nitrogen per acre was drilled each year. The soil test level was pH 6.7, 73 lb Bray P_1 per acre, and 97 lb exchangeable potassium per acre.

BOTH VARIETIES responded well to applied nitrogen in 1969 and 1971, shown in **Table 1.** Unknown to the author, manure was applied to the 1970 site before planting.

Both varieties responded to 50 lb nitrogen per acre. Larker variety averaged 62.5 bu/A, Coho 57.9 bu/A.

Protein content of Coho barley tended to increase with increasing nitrogen rates, but not Larker barley, shown in **Table 2.** Test weights were unaffected by increasing nitrogen rates, but Coho had a higher test

TURN TO PAGE 27

Table 1. Effect of rate of applied nitrogen on yield of Coho and Larker barley varieties

Variety	Nitrogen Rate Lb N/A	Year 1969	1970	1971	Average (a)
				Bu/A	
Coho	0	39.5	54.4	44.2	41.8
	25	52.6	59.9	53.1	52.8
	50	67.4	58.8	63.0	65.2
	75	68.2	59.1	60.8	64.5
	100	74.6	61.2	64.5	69.6
Larker	0	45.3	57.6	50.5	47.9
	25	60.1	55.0	74.6	67.4
	50	70.0	56.2	76.9	73.4
	75	82.2	59.4	62.4	67.3
	100	78.4	58.2	53.2	65.8
LSD (5%)		8.8	NS	17.4	7.6

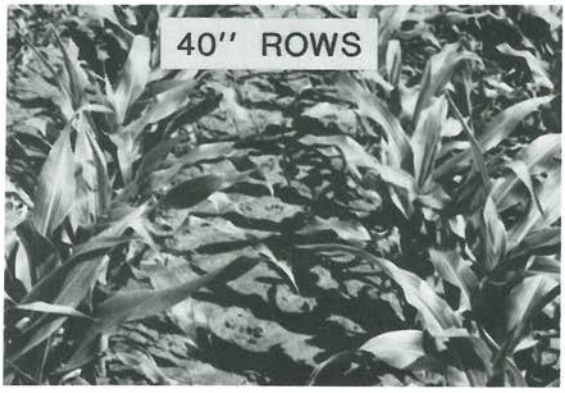
(a) Average of 1969 and 1971, manure in 1970

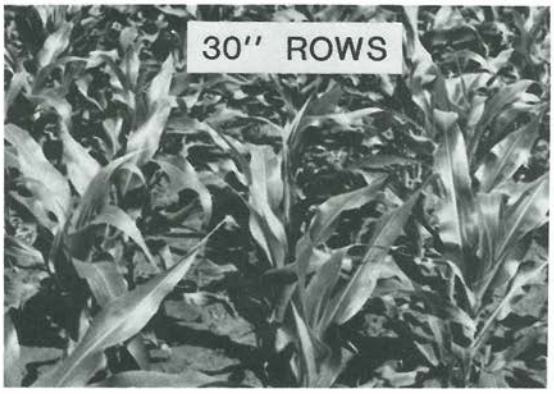
Table 2. Effect of applied nitrogen on protein content and test weight of Coho and Larker barley varieties

Rate of Nitrogen Lb N/A	Protein content Coho	Larker	Test weight Coho	Larker
	%		%	
0	12.9	12.4	49.6	44.5
25	13.0	12.2	49.5	44.9
50	13.7	12.6	49.6	45.4
75	13.3	12.8	49.2	45.5
100	14.5	13.2	49.7	45.5
LSD (5%)	0.9		1.0	

Table 3. Averages for phosphorus, potassium and variety from the phosphorus and potassium study

Effect	Yield Coho	Larker	Protein Content Coho	Larker	Test weight Coho	Larker
	—Bu/Acre—		—%—		—Bu/Acre—	
Phosphorus lb P_2O_5/Acre						
0	58.9	61.9	14.7	14.3	51.5	47.3
25	56.8	58.8	14.4	13.9	50.6	47.6
50	56.4	62.8	14.3	13.8	50.9	47.6
LSD (5%)	ns		ns		ns	
Potassium Lb K_2O/Acre						
0	52.0	54.6	14.6	14.4	50.2	46.8
75	60.4	65.1	14.2	13.8	51.2	48.0
150	59.6	63.7	14.6	13.8	50.6	47.6
LSD (5%)	4.9		ns		ns	
Variety	57.2	60.7	14.5	14.0	50.6	47.5
LSD (5%)	2.0		0.3		0.3	





Row Spacing AFFECTS Corn Yield

W. L. PARKS
UNIVERSITY OF TENNESSEE

SOLAR ENERGY is on everyone's mind today.

The farmer's total enterprise is based on solar energy convertors. Every crop he grows uses solar energy and each plant is a solar energy convertor.

Of the cultivated row crops he produces, corn is the most efficient solar energy convertor—about 5% efficient even under desirable conditions.

Corn has what many call an open canopy. Much of the sunlight striking

TABLE 1—CORN YIELDS AT DIFFERENT ROW SPACINGS

Spacing Inches	3369A 18,000	3369A 22,000	3369A 26,000	3369A Ave.	3145 18,000	3145 22,000	3145 26,000	3145 Ave.
	BUSHELS PER ACRE							
40	158.2	161.6	156.2	158.7	181.7	201.4	197.6	193.6
36	162.9	189.7	170.7	174.4	179.8	196.5	193.9	190.1
30	155.1	156.0	155.7	155.6	198.6	205.4	208.8	204.3
24	164.6	190.1	181.9	178.9	183.5	196.4	199.2	193.0
20	165.3	159.1	152.3	158.9	191.4	201.2	201.5	198.0
18	161.8	194.6	188.9	181.8	176.8	197.5	199.2	191.2
L.S.D.								
(5%)	N.S.	13.7	14.1	9.4	N.S.	N.S.	N.S.	8.8
(1%)	N.S.	18.6	19.1	12.6	N.S.	N.S.	N.S.	N.S.
Mean	161.3	175.2	167.6	168.0	185.3	199.7	200.0	195.0

FIGURE 1—Early corn growth of 26,000 plants per acre show the fullest plant canopy at 20″ rows.

the surface of a corn crop penetrates this canopy. In many cases, 50% or more of this energy reaches the soil surface.

The soybean plant canopy is closed in comparison. Only 5% or less of the sunlight striking a mature soybean canopy reaches the soil surface.

PLANT GROWTH depends on four main inputs: sunlight, water, carbon dioxide, and minerals. So, any attempt at higher yields must consider the plant canopy and radiation distribution—how much to the plants, how much to the soil.

Peters of Illinois found 20-inch rows intercepted a little over 3 times more radiation than 40-inch rows at 15,000 plants per acre, 13 times more radiation at 30,000 plants per acre.

He also reported 1.4 times more radiation reached the soil surface in the 40-inch rows than in the 20-inch rows at 15,000 plants per acre, 2.2 times more radiation at 30,000 plants per acre.

It seems apparent that equidistant plant spacing in a corn field is needed to insure maximum use of solar energy by the plants and reduce the energy reaching the soil to evaporate valuable moisture.

This means corn spaced 18 inches in 18-inch rows would give 19,360 plants per acre and would be the most desirable planting system for a corn hybrid needing almost 20,000 plants per acre for maximum potential yield.

Although such planting systems are possible with present day equipment, many farmers are locked in on row arrangement by their harvesting equipment.

Much of today's corn harvesting equipment will work only 38 to 40-inch rows.

Planting corn in equidistant systems is probably not practical, because different hybrids do not perform uniformly under population stress. And many have different populations for maximum potential yields.

Also, many farmers use several

AND PLANT POPULATIONS—1976

3147			Variety	Spacing
18,000	22,000	26,000	Ave.	Ave.
182.1	203.8	200.2	195.4	182.6
203.3	214.3	220.7	212.8	192.4
205.0	218.0	210.7	211.2	190.4
203.4	216.7	231.4	217.2	196.4
187.2	221.9	214.2	207.8	188.2
214.6	221.3	226.9	220.9	198.0
N.S.	N.S.	18.4	11.9	5.9
N.S.	N.S.	N.S.	15.9	7.8
199.3	216.0	217.4	210.9	191.3

hybrids and different crops in their operations. So they must space rows best suited for their overall operations.

This raises a question very important to the farmer's decision-making process: How do different row spacings of different hybrids at different populations affect corn yield?

EXPERIMENTS at the Plant Science Farm near Knoxville and the Plateau Experiment Station at Crossville have sought some answers. All experiments received 150 lb N, 100 lb P_2O_5, and 100 lb K_2O per acre on a medium-testing soil with 6.2-6.5 pH. It was applied broadcast and disked into the soil before planting.

In **Table 1,** 1976 was a good corn production year. The average yields of the Pioneer varieties—168 bu/A for 3369A, 195 bu for 3145, and 211 bu for 3147—indicate the range of yields from hybrid selection alone in a good corn year.

Results from the annual variety testing program indicate similar relationships for full-season hybrids over medium-season hybrids as well as yield variations among hybrids with each group.

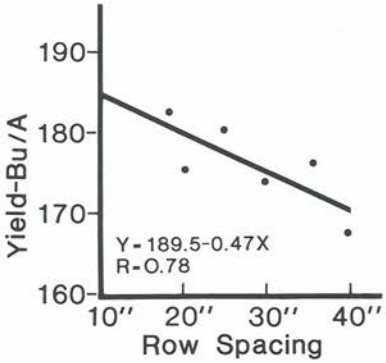


FIGURE 2—Average results for all 1976 trials show a corn grower might add a half bushel per acre for each inch he reduces between plant rows, from 40" down to 20".

The plant population results—182 bu/A for 18,000 plants per acre, 197 bu for 22,000 plants, and 195 bu for 26,000 plants—showed 22,000 plants per acre as the most desirable plant population for the hybrids evaluated during the 1976 production year.

These and other results suggest the 18,000 to 22,000 range to get the most out of good corn production on our good corn soils.

ROW SPACING generally determines plant distribution over the soil area. For example, 20,000 plants per acre in 18-inch rows is very close to equidistant planting, since the distance between plants in the row is about the same as the distance between rows.

But when corn is in 40-inch rows, distance between plants in a row is only 7.8 inches. This crowds plants. It often produces smaller stalks, smaller ears and generally more lodging as the plants tend to shade each other.

Distribution of plants over the soil determines how much incoming radiation the plants intercept—and thereby influences photosynthetic potential.

It also determines how much incoming radiation reaches the soil surface—and thereby evaporates valuable soil moisture.

In **Figure 1,** 26,000 plants per acre at early growth expose less soil to direct sunlight and intercept more radiation in 20-inch rows than 40-inch rows.

Higher yields came when the corn plants were more evenly distributed over the soil area, in these studies.

The highest average yield came from 18-inch rows—even where the yield levels approached 200 bu per acre. Average results for all 1976 experiments are presented graphically.

In **Figure 2,** average results for all 1976 trials suggest a corn producer might gain about one-half bushel per acre for each inch row spacing is decreased from 40-inch rows.

In **Figure 3,** the Pioneer 3147 that averaged 211 bushels per acre in 1976 gained two-thirds bushels of corn per acre for each inch the row width was decreased from 40 inches toward 18 inches, even at this high yield level.

THESE RESULTS indicate closer row spacings do increase yields from 5 to 15 bushels per acre, depending on the extent of row adjustment.

Many producers may not be able to change row arrangement due to an equipment "lock in." But the larger producer may want to consider equipment modification or new equipment to handle new row arrangements for higher yields. **The End**

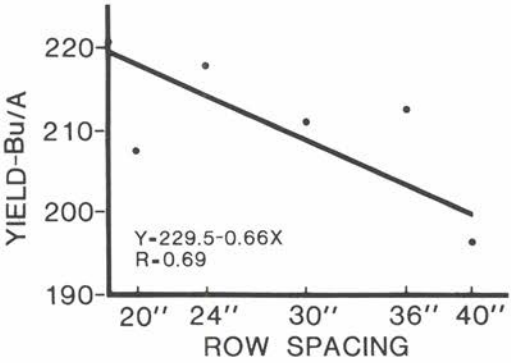


FIGURE 3—The Pioneer 3147 (averaging 211 bu/A in 1976) gained two-thirds bushels per acre for each inch researchers reduced between plant rows, from 40″ down to 18″.

FROM PAGE 22

weight than Larker.

Both varieties responded to 75 lb potash K_2O per acre, shown in **Table 3**—Coho less than required for a significant increase, but very close.

Other fertilizer combinations gave equally good, but not greater yields. Fertilizer treatments did not affect protein content and test weights.

Increasing P_2O_5 rate did not affect yield, protein content, or test weight of either variety. Increasing K_2O rates did not affect protein and test weight.

Larker barley yielded more than Coho, but Coho had the higher protein content and test weight.

Large potash applications near the seed will reduce stands. But the drill used in this study separated the seed from the fertilizer.

Even with 150 lb potash per acre, there was little evidence of seedling damage from fertilizer too close to the seed. Where drills do not separate fertilizer from the seeds, such damage may occur.

Lodging was not severe enough to cause harvest problems—when 50 lb nitrogen per acre was applied. **The End.**

The HUMAN Condition

Edwin Newman, an expert on clear writing and speaking, recently told the AP the less we have to say in a report the more we tend to package it—the more elaborate the package the less in it. We want to make what we do sound beyond the ordinary person's grasp. Certain words suggest special training is needed to understand it. In some so-called lofty fields, no one says "money." They call it "funding." That doesn't pinch like money—especially tax money. (swm)

APPLICATION RATES AND TIMES

Fertilizer Applied	Before Barley	Spring Topdressing	Before Soybeans
		Pounds Per Acre	
N	25	0, 50 & 100	0, 50 & 100
P_2O_5	0, 50 & 100	———	0, 50 & 100
K_2O	0, 50 & 100	———	0, 50 & 100

Make Double Cropping PAY OFF

ROY L. FLANNERY
RUTGERS UNIVERSITY

A HIGH-YIELDING, intensive land-use cropping system is a must for profitable farming with today's land values, taxes and capital expenditures.

Multiple-cropping vegetables and some double-cropping of small grain and soybeans have been used successfully in southern New Jersey.

We tested the possibility of double-cropping barley and soybeans as far north as Central New Jersey—on an area previously used for a wheat-fertilizer study.

Three N, P_2O_5 and K_2O levels were applied yearly to all 27 combinations of a double-cropping experiment with Barsoy barley and Williams soybeans. They were grown on a Freehold sandy loam soil.

Fertilizer rates and application times are shown above.

SOIL TESTS before the study showed all plots very high in phosphorus.

No K_2O was applied to the soil testing medium K. But 100 and 200 lb K_2O rates were applied to soils already testing high.

Table 1 shows some soil test examples before and at the end of the experiment.

The 200 lb K_2O/A was the only treatment still testing high after 3 years.

Soil pH values dropped 0.3 to 0.4 of a pH unit and magnesium levels dropped significantly during the 3-year cropping period.

Phosphorous levels in the soil were increased slightly at both fertilization rates.

Good fertilization is essential for double-cropping success. **Nutrients must be available throughout the growing season—because two crops are feeding at the table.**

SMALL GRAIN & STRAW YIELDS were most dramatically affected by nitrogen. **Table 2** shows the top five fertilizer treatments at each nitrogen level plus the check.

Potassium increased small grain and straw yields slightly.

Although 225 lb N/A produced top yields, severe lodging occurred. So the extra 6 to 12-bushel response to that last increment of N would not be recommended for small grain in the double cropping system. Potassium tended to reduce lodging.

GOOD SOYBEAN YIELDS can be successfully produced in the double-crop system of Central New Jersey.

Good fertilization combined with

Table 1—Soil Test Levels on the Double-Cropping Experiment

Fertilizer Rate			Soil Test Results: Before Initiation of Experiment				After Completion of Experiment			
N	P_2O_5	K_2O	pH	P	K	Mg	pH	P	K	Mg
				—Lbs. Per Acre—				—Lbs. Per Acre—		
25	0	0	6.3	303	105	595	6.0	248	43	365
125	0	100	6.1	295	168	590	5.7	274	112	368
125	0	**200**	6.1	284	**227**	522	5.7	300	**189**	311
125	100	0	6.1	315	124	564	5.7	326	81	388
125	200	0	6.1	362	119	536	5.7	398	72	321
125	100	100	6.1	320	171	570	5.7	327	129	377
125	200	**200**	6.2	344	**218**	512	5.7	360	**187**	226

Table 2—Three Year Average Small Grain and Straw Yields With Lodging Ratings

Fertilizer Rate*			Small Grain Yield Bu./A.	Straw Yield Lb./A.	Lodging Rating**
N	P_2O_5	K_2O			
—Lb./Acre—					
225	200	200	95.7	3310	2.25
225	0	200	91.3	3074	2.25
225	100	200	88.9	3165	2.50
225	0	100	87.1	2771	2.13
225	100	100	87.0	2783	2.34
125	200	200	82.7	2578	1.63
125	100	200	82.0	2615	1.50
125	200	0	81.7	2369	1.88
125	200	100	81.6	2664	1.25
125	0	200	81.0	2653	1.75
25	100	200	55.7	1689	1.00
25	100	100	54.2	1622	1.00
25	200	200	53.6	1641	1.00
25	200	100	50.3	1510	1.00
25	200	0	49.7	1495	1.00
25	0	0	37.2	1264	1.00

*One-half applied before small grain and one-half before soybeans.
**1 = slight or none; 2 = moderate with most picked-up with combine;
3 = severe with 50 to 100% lodged, some grain and straw not picked-up.

Table 3—Average Soybean Yields Following Barley in a Double-Crop System

Fertilizer Rate			Soybean Yields
N	P_2O_5	K_2O	
	Lb./Acre		Bu./Acre
125	0	200	43.3
25	200	100	43.1
125	0	200	43.0
125	200	200	42.9
125	100	200	42.3
125	0	100	42.0
125	100	0	38.7
225	200	0	38.6
225	0	200	37.8
225	100	0	37.5
25	100	0	37.3
25	0	0	36.5

Table 4—Pounds Per Acre of Plant Food Removed by Double-Crop Barley and Soybeans.

Yield/Acre:	Barley Grain 81.0 bu.	Barley Straw 2653 lb.	Soybean Grain 43.3 bu.	Total Lb/A
N	74	13	145	232
P_2O_5	35	7	25	67
K_2O	25	62	50	137
Mg	6	2	6	14

Table 5.

Crops	Yield Bu./Acre	Nutrients Removed (Lb./Acre) P_2O_5	K_2O
Barley	100	40	35
Soybeans	60	49	87
Corn Grain	180	70	48

right variety, row width, weed control, planting timeliness, etc. produced over 40 bu/A. **Table 3** gives the 6 best and 6 poorest yields from the 27 treatments in this study.

Potassium affected soybean yields the most. Top yields were obtained on plots testing high K and on plots receiving annual K_2O applications.

N and P_2O_5 affected soybean yields little, although highest N rate tended to lower soybean yields in the last year of the experiment.

NUTRIENT REMOVAL is heavy in a double-cropping system.

Plant tests were made of barley grain, barley straw, and soybean grain on selected treatments the final two years of the study.

To estimate how much plant food the double-crop system removed **(Table 4),** we used the most profitable treatment in the study **(Table 6)** and the two-year average nutrient composition from plant tests at these nutrient levels.

Compare the 67 lb/A P_2O_5 and the 137 lb/A K_2O this double-crop system removed with what high yields of three major crops removed in **Table 5.**

A double-cropping system demands more nutrients than any of the high yielding crops in **Table 5.**

Adequate, balanced fertilization is vital for BOTH crops to have enough nutrients for profitable production.

DOES IT PAY? All 27 treatments were economically tested, using 1975-76 average costs and prices.

Two treatments netted over $160 per acre **(Table 6).** Nine of the 27 treatments are shown, including the highest and lowest net returns per acre.

The economic tests showed this:

1. Adequate, balanced fertilizer applications each year increased net returns more than $100 per acre above the check (25-0-0). Or more than $10,000 return on a100-acre field.

2. The 125 lb N/A was most profitable. Table 6 shows the most profitable treatment for each N increment. Applying 125 lb N/A was $10/A more profitable than adding another 100 lb N and about $60/A better than the 25 lb N/A. Severe lodging at 225 lb N/A also favors 125 lb N/A.

3. Each N rate needed K_2O applications yearly for top profits, but not P_2O_5, on soils testing very high P_2O_5 and medium-to-high K_2O. Balancing 125 lb N with 200 lb K_2O increased net returns $20 per acre—or a little over 100 percent return on the K_2O investment.

Table 6—Net Returns From a Double-Cropping System

Fertility Rate N	P_2O_5	K_2O	Barley Grain Yield	Straw Yield	Soybean Yield	Gross* Return	Production** Cost	Net Return
—Lb./Acre—			Bu./Acre	Lb./Acre	Bu./Acre	$/Acre	$/Acre	$/Acre
125	0	200	81.0	2,653	43.3	474.86	307.81	167.05
125	0	100	78.5	2,440	42.0	457.80	296.52	161.28
125	100	200	82.0	2,615	43.0	474.30	319.67	154.63
125	0	0	72.3	2,197	40.0	428.54	282.15	146.39
225	0	100	87.1	2,771	40.7	473.82	315.70	158.12
225	100	100	87.0	2,783	42.2	482.86	328.35	154.51
225	0	200	91.3	3,074	37.8	470.88	326.20	144.68
25	100	100	54.2	1,622	41.5	389.84	282.55	107.29
25	0	0	37.2	1,264	36.5	318.68	254.00	64.68

*Crop prices used: $2.00/bu. barley grain; $6.00/bu. soybeans; $1.00/50 lb. straw bale.
**Costs used: $250/A. for fixed and variable costs plus:
$16.00/100 lb. N.
$12.00/100 lb. P_2O_5.
$ 9.00/100 lb. K_2O.
$.20/bu. harvesting & handling barley grain over the 37.2 bu. check.
$.40/bu. harvesting & handling soybeans over the 36.5 bu. check.
$.30/bale (50 lb.) straw over the 1,264 lb. check.

Table 7—Economic Analysis for 27 Treatments in New Jersey Double-Crop Experiment

Fertilizer Rate N	P_2O_5	K_2O	Barley Grain Yield	Barley Straw Yield	Soybean Yield	Gross Return	Production Cost	Net Return
Lb./Acre			Bu./Acre	Lb./Acre	Bu./Acre	$/Acre	$/Acre	$/Acre
25	0	0	37.2	1,264	36.5	318.68	254.00	64.68
125	0	0	72.3	1,197	40.0	428.54	282.15	149.39
225	0	0	80.4	2,704	39.9	454.28	304.64	149.64
25	0	100	49.6	1,545	40.6	372.90	268.81	104.09
125	0	100	78.5	2,440	42.0	457.80	296.52	161.28
225	0	100	87.1	2,771	40.7	473.82	315.70	158.12
25	0	200	49.3	1,533	40.3	371.06	277.55	93.51
125	0	200	81.0	2,653	43.3	474.86	307.81	167.05
225	0	200	91.3	3,074	37.8	470.88	326.20	144.68
25	100	0	48.4	1,410	37.3	348.80	269.44	79.36
125	100	0	75.9	2,341	38.7	430.82	297.08	133.74
225	100	0	80.9	2,715	37.5	441.10	315.85	125.25
25	100	100	54.2	1,622	41.5	389.84	282.55	107.29
125	100	100	78.2	2,434	39.5	442.08	307.42	134.66
225	100	100	87.0	2,783	42.2	482.86	328.35	154.51
25	100	200	55.7	1,689	41.0	391.18	292.05	99.13
125	100	200	82.0	2,615	43.0	474.30	319.67	154.63
225	100	200	88.9	3,165	42.3	494.90	340.07	154.83
25	200	0	49.7	1,495	41.3	377.10	282.81	93.29
125	200	0	81.7	2,369	39.4	447.18	310.69	136.49
225	200	0	84.1	2,903	38.6	457.86	330.05	127.81
25	200	100	50.3	1,510	43.1	389.40	293.74	95.66
125	200	100	81.6	2,664	41.1	463.08	322.12	140.96
225	200	100	84.0	3,011	41.0	474.22	340.64	133.58
25	200	200	53.6	1,641	39.8	378.86	302.86	75.96
125	200	200	82.7	2,578	42.9	474.36	331.54	142.82
225	200	200	95.7	3,310	41.2	504.80	353.86	150.94

A STRONG MESSAGE for 1977

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John Douglas, TVA

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