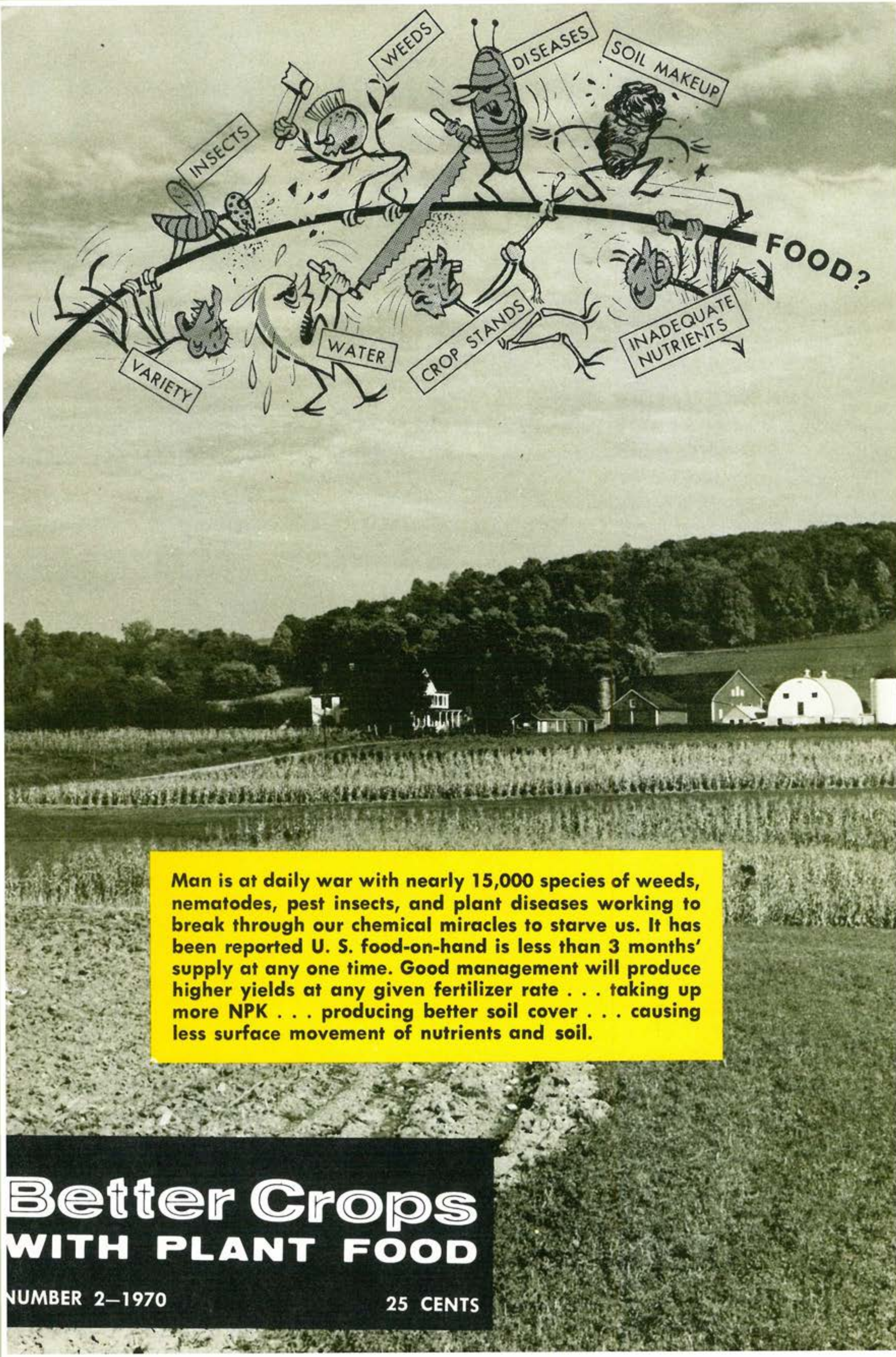


Man is at daily war with nearly 15,000 species of weeds, nematodes, pest insects, and plant diseases working to break through our chemical miracles to starve us. It has been reported U. S. food-on-hand is less than 3 months' supply at any one time. Good management will produce higher yields at any given fertilizer rate . . . taking up more NPK . . . producing better soil cover . . . causing less surface movement of nutrients and soil.

Better Crops WITH PLANT FOOD

NUMBER 2—1970

25 CENTS

TIPS FOR SUMMER STRESS

EVERY FARMER HAS PROBLEMS . . . and every field he works to supply American homes and industries has problems. But he keeps plugging away to make sure we have enough to eat and supply industries . . . thank goodness. The key—and hope—for any future is to control and prevent as many yield-robbing problems as possible. . .

- **Wrong hybrid or variety for a specific fertilizer-management program.**
- **Planting too late and incorrect number of plants.**
- **Wide rows that waste valuable sunlight.**
- **Diseases and pests at work on lush plants.**
- **Hidden hunger for nutrients often there but unable to get into plants.**
- **Lime placed wrong—or not at all.**
- **Pruned roots from careless cultivation, etc.**

Now—during the growing season—is the time to trouble shoot. The facts you find may not help you this year but will help you adjust for a champion year next season. Top farmers trouble shoot during summer stress.

1—What is HIDDEN hunger, exactly?

Say you FERTILIZE for 110 bushels of corn but MANAGE everything else (seed choice, planting date, etc.) for 150 bushels. You can lose 40 bushels to HIDDEN hunger. Top farmers prevent it by fertilizing according to soil and plant test findings—and often beyond them! They maintain STRESS-SURE fertility to feed a crop all it needs at *every* stage of growth.

2—Will FULL fertilization insure me against average yields?

No, sir. Well fertilized crops sometimes produce half or less of what they are capable of giving you. It can happen when you use the wrong hybrid or improper plant spacing or poor pest control or any ONE practice that puts HIDDEN BRAKES on fertility. A good researcher carefully watches ALL factors when working to improve just ONE factor. So does a good farmer. Forty or 50 bushels per acre MORE is worth it. This is what trouble shooting is all about.

3—If my soils test high in a certain nutrient, should I add more of it?

Many do. Most labs label a soil "high" not because of super-high conditions, but because odds point to little response to applications of that nutrient *that year*. Top farmers REMEMBER the heavy appetite of some crops and the hazards of soil environment. A certain P test may be "high" for corn but "low" for potatoes. A certain K test may be fine UNTIL soil conditions (too cool, too wet, too dry, too compacted) restrict root reaching or aeration. Potash rate can go from "high" at the start to "medium" at the end of just one season after cutting 6 tons of alfalfa hay—like a gas gauge from "full" to nearly "empty" on an auto trip.

4—Why does my advisor or test lab want a complete management record?

Because many things besides fertility can affect chemical composition of plant parts. Increasing stand or heavy weeds may pull down leaf nitrogen. Very dry

TO COVER 3

A complete set of these Trouble Shooting Tips (20 answers to key questions) are available in a kit offered on cover 3.

Better Crops
WITH PLANT FOOD

Published Quarterly by
The American Potash Institute Inc.

1649 Tullie Circle, N.E.
Atlanta, Georgia 30329

Santford Martin, Editor
Selma Bushman, Assistant Editor

Vol. LIV/2/70

$1.00 per year, 25¢ Per Copy

Controlled circulation postage paid at Washington, D. C.

CONTENTS

Feeding a HUNGRY WORLD

We U. S. agricultural scientists may be biased—after 40 years of being associated not with crop and livestock famine, but with surpluses that have often glutted the market.

Dare we be optimistic about world food hopes for the 1970's, the '80's, and even the '90's? Fear has always created more headlines than hope. But hope must win.

Out of dark corners, birth control now receives open discussion. Could it go too far in the U. S.? Will our pills, IUD's, etc. "control" us into stagnation?

Every time production goes up—on a tiny farm in Bolivia or a huge U. S. ranch—prices go down and the grower asks, "Why produce more?" Who knows the ceiling if profits were there?

EDITOR'S NOTE: Many scientists paint a bleak picture of food resources in the future of man. We see the alarm almost daily in the press. Dr. Georg Borgstrom, world-respected biologist now of Michigan State University and formerly of Sweden, discussed the impending food crisis at exercises launching a new biology building and professorship at Georgia Southern College. When they invited the Michigan author of THE HUNGRY PLANET and TOO MANY, they also invited the president of the American Potash Institute, J. F. Reed, to give technology's reply to Dr. Borgstrom's lecture on "Man and Nature on Collision Course." The following article contains much of Dr. Reed's reply.

FOR THOUSANDS OF YEARS man has worked and prayed for food enough to keep himself alive and well.

In some parts of the world, food has always been available to those who would work for it. In other areas famine has been a constant threat and the people have faced starvation and suffered malnutrition repeatedly.

As far back as 1798, economist Thomas Malthus theorized that mankind is doomed to hunger "because population grows faster than food production." This theory has been quoted through nearly two centuries—proclaimed in one decade, condemned in another.

This seems to be one of the "proclaiming" decades. Many scientists today cite facts to prove that mankind is on the threshold of famine. The issue is serious; it demands our best study, planning, and action; it must be examined from ALL angles.

AS AN AGRICULTURAL SCIENTIST I must confess bias. For forty years, I have been closely associated not with crop and livestock shortages, but with surpluses that often glutted the market.

Except for a short time during World War II, farmers, economists, politicians of all parties, and agri-business leaders have wrestled with these surpluses—not only in America, but in many developed nations of the world.

Just five years ago, American farmers were challenged to cope with a critical shortage of wheat looming just over the world's horizon. As usual, they went to "coping" immediately.

Today the world talks of a wheat glut! In five years, world wheat production has risen 21%. Surplus stocks have risen to 60 MILLION TONS in four main exporting areas. And prices have collapsed. Don't talk to a Canadian or a western U.S. wheat farmer about the need for more wheat!

Surplus wheat and rice—cotton and corn—beans and butter—eggs and milk—embarrass scientists and politicians alike. Even worse, they depress prices and frustrate the producer. Powdered milk stocks have doubled since 1962.

Let's see if there are reasons to be even a little bit optimistic about world food hopes for the 1970's, the '80's, and even the '90's. We face a population explosion. Indeed, we are in the midst of one! Very few land areas are still unopened. Dare we be optimistic? Fear has always created more headlines than hope. But hope must win.

The world produces 3 times the protein and calories it needs, but suffers mammoth protein hunger. FAO's new war on waste (in milling, storage, etc.) will help.

Water problems boil down to usable quality. Adding 135,000,000 irrigated acres to the world between 1962 and '85 would cost $37 billion—a year's budget for the Vietnam war.

THE WORLD IS WAKING UP to the stark realities of the population-food race. Well-fed people who see supermarkets bulging with food and storehouses loaded with surpluses are not easy to sell on world food problems of tomorrow. But they will act when the occasion demands.

Well-written, well-documented books—*The Hungry Planet, Too Many*—have rightfully convinced millions in the well-fed nations, now struggling with surpluses, that we must plan NOW to feed as many MORE people as we now have in the world. In two years, world numbers will increase by an amount equal to the entire population of the U.S.! Recognizing there IS a problem is the first step to victory.

IS ANY PROGRESS BEING MADE in population control? We should be encouraged. Out of the dark corners, birth control now belongs to open discussion.

Not only the sophisticated groups of the developed nations, but also the hard worked, uneducated masses in the developing nations face this issue—more every day. It's not easy to sell in some areas, true. But great progress has been made in just a decade.

We might even ask, "Could population control go *TOO* far in some of the developed nations?" The U.S. birth rate per 1,000 had dropped for the 10th consecutive year by 1969. Population is now climbing less than 1% in developed areas, over 2.5% in developing areas.

Some groups now recommend "zero growth rate" in the U.S.—as an example to the world. Perhaps we in the U.S. should beware lest we become *TOO* adept with our pills, IUD's, and liberal abortion laws.

AND DON'T FORGET POPULATION explosions presume no nuclear war and continued victories over disease. A recent *Wall Street Journal* head declared, "Science Loses Ground in War Against Disease in Impoverished Lands."

They do not exaggerate. Malaria is on the climb again. Malaria, trachoma, and schistosomiasis now infect 800,000,000 people—almost 25% of the world. Optimism for controlling these three cripplers has faded.

An authority on schistosomiasis recently said he could sum up the present fight against schistosomiasis in one word, "Hopeless."

THE GREEN REVOLUTION—that's what the technological advances of modern agriculture have been labeled. Many of its accomplishments stagger the imagination. They seem to belong almost to science fiction.

This revolution has created and combined new crop varieties, agricultural chemicals, and redesigned agricultural practices to increase food production dramatically, and offer a glimpse into how great the potential really could be.

For years, well-trained agricultural scientists, biologists, engineers, and geneticists have been kept under wraps in the developed nations. Why shoot for greater production when price-depressing surpluses plagued the nations where many of these scientists worked and lived.

I don't believe anyone really knows what an all-out effort would really do for our food supply.

What sparked this GREEN REVOLUTION? New high-yield wheat and rice varieties played a big role. Less developed nations have adopted them more rapidly than even the most optimistic could predict.

LOOK AT THE WHEAT. Less developed areas are planting large acreages. Lester Brown reports in his *New Era in World Agriculture* how India imported 18,000 tons of new high-yield seed from Mexico in 1966.

Mexico had been an importer of wheat before 1964. This 18,000 tons produced enough seed for Indian farmers to sow 8.6 million acres by 1968.

In 1967, Pakistan imported 42,000 tons of Mexican wheat, sowed 1,655,000 acres, and now has enough seed to plant its entire wheat area with high-yielding Mexican wheat.

LOOK AT THE RICE. In less than a decade, science has essentially redesigned the architecture of the tropical rice plant. New high-yield varieties have evolved, along with a whole new set of yield-boosting practices.

By 1968, about 5% of the rice area in South and East Asia—4,000,000 hectares—were planted to the new varieties. From about a $20 million investment in rice in 1968 alone, the world's rice farmers realized 400 million U.S. dollars return, the Rockefeller Foundation estimates.

But in another way, the new varieties and improved practices have produced the same old discouraging problem. World rice prices had been slowly climbing as population pressures built up—until 1967. Then surpluses appeared, forcing a drift in rice prices.

Annoying surpluses now appear in Asian nations looking for an export market. Japan has had to limit rice production—may even allocate over 1 million tons of its 1969 production for sale as feed. We read of a 6 million ton surplus of rice in Japan, much of which is rotting.

And here lies one of the great obstacles to world increased food production. So often when production goes up—whether on a tiny farm in Bolivia or a huge U.S. ranch—prices go down, and the grower asks, "Why produce more?" Who knows the ceiling if profits were there?

LOOK AT SOYBEANS. The world needs new and better sources of protein. More fish or livestock (or synthesized amino acids!) are not the only answer. Higher yields of higher-protein crops will play a big role tomorrow.

Soybeans offer much hope. The world's increasing recognition of this crop has been fabulous during the past 40 years. The U.S. produced less than 5 million bushels in 1925—but 840 million bushels 40 years later!

Today scientists are developing high-yield soybeans with lots of protein. A good farmer can produce 2 tons of protein per hectare. What would happen if high-protein varieties were developed for the hungry areas of the world?

This is not a dream. The FAO and the International Atomic Energy Agency are working right now to increase world supply by this method. Not long ago world scientists discussed new breeding approaches for improved plant protein in a meeting in Sweden.

Such progress in wheat, rice, and soybean production are not isolated events. Look for similar work in maize, barley, sorghum, and livestock in the future.

WHAT ABOUT THE CALORIE-PROTEIN QUESTION? Scientists consider protein deficiency a far bigger problem than calorie hunger. As rice, wheat, and other food sources increase, the world's calorie needs may be more easily met than its protein needs.

We may tend to overstate daily calorie requirements. With proper mineral, vitamin, and protein intake, many nutritionists now suggest a lower daily calorie requirement than we once thought needed. This considers the more sedentary occupations of modern man.

A short term way to keep protein production up with population might be through animals that reproduce rapidly—pigs and poultry, in contrast to cattle. Japan's poultry production was up 19% in 1969. But the ruminant animal is an amazing converter and will be serving man for a long time.

Animal protein will be supplemented and substituted in the long run by more vegetable protein from higher-yielding, higher-protein soybeans, from high-lysine corn, etc.

WHY DOES THE WORLD PRODUCE THREE TIMES the protein and calories it needs but still suffers widespread protein hunger? Waste, according to Dr. Parpia, Chairman of the Protein Advisory Group set up by UNICEF, WHO, and FAO.

Food is wasted at all stages—from production to consumption. This drains hard on cereal grain, legumes, and oil seeds which provide much of the protein and calories in many less developed areas.

India stores and consumes over 70% of its food in rural areas. They lose almost 17 million tons of food supplies containing nearly 3 million tons of protein in storage, handling, milling, etc.

Reducing, if not eliminating waste could help bridge the protein gap between today and tomorrow. It would also boost per capita income of the nations.

How do we reduce waste? Build storage facilities that keep out insects and rodents and resist biological deterioration. People pay fantastic storage prices when they lose millions of tons to poor facilities.

FAO has declared a "War on Waste." This could increase the world's food supply by saving more of what it now produces. The total saving may astound us, if the people can win this war.

WATER PROBLEMS BOIL DOWN TO QUALITY—water of usable quality at the right place at the right time. Anyone considering the food production capacity of the world must run up against the limitations imposed by lack of water. Much of the world's land area is dry either most of the time or for a period long enough to limit yields.

Some steps are now being taken to cope with this. The indicative World Plan proposes to increase the irrigated harvested areas in Asia from 72 million to 139 million hectares by 1985 at a cost of U.S. $37 billion.

So, possibilities of increased production are there, if there is better use of the world's water. But this is expensive. Who's going to pay for it? Thirty-seven billion dollars! Why that's almost as much as it costs to wage war for a year in Vietnam. It all depends on where the world decides to place the emphasis.

ABUNDANCE WILL NOT SOLVE EVERYTHING. We might control population. We might insure plenty of food. But we will still face the ageless question: "How do we feed those who are hungry or malnourished but do not eat because they lack the land, work, or money?"

Even if it is successful in food production, the benefits of the Green Revolution must be shared by many to make it really effective. Too many will be bypassed. The benefits to those in the city slums so often are absent or obscure.

This is not a production or population problem at the moment. It's part of the riddle that has faced mankind for generations. Why must there be starvation in a world of surpluses? A few men have had the courage to wrestle this problem through the years. Some are still trying—neither greedy nor impractical men, but incentive builders doing their best to create businesses and programs that reward men fairly for their efforts and stimulate the better side of man's nature.

Some people call it incentive. Some call it initiative. Some call it recognition. Some call it profit. I believe farmers can produce what the world needs for a long, long time IF they have the incentives to do so.

And incentive means reasonable profit. We need a system of fair profits for the man who sweats out biological and meteorological hazards to get food to us.

Will we have enough to feed us in the future? Will the agricultural express use the power it has never unleashed? It has scientist-conductors gripping the "go-cord" for a chance to shoot for "moon-high" yields. It has farmer-passengers eager to earn a better return from those higher yields.

Yes, there will be hunger and malnutrition in the future. There has been in the past. Thousands of years ago Joseph told Pharoah, "There shall be seven years of famine and the famine shall consume the land." **And the Egyptians made plans.**

Today's world can forestall *mass* famine if it decides to re-align its priorities. We must learn to build the world with the marvelous tools that science has made available, rather than blow ourselves up with these same tools.

THE END

Irrigated Alfalfa Depletes POTASSIUM In Sandy Soils of S.E. Kansas

HAROLD E. JONES
KANSAS STATE UNIVERSITY

COMMERICAL CATTLE feed-lots and increased irrigation have stimulated much interest in alfalfa production on the sandy soils of south central Kansas.

These soils cover a big area. They were formed mostly from wind re-worked outwash materials. They have nearly neutral surface soil pH's and base exchange capacities of less than 10 me per 100 grams of soil. They have not generally responded to potash fertilizers under dry land conditions.

Under irrigation, with yields of 7-8 tons per acre of alfalfa hay, the available potassium status of these soils changes rather rapidly.

Soil tests from D. L. Barngrover's farm at Kinsley show how quickly alfalfa can reduce potassium levels. Barngrover, one of the earliest in the area to go into irrigated alfalfa production, had noticed a definite decline on his older alfalfa stands.

When the fields were inspected in September, 1969, they did not show visual symptoms. But soil tests for potassium did reveal the reduced potassium supply, as the table shows:

Phosphorus levels appear to have been reduced also. One irrigated field on another farmer's place tested as low as 66 lbs. of exchangeable K.

This spring 80 lbs. of potash (K_2O), as well as more phosphate, were broadcast on the fields that were planted to alfalfa in 1961, 1962, and 1963.

Research plots on both newly seeded and old alfalfa stands are being established at four sites in the area. Close attention apparently needs to be given to future potash demands of these soils under irrigated conditions.

Soil Tests, D. L. Barngrover Alfalfa Fields, Sept. 1969

Year Alfalfa Planted	pH	Organic Matter %	Extractable P Lbs/A	Exchangeable K Lbs/A
1961	6.9	0.8	4.4	136
1961	6.9	0.8	5.2	144
1962	7.1	0.7	7.0	152
1963	7.2	0.4	15.3	148
1967	7.2	0.8	29.7	248
1967	7.1	0.6	21.0	217
1967	6.9	0.6	23.6	244
1969	6.8	0.5	11.4	248

TABLE 1—ASPARAGUS YIELDS (6-YEAR AVERAGE)

	Yield, Lbs./Acre		
Annual Nitrogen Rate:	**No. 1**	**No. 2**	**Total**
50 lbs./acre	1842	1026	2868
100 lbs./acre	1930	996	2926
LSD 0.05	N.S.	N.S.	N.S.
Phosphorus Soil Test Level:			
Low (5-15 lbs./acre)	1762	1156	2918
Medium (20-30 lbs./acre)	2136	1186	3322
High (50-60 lbs./acre)	2062	1064	3126
LSD 0.05	355	N.S.	396
Potassium Soil Test Level:			
Low (50-75 lbs./acre)	1404	862	2266
Medium (150-175 lbs./acre)	2142	1143	3285
High (225-250 lbs./acre)	2164	1286	3440
LSD 0.05	376	236	409

K PLAYS BIG ROLE . . .

Top-Yield ASPARAGUS Program

ROY FLANNERY
RUTGERS STATE UNIVERSITY

PRODUCING ASPARAGUS would be much simpler if all soils contained the right amounts of all essential elements in forms available for the plant to use. But most asparagus soils in New Jersey must be supplied annually with nitrogen, phosphorus, and potassium and periodically with magnesium, calcium, and boron for maximum production.

Asparagus soils should be maintained at about 6.5 pH. Soils with lower pH values should be limed. Soil test summaries for the past 10 years indicate about ⅓ of New Jersey's asparagus soils need lime. About ⅕ of our asparagus fields are too low in magnesium for most best production.

Where magnesium is needed, supply it by dolomitic limestone on low pH soils or by fertilizer containing soluble magnesium such as sulfate of potash magnesium or keserite on soils where lime is not needed.

Soil test summaries also show about 80 percent of the soils high in phosphorus, but only 50 percent high in potassium. Barely 30 percent of the asparagus are properly balanced with these vital nutrients for top production.

HOW DO N RATES and maintained P-K soil test levels affect asparagus yield and quality? Table 1 shows average yield for the third through the eighth harvest years of one study on Aura sandy loam soil.

Raising N rates from 50 to 100 lbs. per acre did not increase asparagus yields much. But raising P-K soil test from low to medium significantly boosted No. 1 size spears and total yield.

Potassium affected asparagus yields the most in this study. Where soil test K was raised from low to medium, average annual total yield of asparagus spears climbed 1,174 lbs. per acre.

Yields on high potassium soil ran higher than those on the medium potassium soil, but not significantly higher for the six harvest years reported for this study.

MANY FARMERS ARE LOOKING to higher plant populations for better yields. As they shift to higher populations, how should they change their fertilization program to get top-profit yields?

An 8-year experiment studied two plant populations grown on Aura sandy loam soil maintained at low, medium, and high

Table 2. Row Spacing, Nitrogen Fertilization Rates, and P-K Soil Test Levels Affect Asparagus Yields.

Nitrogen Fertilization Rate, Lbs./A	Spear Yield, Lbs. Per Acre					
	8-inch Spacing [1]			16-inch Spacing [1]		
	No. 1	No. 2	Total	No. 1	No. 2	Total
50	1950	1231	3181	1876	941	2817
100	2032	1222	3254	1906	956	2861
LSD 0.05	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Soil Phosphorus Level, Lbs./A	**Spear Yield, Lbs. Per Acre**					
	8-inch Spacing			**16-inch Spacing**		
Low (5–15)	1846	1224	3070	1821	956	2777
Medium (20–30)	2082	1309	3391	2096	982	3078
High (40–60)	1941	1221	3162	1762	921	2683
LSD 0.05	226	N.S.	302	238	N.S.	286
Soil Potassium Level, Lbs./A	**Spear Yield, Lbs. Per Acre**					
	8-inch Spacing			**16-inch Spacing**		
Low (50–75)	1542	1061	2603	1608	886	2494
Medium (150–175)	2276	1258	3534	1986	963	2949
High (225–250)	2250	1321	3571	2142	976	3118
LSD 0.05	256	195	328	215	N.S.	316

[1] Equivalent to 13,200 and 6,600 crowns planted per acre respectively.

levels of phosphorus and potassium.

Two nitrogen rates were applied yearly for each plant population and soil test P and K. Table 2 shows harvest years 3 thru 8.

Doubling plant population from 6,600 plants to 13,200 plants per acre significantly increased yield of total and No. 2 size spears. But No. 1 size spears changed little in yield.

Higher plant population did not seem to demand higher soil fertility level to get top yields in this study. The higher plant population evidently was better able to use nutrients available in the soil.

Increasing annual N rate from 50 to 100 lbs. per acre did not significantly improve asparagus yields at either plant population. Combining 100 lbs. N with medium to high P-K soil test levels raised yields slightly.

But raising P-K soil test level from low to medium boosted No. 1 spears and total asparagus yield significantly. The greater part of this increase was in No. 1 or better quality spears.

Changing potassium soil test level from low to medium improved asparagus yields more than soil-phosphorus or nitrogen applications.

A GOOD FERN OR BRUSH growth of asparagus following spring harvest is essential for next year's production. Their food is manufactured in the top and translocated and stored in the crowns for next spring's production. Thus, good, healthy brush growth is essential for top production the following year. Soil potassium boosted brush growth.

Based on these studies and farmer experience, we now recommend for asparagus cutting beds 70 lbs. N, 140 lbs. P_2O_5, and 210 lbs. K_2O per acre per year.

For asparagus beds four or more years old, on high fertility soils, this recommendation is reduced to 50-100-150 lbs. N-P_2O_5-K_2-O. Most asparagus soils in New Jersey need 2 lbs. of boron per acre every three years.

These recommendations are based on average asparagus soil conditions and are often adjusted to soil test levels for individual fields. **THE END**

The next time your newspaper pictures them—today's more radical militants luring bright young idealists toward violence—take a close look.

They look remarkably well fed—for admitted "revolutionaries."

Among their placards that say DOWN with so many things, maybe one should say UP with American agriculture.

A few years ago, most of them would have been getting the fields ready to plant about the time the Kent State tragedy happened. If they had forsaken those fields, millions of people —including themselves—would have gone hungry.

What happened? A nationwide system of agricultural colleges converting farm boys into remarkable scientists and specialists . . . that's what happened.

Two blades of grass where one once grew . . . three fat ears of corn for a single chaffy one . . . thousands of automatic harvesters for a handful of mules . . . that's what happened.

And a single man producing the food that 42 men once sweated out of the land . . . that's what finally happened.

Forty-two men freed to go to town to cure polio and TB . . . to create countless businesses and professions.

Freed to write humane laws that brought social security to old people, drudgery-lifting electricity to remote homes, minimum wages a man can pay you and maximum hours he can work you.

Freed to provide thousands of educational grants for worthy students without a dime to go on.

And more recently, some freed to sneer not only at the evils in their heritage, but often at its remarkable strides—so violently that they try to burn it down and urinate on the embers, so hatefully that they label the memory of FDR or Stevenson or Ike "a Neanderthal square."

The thousands of sincere idealists marching behind the handful of shouters will find few, if any, agricultural students and teachers among the shouters.

Why?

Not because the agriculturist does not dream of better things for the world.

But because he has marched before . . . into Auburn and Purdue and Cornell . . . out of small valleys and sweeping prairies . . . with no money . . . no contacts . . . no fancy urban high school education to "lay on them."

Into Clemson and Kansas State with what today's softly affluent youngsters would call good reasons to be "up tight."

Out of a boyhood of hard work when a dime to see "The Trail of the Lonesome Pine" in a skinny little theatre was luxury . . . when oatmeal from 100-lb. sacks and milk from a borrowed cow gave strength to send his plow zinging through the loam . . . when a ride to town on Saturday afternoon was more of a gift than a right.

After he arrived at Illinois and Michigan State, he could easily have resented the establishment.

Instead, he found a place to sleep in a sub-basement so he could deliver milk before dawn.

He could have sneered at the inequities.

Instead, he found some tables he could serve in a boarding house for three meals a day and still make his afternoon lab if he ran fast enough across that long campus.

He could easily have "flaked out."

Instead, he spent many late hours running chemical tests in a soils lab, recording data for an economics office, and tutoring a blind student—a thousand hours a year in jobs to keep himself in college.

He could easily have envied —and hated.

Instead, he found a small church to which a young country man could carry his faith each Sunday—a stumbling, always imperfect man faithfully trying to do right.

He could have complained

and petitioned against certain studies.

Instead, he chose to master them—and to graduate with one of the highest records in the university's history on his way to a doctorate.

He could have fanned the youthful fires of discontent in his students as a department chairman at the university.

Instead, he taught them firmly but fairly not to whimper and whine, but to study and learn and eventually shine as mature minds—forever encouraging the underdogs who early sensed this tall country man understood their feelings out of his own past. They awarded him every honor at their command.

He could have adapted himself to secure university presidencies that were dangled in front of him.

Instead, he chose not to break his country man's spirit—that strong mixture of self-respect, human sensitivity, and stubborn independence rural men have brought out of their meadows for centuries.

He chose to continue to walk tall and free enough to champion the agriculture that had sired him—especially now when many say its influence is dead.

He laughs at that idea. Let those who preach it miss a few meals and agriculture would become history's liveliest corpse.

It's not the future of agriculture that worries him, but the future of advanced education. Will it become a corpse?

Typical of such leaders is Dr. E. T. York, University of Florida's Provost for Agriculture, who says he has "never seen a time when higher education commanded such low respect from the public and legislative bodies that must support it."

Dr. York has led the faculty and students of his Institute of Food and Agricultural Sciences in supporting their president's efforts to keep the university open for students who want to keep learning.

He has no quarrel with proper dissent, he said. But he deplores protests that yell free speech only to shout down honest answers . . . that burn buildings and make impossible demands on educators . . . that bring bloodshed to communities of reason.

"Burning is not the only way to destroy universities," he warned. "They cannot survive without sympathetic understanding of their supporters."

By "supporters," I presume he means the state legislatures that supply tax money to keep the state universities going. Maybe the men we elect to make our laws and appropriate our money are getting fed up with the way a few groups abuse those laws and funds.

The tragedy—the greatest tragedy—will come if programs led by men like York are penalized along with the irresponsible shouters.

Freedom to shout is a very delicate right, I realize. Keeping ahead of our food needs is more than a right—it's a necessity. And only the scientists and students of agriculture can keep us ahead.

Visit your state's agricultural college sometime. You'll find there men more given to action than rhetoric.

Men filling young minds not with atheistic garbage that leads to a tyranny too hideous for the young to see, but with ideas to improve the everyday lives of ALL people in this remarkably diverse democracy.

You'll find there men advising growers who manage more capital than most businessmen . . . men who like sunshine and open collars and a soaking rain in August, but not droughts or dandy dressers or weeds.

You'll find there men searching for more than food and fiber, for ways to stem the tide of helpless humanity into suffocating cities, for ways to use our shrinking acres more wisely.

Men teaching young minds not to hate and burn, but to hope and build—and, many, to enjoy the sweat of their brows.

You'll find there men whose work carries them down long, lush rows, far removed from intellectual palaver, but very close to the land and nature and the Master of it all.

Such men lead young people in the right direction. No state legislature should forget this.

THE END

SUCCESSFULLY . . .

Fighting STING Nematode

J. FRANCIS COOPER
GAINESVILLE, FLORIDA

SOME LEADING PASTURE and hay grasses of the Southeast, especially in certain sandy soil areas, have been plagued by yellowing and little or no growth except during hot summer months.

In a search for the cause, investigators have applied iron and other nutrients to no avail.

During summer, 1969, Florida Agricultural Experiment Station researchers, Drs. F. T. Boyd and V. G. Perry, pinpointed the sting nematode as the culprit. It was destroying the feeder roots of such desirable grasses as Pensacola bahia, Coastal bermuda, and pangola.

The sting nematode is a very small, eel-like animal almost too small to be seen by the naked eye. It attacks primarily the tips of roots, destroying practically all feeder roots of susceptible plants.

Since the South's cattle industry depends largely on grass as cheap feed, the depredations have been and are a serious factor.

THE SCIENTISTS MADE the further startling discovery that the sting nematode attacks grass roots in the top six inches of soil only when the soil temperature one inch below the surface is below 103 degrees Fahrenheit. When the soil temperature reaches 103, the pest either goes to deeper and cooler climes or is inactivated by the heat.

Dr. Perry cautions that the sting nematode is not the only one attacking grasses in the Southeast.

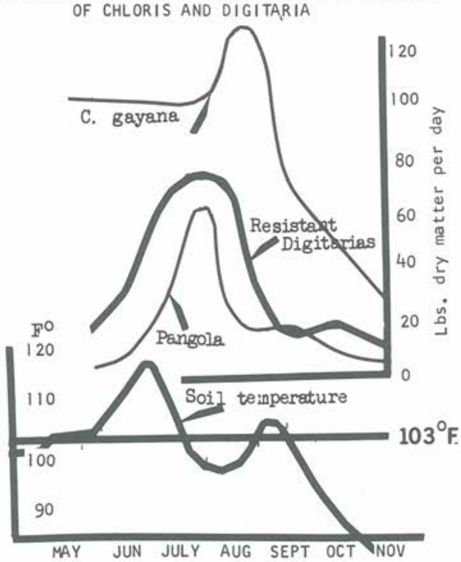
In spring, 1969, Boyd planted a number of different grasses in a forage grass evaluation study at Gainesville, Florida. There were marked differences in yield among the varieties and strains. Strains resistant to the sting nematode making satisfactory growth all spring, summer, and fall, while susceptible kinds flourished mostly in hot summer months.

Table 1 shows yields of six resistant and 10 susceptible grasses tested on the Agricultural Experiment Station's agronomy farm during summer, 1969. Plots were 1/1245 acre in size. Three fertilization rates, applied July 7 and August 14, were compared.

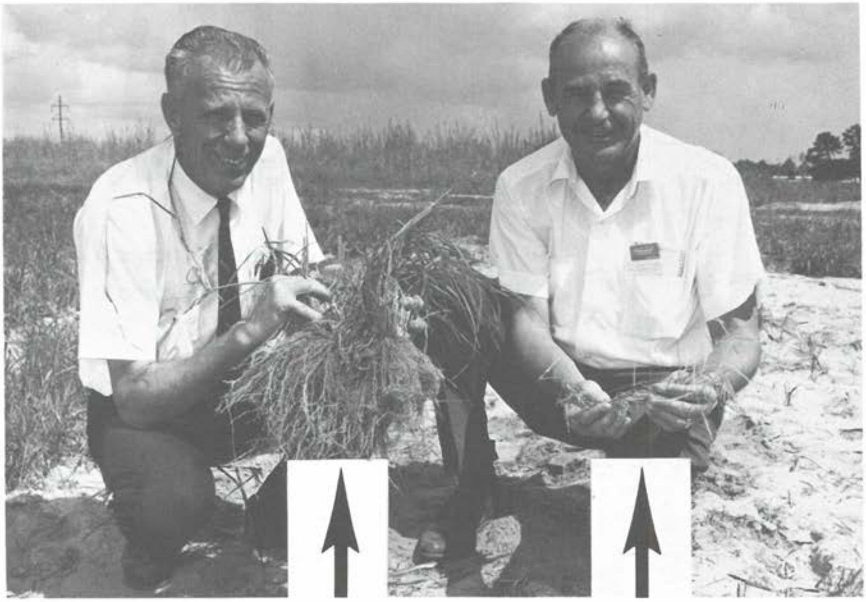
THE LOW RATE included a total of 200 lbs./A 12(N)-4(P)-8(K)-0.5(Cu)-0.5(Mn.)-0.25(Zn)-0.10(B) for the two applications. The medium rate was twice that—400 lbs./A. The high rate was four times that amount—800 lbs./A.

Fortunately, Boyd found some good

SEASONAL SOIL TEMPERATURES AFFECT PRODUCTION OF CHLORIS AND DIGITARIA



When Dr. Boyd charted three grasses, growth increased materially right after soil temperature passed 103 degrees. Chloris grasses were his highest yielders in 1969.



RESISTANT CHLORIS **SUSCEPTIBLE CHLORIS**

Two strains of Chloris grass show effect of resistance to the sting nematode. Both strains are the same age. Dr. Boyd holds the susceptible strain, Dr. Perry the resistant strain.

grasses that resisted the nematode at Gainesville:

Paraguay 22, with seed presently available, is vigorous and shows some resistance.

Coastcross 1 bermuda, developed at the Georgia Coastal Plain Experiment Station and released in recent years, is vigorous, highly digestible, and has some resistance. Its principal drawback is a weakness to attack by certain leaf diseases in conditions of high moisture.

Vegetative planting material is commercially available.

Slenderstem digitgrass just released by the Florida Station for planting central and southern Florida, has excellent growth and feeding qualities as well as nematode resistance. But it is not cold-tolerant.

The agronomist found more than 100 kinds of grasses susceptible and around 36 resistant in the Gainesville plots.

A number of strains of Chloris species have shown up well, and several of them show promise of being cold-resistant, nematode-resistant or tolerant, high yielding, and nutritious.

Boyd hopes some of them will be worth releasing after further tests. He hopes they will apply widely to this Southeast problem. **THE END**

TABLE 1—Fertility Response of Nematode-resistant and Nematode-susceptible Tropical Grasses When Harvested at Tri-weekly Intervals.

	Low Fertility	Medium Fertility	High Fertility
Resistant Varieties	Tons Dry Matter per Acre		
Digitaria 601	2.53	3.72	3.86
D. X 125-1	2.38	2.58	3.73
Slenderstem digitgrass	3.01	4.10	3.33
D. gazensis	2.19	3.66	2.53
Coastcross	1.80	1.92	2.68
Bermuda 52	2.09	2.72	3.02
Average	2.33	3.12	3.19
Susceptible Varieties			
Stargrass	2.43	2.17	2.64
Ethiopian bermuda	1.83	2.36	2.60
Coastal bermuda	1.90	1.49	2.62
D. X 124-4	1.70	0.78	2.46
D. pentzil 602	2.07	1.56	2.27
Tannergrass	1.75	1.94	1.89
Pangola	1.11	1.18	1.67
Hemarthria 93	0.49	0.35	0.62
Hemarthria 94	0.70	0.21	0.40
Hemarthria 95	0.75	0.65	0.76
Average	1.46	1.27	1.79

Gainesville, Fla., 1969

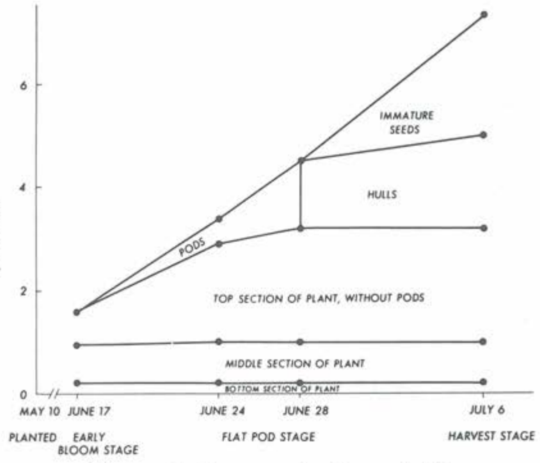


Figure 1. Increase in dry weight per pea plant

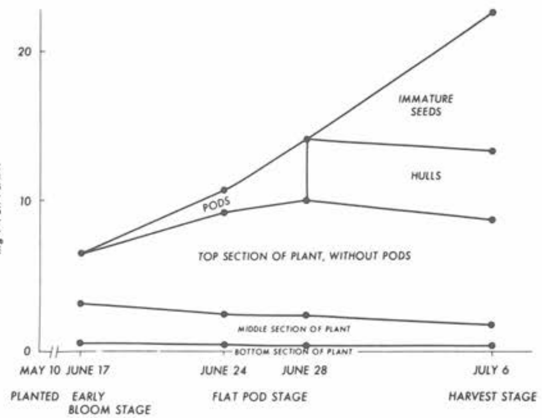


Figure 2. Uptake of P per pea plant

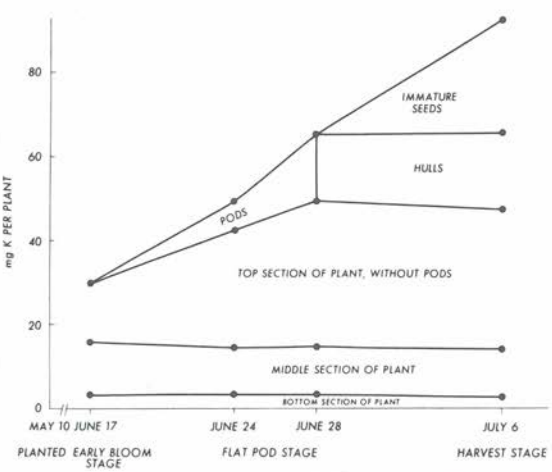


Figure 3. Uptake of K per pea plant

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

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

PEAS WERE GROWN in soil that had received three previous applications of 4 rates of concentrated superphosphate (CSP) and 4 rates of potassium chloride (KC1). The Little Marvel variety of peas was used as a standard variety to study uptake of P and K, and Perfected Freezer-60 was used as a standard processing variety.

The dry weight and content of P and K per plant doubled during the last two weeks of growth and development before harvest at the processing stage. Most of the increases occurred in the immature seeds.

This rapid increase in dry weight and uptake of P and K during the last two weeks of growth indicates that, except for small amounts of available nutrients in the rooting zone of the seedlings as a starter fertilizer, large amounts of the nutrients can be placed throughout the rooting zone for later uptake **(Figures 1, 2 and 3).**

Total dry weight and P-K uptake by Perfected Freezer-60 totaled twice that by Little Marvel.

Pea plants remove about as much P and K as one harvest of alfalfa. Peas are growing for only about two months, while alfalfa is growing throughout the growing season.

But this does not exclude the desirability of having adequate available nutrients in the rooting zone for peas, especially during the later stages of growth and development before harvest.

Applied potassium chloride nearly tripled K (from .6 to 1.6 percent) in the conductive and leafy portions of the plants.

Concentrated superphosphate increased P concentration in the conductive and leafy portions of the plants from .19 to .28 percent. Concentrations of P and K in the tissues declined during the growing season.

The immature seeds (at the processing stage of maturity) had about .45 percent P and 1.2 percent K. Both CSP and KC1 caused a greater range in the percentages of P and K in the vegetative tissues than in the reproductive structures of the plants.

Recently fully expanded leaves on the middle or upper portion of the pea plants best indicated P and K uptake from applied CSP and KC1. These leaves have wide range in P and K percentages due to applied CSP and KC1.

Peas grown for processing are planted in early spring and are harvested during late June or early July. Two stages of fertilization are critical: **(1) Early in the cold soil to supply adequate nutrients in the rooting zone for uniform seedling emergence without excessive salts to cause injury to the germinating seeds; (2) Large amounts of nutrients during the grand period of growth before harvest.**

Peas grown for processing are mechanically harvested. So the plants must have uniform growth with uniform pod set and seed development to get a high yield of immature seeds at one harvest. **THE END**

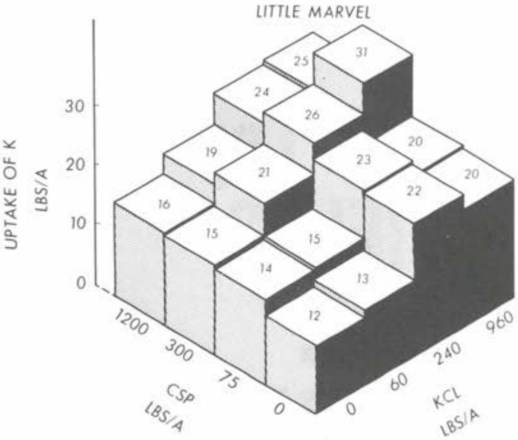


Figure 5. Total uptake of K by pea plants

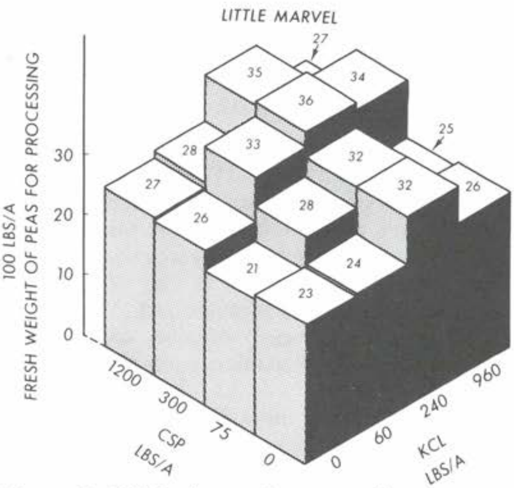


Figure 6. Yield of peas for processing at harvest time

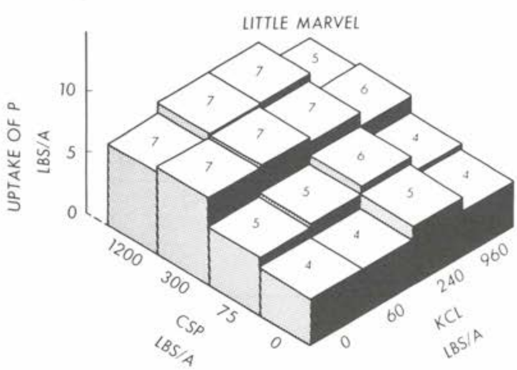


Figure 4. Total uptake of P by pea plants

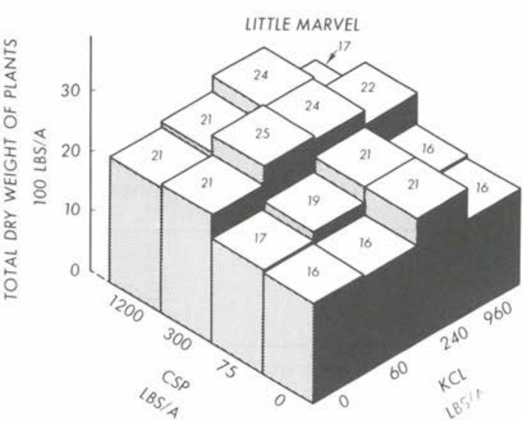


Figure 7. Total dry weight of pea plants at harvest time

FIRST HARVEST in mid-July of an alfalfa-timothy seeding (right) vs. forage oats underseeded with alfalfa (left). This high population stand (about 25 alfalfa plants per sq. ft.) is needed to intercept more light early in the season for top yields in seeding year.

Get Top YIELDS from ALFALFA Seedings

C. S. BROWN AND R. F. STAFFORD
UNIVERSITY OF MAINE

ALFALFA ON LIVESTOCK farms has undergone big change in recent years.

It's adaptability to short rotations with corn is now widely recognized. Its potential productivity in the seeding year has become an accepted fact. The old idea of a "lost year" of slow establishment beneath a companion grain crop has been discarded.

More and more dairymen are planning at least two harvests of alfalfa during the first season. Well-managed spring seedings have produced 3 to 4 tons of hay on northeastern farms under normal rainfall.

Using alfalfa seedings as a major source of forage has come from basic changes in management practice. Farmers have learned that modern fertilization and weed control can insure alfalfa establishment and guarantee a dependable source of forage.

Fertilization programs now include lots of potassium in the seeding year, complementing the long-accepted practices of liberal liming and phosphorus fertilization. New herbicides control weeds well.

So, in a relatively short period, alfalfa seedings have become a primary crop worthy of management comparable to that given to the corn crop on livestock farms.

WHAT ABOUT PLANT POPULATIONS? Inadequate stand density appears to be the major factor limiting yield of alfalfa seedings on many Northeast farms. Most farmers do not know critical minimum populations for maximum yield of these seedings. The seeding year demands much higher population than later years following crown enlargement.

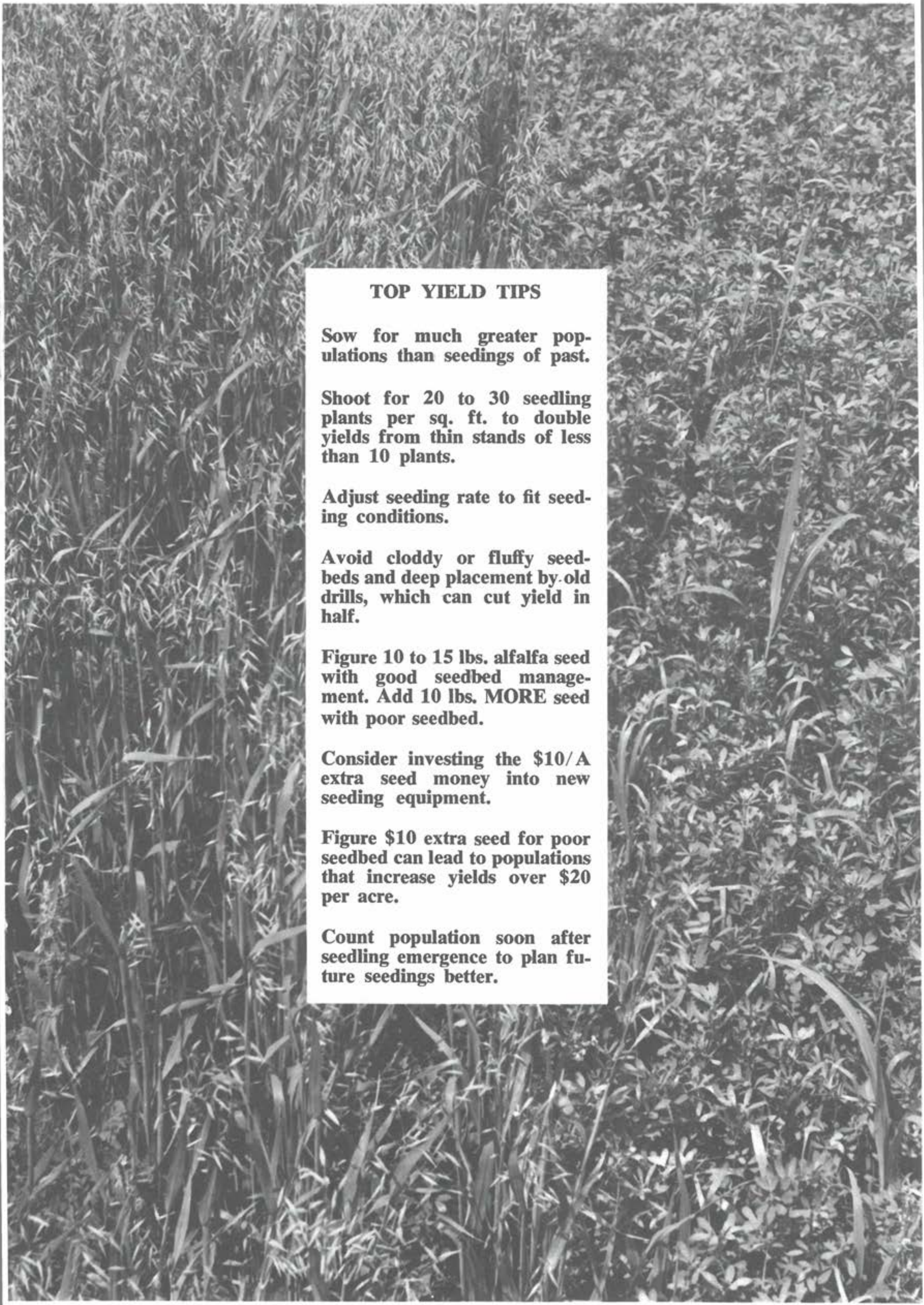
Recent studies suggest at least 30 seedling plants per square foot to get top yields in the first harvest—or about three times the minimum population needed for top yields in mature stands.

Our Forage Research Center has shown the importance of population density in alfalfa seedings. We sowed alfalfa in simple mixtures with each of several common grasses over a wide range of alfalfa seed rates. **TABLE 1** shows how 22 plants or less per square foot severely reduced yields. The minimum population for maxi-

Table 1. Seeding Rate and Plant Population Affect Alfalfa Yield in Spring-Seeded Alfalfa-Grass Mixtures.

		Alfalfa dry matter, tons/acre		
Alfalfa seed lb./acre	Aflalfa * seedlings no./sq. ft.	1965 seeding (Narragansett)	1966 seeding (Saranac)	1969 seeding (Iroquois)
2	8	1.29	—	1.13
4	13	1.88	1.59	1.83
8	22	2.09	2.01	—
16	43	2.68	2.47	2.49

* Mean of all mixtures and all years.



TOP YIELD TIPS

Sow for much greater populations than seedings of past.

Shoot for 20 to 30 seedling plants per sq. ft. to double yields from thin stands of less than 10 plants.

Adjust seeding rate to fit seeding conditions.

Avoid cloddy or fluffy seedbeds and deep placement by old drills, which can cut yield in half.

Figure 10 to 15 lbs. alfalfa seed with good seedbed management. Add 10 lbs. MORE seed with poor seedbed.

Consider investing the $10/A extra seed money into new seeding equipment.

Figure $10 extra seed for poor seedbed can lead to populations that increase yields over $20 per acre.

Count population soon after seedling emergence to plan future seedings better.

mum yields appears to exceed 30 seedling plants per square foot in our studies.

You must distinguish between essentially pure alfalfa seedings and those seedings in which you desire a vigorous associated grass. Choose a lower alfalfa population goal whenever you desire a strong grass partner in the seeding.

Under high mineral nutrition, dense stands of alfalfa seedlings severely reduce grass establishment. Alfalfa can dominate timothy and bromegrass so much that little or no grass is found in high population stands. Orchardgrass is less dominated, although alfalfa can significantly suppress it.

Lower seeding rates improve grass establishment without sacrificing forage yield. Total yields from alfalfa-grass seedings have increased little above an alfalfa population of 15 to 20 plants, in contrast to the minimum need of 30 plants in pure alfalfa seedings.

WHAT ABOUT SEEDING RATE? Optimum seeding rate of alfalfa is less easily prescribed than its plant population goal.

Because of small seed size, alfalfa requires shallow planting in a fine, firm seedbed. Seedling emergence varies greatly from field to field depending on seedbed conditions and seeding equipment.

With ideal seed placement, you may get 50 to 60% emergence rather consistently. But under average farm conditions, you can look for less than half this.

Carefully calculate seeding rate of alfalfa for a specific field planting:

1—Select the desired population goal—from 15 to 20 seedlings in grass mixtures to 30 or more in pure alfalfa stands.

2—Estimate the expected emergence percentage. This will range generally from about 60% under excellent conditions to as little as 20% with mediocre seedbeds or antiquated seeding equipment.

Following these two steps, you can calculate seeding rate, assuming each pound of alfalfa seed delivers about 5 seeds per square foot.

TABLE 2 shows how potential conditions at seeding can influence seeding rate. Over the full range of expected emergence, alfalfa seeding rate may vary from 7 to 20 pounds per acre in alfalfa-grass mixtures, from 10 to 30 pounds in pure alfalfa seedings. Poor seedbeds or inadequate seeding equipment demand much greater seeding rates to get top alfalfa yields in the seeding year.

Table 2—Alfalfa Seeding Rates Required To Get Top Yields From Alfalfa-Grass Mixtures And Pure Alfalfa Stands In Seeding Year

Population goal, alfalfa seedlings per sq. ft.	Estimated emergence, %	Seeding* rate, lbs./acre
20 (sown with grass)	60 (excellent)	7
	40 (fair)	10
	20 (poor)	20
30 (sown alone)	60 (excellent)	10
	40 (fair)	15
	20 (poor)	30

* Assuming each pound of seed delivers 5 seeds/sq. ft.

In conclusion, the importance of population density in alfalfa seedings should become more widely appreciated. Tomorrow's research should define critical population levels under various environmental conditions.

Population control cannot be ignored for alfalfa, any more than for corn, in today's high-yield agriculture. **THE END**

SHARPEN YOUR FIELD-SIDE MANNER

With tips from a color slide set on "Field Diagnosis and Tissue Testing."

COVER 3

Plant Food Impresses Youth

RUTH K. STROH, Maryland School Teacher

HAVE YOU EVER SEEN the wonder in the eyes of grade-school youngsters when plant food makes plants grow much better? I have. I teach them.

I have seen them peer closely at the poorer plant—the one without plant food —and then at the fertilized plant. And I have heard them exclaim!

I have seen them examine fertilizer bags—commenting on the formula on the bag carrying some of the names they had learned from their blackboard: potassium, nitrogen, phosphorus, etc.

I have seen them search through pamphlets on plant food—sometimes exclaiming about the huge amounts of nitrogen, phosphorus, and potassium 150 bushels of corn will contain.

I have seen them look down eroded slopes—staring hard at soil robbed by washing rains, listening carefully to the causes of this loss.

I have seen them turn their bulletin board into a plant food education exhibit to "enlighten" others—featuring Bugs Bunny's biggest carrot as the one to which he applied the right amount of nutrients.

And I have seen them compare plant growth in poor soils to the growth of frail, undernourished children—taking all this knowledge home to parents often "in the dark" about plant food's role in their lives.

You've missed something if you haven't taught children—and seen the wonder in their faces receiving new knowledge.

Great Protein Producer

LESTER SMITH

IN PURDUE AGRONOMY NOTES

ALFALFA PRODUCES more protein per acre than any other agronomic crop.

Recent Purdue University agronomy and animal science research is pointing the way to protein production from alfalfa of 3,000 pounds or more per acre.

Based on a price of 10 cents per pound for protein in soybean oil meal, this alfalfa protein is worth $300.

When alfalfa is established, fertilized and harvested to achieve maximum yield of high quality forage, it is a low-cost source of protein in rations of high-producing dairy cows.

Research at Purdue-operated Normandy Farm near Indianapolis proved this.

THE VALUE OF ALFALFA must be based on its high protein content. How does it compare to corn silage, an energy feed?

Compare this increasing value of alfalfa low moisture silage with 20 tons of 30 percent dry matter corn silage worth $97.20 per acre in a ration of soybean oil meal and ground corn:

Crude protein alfalfa silage	Tons/50% D.M.	Value per Ton	Total value of alfalfa silage/A
13%	12	$ 4.73	$ 56.76
15	12	10.68	128.16
18	12	13.86	166.32

Twelve tons of low moisture alfalfa silage is not a high yield per acre but look at its 18 percent protein value when it is cut in the early bud stage for silage.

It is worth almost $70 more per acre than 20 tons of corn silage.

So, dairymen and other livestock men are challenged to produce more protein from high quality alfalfa and energy from corn silage.

MANY INDIANA FARMERS can produce 10 tons of alfalfa-orchardgrass. The 8.6 tons produced in 1965 removed twice as much potassium in the hay as had been added in fertilizer. The soil supplied half the potassium that year.

We now know that yields of 4.5 tons or more remove 50-70 pounds of potassium per ton. A few farmers now reach the 10-ton goal. Others get 8 and 9-ton yields.

HERE IS THE 10-TON RECIPE for the Hoosier livestockmen to achieve:

- Bandseed 10 pounds of a certified

wilt-resistant alfalfa variety and four pounds of orchardgrass in early spring or late August. Orchardgrass is the best grass to seed for a 30-35 day harvesting period while obtaining the highest protein yield from the alfalfa.

• Use chemical weed control on the spring seeding.

• Lime to pH 6.8-7.0 and fertilize before seeding as follows:

Soil Test Level	Unit	P_2O_5	K_2O
Very low	lb./A	180	480
Low	lb./A	150	420
Medium	lb./A	120	390
High	lb./A	90	300
Very high	lb./A	30	240

• At seeding time, apply 40 lbs. per acre of phosphorus in the band on dark-colored soils such as Brookston, Chalmers, and Pewawo. On light-colored soils such as Crosby, Miami, and Tracy apply 15 lbs. of nitrogen in addition to the phosphorus.

• For the second year, fertilize according to the table above. Remember that 10 tons of forage can remove 300-400 lbs. or more of potassium.

BORON IS MOST LIKELY to be needed, especially in southern Indiana and the northern Indiana sands.

Plant analysis can tell you the need. When plants contain less than .002 percent (20 ppm) Boron they are probably deficient. Applying 2.5 to 4 lbs. actual boron will correct the deficiency. Up to 10 lbs. may be applied once every three years. Deficiency happens most in dry periods.

WHAT IS ALFALFA'S FUTURE? Encouraging, because stands will be seeded for maximum life on the less level land.

Fertilizer, especially potassium, will be applied according to the crop's demands.

Four and five harvests will be made to obtain maximum protein from hay or silage.

And protein in alfalfa may find its way into human food in other areas of the world.

THE END

Quick Estimates

LOOKING FOR "QUICKIE" estimates of alfalfa yields? There are many simple methods to make quick comparisons of alfalfa yields in plots or even to get rough yield estimates of a field. Here's one you may want to try:

• Use a hand sickle and cloth sack or basket, a milk scale and a yard-square frame which can be made from a 9-foot length steel rod, bent into a U-shape, one-yard square.

• Cut 6 square yards of alfalfa with the hand sickle, each yard from a randomly selected spot within the area in question. Cut the hay at normal mowing height. Put the green hay from the 6 square yards in the sack or basket. Weigh the whole sample, subtracting, of course, the sack or basket weight.

• The tonnage of air dry hay can be estimated by dividing the green weight by 10. For example, if the sample weighs 12 pounds, you can estimate 1.2 tons per acre for that cutting. This assumes 75% moisture at cutting.

• Don't sample when hay is abnormally wet. Hay silage weight is estimated simply by multiplying the tonnage figure by 3.

• For more accurate estimates, samples may be oven-dried.

• One could also cut a strip 18 feet long and 3 feet wide or 9 feet long and 6 feet wide. A mower or electric hand scythe could then be used more easily. Such a technique is not as good when estimating yields of a field but for small plots it works well.

(From a Minnesota leader.)

RED apples need BALANCED N-K team

• Treatments that increased leaf K improved fruit color and quality.

• Firmest fruit came from trees with leaves low to medium in N, high in K.

• Longer storage period increases the importance of balanced N-K teamwork.

Mack Drake, James F. Anderson, John H. Baker, Louis F. Michelson, and F. W. Southwick

UNIVERSITY OF MASSACHUSETTS

CONSUMERS PREFER red apples in most parts of the country. Poorly colored apples of a given variety usually sell at a lower price and must often be processed into pie stock, sauce, or juice.

The amount of red color on an apple's surface at harvest depends on such factors as genetics of the variety, light, temperature, and mineral nutrition.

Weeks, Southwick, Drake, and Steckel (1954) reported on the effects of fertility treatments in a commercial McIntosh orchard. Before it received the different fertilizer treatments, this 16-year-old orchard was uniformly treated with nitrate of soda or ammonium nitrate. Dolomitic limestone was applied periodically to supply calcium and magnesium and to reduce effects of sulfur spray materials on soil reaction.

Table 1 shows how the treatments supplied different amounts and ratios of nitrogen (N) and potassium (K) and greatly influenced chemical composition of leaves and fruit color. The number of fruit grading 50 per cent or higher in red color ranged from a low of 28.3 to 79.5 per cent for different treatments.

FRUIT COLOR WAS closely associated with the leaf N/K ratio (r=—.944). High ratios were associated with poor color. Closer ratios of leaf N/K produced excellent fruit color and quality.

For example, applying 1.33 and 2.0 pounds of N as ammonium nitrate and no potassium fertilizer produced leaves with 0.88 and 0.85 percent K and poor fruit color. This is far below the accepted leaf level, 1.2-1.5 percent K. Treatments which increased leaf K improved fruit color.

Most crops need plenty of nitrogen for best yields. Highest yields in this experiment came with high leaf N. But *highest nitrogen* produced the poorest colored fruit.

For example, applying 1.33 and 2.0 pounds of N as NH_4NO_3 without fertilizer K produced 5.5 and 6.3 bushels of fruit with 50 or more percent red color, respectively, while the hay mulch supplying 2.0 pounds of N and 2.0 pounds of K produced 11.5 bushels of fruit with 50 percent or more red color.

Applying 1.3 pounds of N and K as inorganic fertilizer produced 9.1 bushels of fruit with 50 percent or more red color.

FRUIT FIRMNESS is one barometer of quality and storage life. Firmest fruit came from trees with low to medium N and high K leaves. Fruit from high N-low K leaves was much softer, indicating shorter storage life.

Later University of Massachusetts work has confirmed the relationship between a narrow N/K ratio in the leaf and firm, highly-colored fruit.

This more recent research has shown how hard it is to increase leaf K in trees with high leaf N but low K. It was much harder to increase leaf K at high N rates than at medium rates. Under the sod mulch system of orchard management, liberal N rates stimulate grasses in the sod mulch. The grass roots then compete with the tree roots for both N and K.

Controlled atmosphere storage (C.A.) has greatly extended the marketing period for fresh apples, especially McIntosh. Until the mid 1950's, most McIntosh apples had to be marketed before March because of their rapid deterioration in storage.

Today's C.A. storage retains high quality McIntosh apples until July, dramatically extending the availability of high quality fresh apples.

Table 1—N/K Ratio In Leaf Affects Red Color of McIntosh Apples

Pounds Applied N	Pounds Applied K	Per cent in Leaf N	Per cent in Leaf K	N/K ratio x 100	Apples with fifty per cent or more red color
1.33	1.33	**1.86**	**1.56**	113	**79.5%**
0.67	0.67	**1.88**	**1.45**	129	**71.3**
2.00	2.00	**1.99**	**1.39**	143	**71.3**
1.33	0.00	**1.96**	**1.15**	162	**64.5**
1.33	0.67	**2.02**	**1.30**	155	**56.1**
1.33	1.33	**2.02**	**1.26**	160	**55.8**
1.00	0.00	**2.06**	**1.24**	166	**54.6**
2.67	1.33	**2.16**	**1.17**	185	**42.1**
2.00	0.00	**2.20**	**0.85**	259	**30.2**
1.33	0.00	**2.14**	**0.88**	240	**28.3**

Red color as related to N/K ratio, r= −.944

THIS LONGER STORAGE period increases the importance of balanced mineral nutrition required to produce firm, high quality apples.

Between 1957 and 1967, the Northeast suffered a cycle of 10 dry years. Moisture deficiency may have caused some organic forms of soil-plant residue (grass and leaves) to accumulate.

June-July-August rainfall in 1968 and 1969 was above average. Rich foliar growth in 1968 and 1969 indicated more nitrogen was being mineralized than during 1958-68.

Such transformation of nitrogen is so gradual that a more precise technique than routine leaf N analysis is required to detect an increase in twig and leaf nitrogen.

Based on tests in Table 1 and on field observations, increased potassium applications would narrow the N/K ratio, as desired.

Narrowing the N/K ratio would improve the color—increasing the number of boxes of highly colored fruit per tree.

Bitter pit strikes Baldwin, Spy, Cortland, and even McIntosh varieties: Small, circular, depressed brown or black areas in the apple peel, more prevalent on the calyx or blossom half of the fruit.

Directly under this depressed skin is a dry, corky, brown tissue about the size of a match head—too deep to be removed in normal peeling. Such apples are unsightly and not considered fresh fruit. Apple peels with bitter pit contain only half the calcium in normal apple peel.

Spraying the foliage and fruit 3 to 6 times with a dilute (½ percent) calcium nitrate solution reduced bitter pit, but did not eliminate it.

Growers spreading about 3 tons of dolomitic or magnesian lime (5-8 percent MgO) every 2-3 years have much less bitter pit.

INCREASING SOIL SOLUTION potassium without increasing calcium and magnesium raises potassium but lowers calcium and magnesium in the plant tissue.

Conversely, increasing calcium and magnesium without adding potassium fertilizer often raises calcium and magnesium but lowers potassium in the plant.

Skillful soil management will maintain a desirable level and balance of cations in the plant. And leaf analysis can tell you.

Fruit growers should continue to use higher fertilizer rates especially N and K —"dovetailed" with lime on most soils in humid areas. If there be error in liming, error on the high side. Lime liberally!

THE END

REACHING PASTURE POTENTIALS in the Midwest and South depends on much more than the aesthetic appeal of cool green pastures dotted with one's favorite bovine hues.

It depends on much more than gross per acre yields measured in pounds and tons.

It depends on the identification, sound pricing, and economic interpretation of "qualitative" factors often ignored when evaluating treatment responses.

Almost every treatment alternative affects either forage quality, species mix, seasonal growth or quality patterns, or intra- or inter-year yield variance.

Pasture Value is NOT Gross Yield

VICTOR E. JACOBS
UNIVERSITY OF MISSOURI

Each of these treatment effects has, in turn, important ramifications in terms of animal performance or costs that are not adequately reflected in gross per acre yields of beef, milk, or forage.

"PER ANIMAL" VS "PER ACRE" While there are fixed costs per acre, there are also fixed costs per head—and an intricate relationship results! Take a spring-buy and fall-sell steer program as an example. We may well find our true pasture values best measured by the approach used in Table 1.

From the standpoint of what we have left to pay for the pasture, two pounds per day gain is not worth just twice what one pound is worth—but seven times! Animal performance—or gain per head—tends to dominate our economics rather than gain per acre.

When fixed per head costs may go as high as 20¢ per day (or $36 for a six month season), the real economic return per acre is the gain per head ABOVE fixed costs per head times the number of head.

The 20¢ fixed cost per steer day may seem too steep. It may be in many situations. But it can well be "within the ball park."

Over a recent 9-year period, 850 pound steers sold for $3.43 per cwt. less in October than 600 pound steers did in April. This price drop on an initial 600 pounds amounts all by itself to over $20 per head for the season that must be covered by the gains before anything remains for pasture.

Two-way transportation, buy and sell commissions, interest on investment, death loss, veterinary, labor, etc. can easily add to the remaining $16 per head assumed in Table 1.

While the $24 selling price seems low today for feeder steers, it is well in line with longer run averages.

ANIMAL PERFORMANCE is an important key, as shown in Table 2. Here Table 1 assumptions are extended an additional step for a six-month grazing season.

Given the price and cost assumptions of Table 1, the half-pound rate results in even larger losses as carrying capacity and total acre gains are increased.

It is also clear that 100 pound gain per acre, if produced as 2.0 pounds per day per steer, leaves more for pasture than 300 pounds per acre produced at half the gain per steer day.

While costs, performances, and prices may vary by areas, periods, and managers, one fact stands out:

The relevant gain from the standpoint of paying for pasture is that produced in

TO PAGE 26

TABLE 1. Residually Estimated Pasture Values With Varied Rates of Gain of Steer.

	Daily Gain Per Steer			
	.5#	1.0#	1.5#	2.0#
Gross value of gain @ 24¢	12¢	24¢	36¢	48¢
Minus fixed per head cost per steer day	20¢	20¢	20¢	20¢
Remaining to pay for pasture per steer day	−8¢	4¢	16¢	28¢

TABLE 2. The Comparative Net Rents Remaining Per Acre of Pasture with Differing Gain Per Steer and Per Acre

Total Steer Gains Per Acre	Rates of Gain Per Day for a 180-Day Grazing Season			
	0.5#/Day	1.0#/Day	1.5#/Day	2.0#/Day
100#	−$16.00	$ 4.00	$10.67	$14.00
200#	−$32.00	$ 8.00	$21.33	$28.00
300#	−$48.00	$12.00	$32.00	$42.00
400#	−$64.00	$16.00	$42.67	$56.00

TABLE 3. The Estimated Break-Even Price That Could Be Paid for Pasture (Or Other Feed) That Will Produce 1.25 Pound Per Day Gain of Steer.

Item	Period		
	April 1 to July 1	July 1 to Oct. 1	Oct. 1 to April 1
Gross value of 1.25# daily gain at average 600# feeder steer price	30.34¢	29.26¢	30.49¢
Daily change in value of the present 600# due to seasonal price movements	−12.99¢	+1.57¢	+5.00¢
Daily change in value of the initial 600# due to animal gains in weights	−5.65¢	−2.85¢	−6.30¢
Other fixed costs per day of ownership	−8.00¢	−8.00¢	−8.00¢
Net remaining per day to pay for pasture	3.70¢	19.88¢	21.89¢

TABLE 4. The Comparative Economic Value of a 50 Per Cent Increase in Pasture Yield When the Value Per Cow Day is Affected.

Item	Change in Value Per Cow Day		
	Increased 5 Cents	Unchanged	Decreased 5 Cents
Value of initial 100 cow days @ 15¢	$15.00	$15.00	$15.00
Value of 150 cow days at resultant value	$30.00	$22.50	$15.00
Net value of pasture improvement per acre	+$15.00	+$7.50	0.00

excess of the costs of buying, handling, owning, and selling the steer.

Gain per acre only beclouds the issue beyond any intelligible economic analysis! All treatment effects that influence animal performance and costs must be identified, measured, and included in the analysis.

JUNE IS NOT AUGUST—nor February! Pasture is a seasonally produced, perishable, and only expensively storable commodity.

While an imperfect rental market may fail to discriminate in its pricing, you can expect wide differences in pasture value by seasons. Since pasture quality (and animal performance) are affected most by stage of maturity, pasture "balance" (or lack) often becomes the primary factor behind season gain per steer found so important in Tables 1 and 2.

Whether the pasture rental market does or does not reflect seasonal differences, the cattle market does—as Table 3 demonstrates. This table is based on 9-year average monthly prices and costs appropriate to a spring buy-fall sell steer program.

Differences in seasonal growth patterns are important in their effects on other costs —particularly wintering costs.

Stockpiled fall growth may have a quite high value per cow day because it substitutes for a drylot hay feed of which ½ to ¾ the cost comes from harvesting, handling, and storage.

THE BASIC ISSUE. The value of an acreage of pasture is not the value of all the beef or milk produced in the system in which pasture is used.

Wintering costs, negative price margins, and all other per head costs must be taken into account in estimating pasture values from final product yields.

Neither, however, is pasture value estimable just at flat rates per steer or cow day when quality and seasonal distribution are affected by the treatments being considered. Rather, the real economic problem is best represented by Table 4.

While such changes in per day values may seem large, they may well be reasonable.

Table 1 demonstrated the effect of quality on steer programs. In a comparison with beef cows, three possible effects were studied. When a 100 pound increase in weaning weight was combined with a 90-day longer pasture season and a 4¢ per day lower wintering cost (suggested by a shorter wintering period and a fleshier cow to be wintered) break-even price per cow day on pasture climbed from 10.7¢ to 21.3¢. Such effects become crucial in economic analysis and systems planning.

GROSS BEEF GAIN is not enough! Treatment effects on species mix, quality, seasonal and inter-year production variance, and calendar length of pasture season are all too important to be obscured by gross per acre yields of beef or hay.

Gross beef gain per acre simply obscures more than it reveals. Pasture is but a part of the total inputs in any cattle system.

The economic value of pasture depends on much more than gross yield—whether measured in tons, cow days, or pounds of beef. When pasture species and treatments are selected on such measures alone, the opportunities for disappointment are excellent.

Just such disappointments historically have applied the brakes to grass-land development. Systematic identification and objective measurement and pricing of these other treatment effects are badly needed if more profitable systems are to be developed. **THE END**

WHAT ABOUT REPRINTS?

Can you use reprints of any articles from this issue?

See bottom of page 31

ACTION MAKERS

	Free Sample	Cost Each In Quantity
NEWSLETTERS		
Add Extra Days To Spring With Fall-Winter Fertility (For North M-150____; South S-155____)	______	______ 3¢
FOLDERS		
Let's Face Fall-Winter Facts (For Midwest, C-Su-66)	______	______ 3¢
Potash Can Toughen Your Turf, T-Su-65	______	______ 3¢
Put KUALITY In Your Lawn Turf, A-1-66	______	______ 3¢
Ten Tons Alfalfa NOW, A-Su-66	______	______ 3¢
Are You Geared For 10 Tons Forage? B-2-67	______	______ 3¢
Potassium Builds Alfalfa Quality, D-1-68	______	______ 2¢
Potassium Builds Quality in QUALITY GRASSES, G-1-68	______	______ 2¢
WALL CHARTS		
Fall-Winter Fertilization Pays		______10¢
Soybeans Get Hungry, TOO!		______10¢
Plant Food Utilization—Nutrients Used Up By 20 Major Crops		______10¢
PLACE MATS (For Dinner Meetings)		
Year-Round Fertilization Starts Today	______	______ 2¢
Grow 10-TON Alfalfa	______	______ 2¢
Keep Your Turf From Getting Behind The 8-Ball	______	______ 2¢
Aim for 80+ Bushels Of Soybeans	______	______ 2¢
You Can Grow 200 Bushels Of Corn	______	______ 2¢
COLOR POSTCARDS		
Plan For "FULL-FEED CROPS" To Prevent HIDDEN Hunger	______	______ 2¢
Year-Round Fertilization Tips To Top-Profit Yields	______	______ 2¢

Facts FAVOR Fall-Winter Fertility:

For South 10-day Loan______; Purchase______$6.25

For North 10-day Loan______; Purchase______$6.25

Total Payment: $__________

Name____________________ Address____________________

City______________ State______________ Zip Code__________

Organization____

American Potash Institute • 1649 Tullie Circle, N.E. • Atlanta, Georgia 30329

Fig. 1—K_2SO_4 vs. elemental S on first cutting alfalfa. Both plots received 210 lbs. K/A.

ALFALFA

R. G. HOEFT AND L. M. WALSH
UNIVERSITY OF WISCONSIN

SULFUR DEFICIENCY may exist in Wisconsin soils (1) low in organic matter, (2) without manure in recent years, (3) not located in an area of heavy atmospheric pollution, or (4) coarse in texture.

Research in 1968 indicated this. It raised a key question:

What source and rate of S fertilizer is best for corn and alfalfa on these soils?

To answer this question, research supported partly by the Sulphur Institute and Farmers Union State Exchange was launched at 10 locations in west-central Wisconsin.

In the fall of 1968, potassium sulfate (K_2SO_4) and prilled S (88% S) were applied at rates of 0 to 100 lbs./A of S on established alfalfa at 9 different sites. Potassium-magnesium sulfate (K_2SO_4: $2MgSO_4$) was also included in these trials at a rate of 50 lbs./A of S.

At the tenth location, irrigated corn was grown. In this trial, four rates of K_2SO_4, $(NH_4)_2SO_4$ and prilled elemental S were broadcast in the spring of 1969. All alfalfa plots received a total of 210 lbs./A of K, and all corn plots received a total of 150 lbs./A of N and 210 lbs./A of K.

These trials were conducted on either Plainfield or Hixton sandy loam soils.

Hay and corn grain yields were determined as a measure of improved crop quantity. Crude protein content (Kjeldahl N x 6.25) was determined as a measure of improved crop quality.

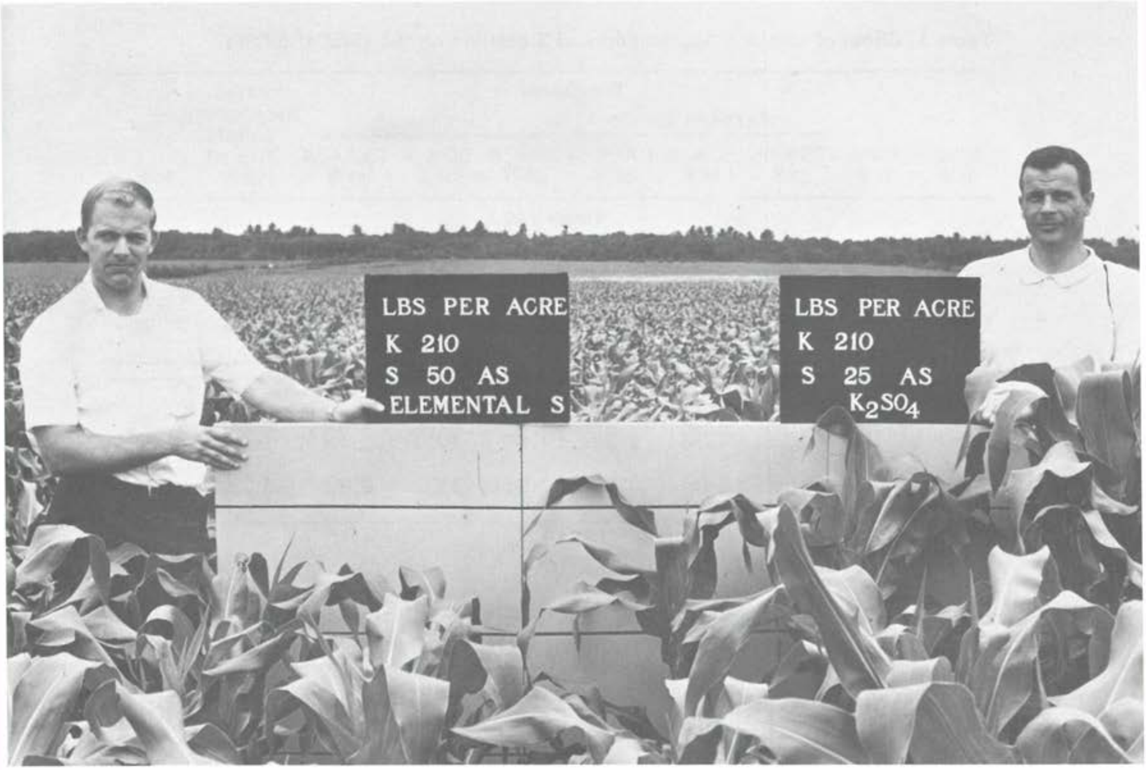


Fig. 2—K_2SO_4 vs. elemental S on corn 75 days after application. Both plots received 210 lbs. K/A.

and CORN RESPOND to SULFUR

ALFALFA RESPONDED to S fertilizer at 6 of the 9 locations. **Table 1** shows yield results from two of these locations. Applying K_2SO_4 increased yields significantly at both cuttings.

Elemental S treatments did not increase yield significantly over the check treatment at first cutting. But second cutting, 100 lbs./A of elemental S increased yields significantly at most locations.

Yield increases from 25 to 50 lbs./A of elemental S were usually nonsignificant. At equivalent rates of application, K_2SO_4 and $K_2SO_4{:}2MgSO_4$ corrected S deficiency with equal effectiveness.

Figure 1 shows growth difference at first cutting. Alfalfa on the K_2SO_4-treated plot had a darker green color and was 6 to 8 inches taller. The optimum rate of K_2SO_4 was 25 lbs./A of S. Increasing the rate to 50 or 100 lbs./A of S did not increase yields significantly for either cutting.

WHY THE DIFFERENCE in effectiveness between sulfate and elemental forms of S? Because these materials react very differently in the soil.

Plants use the sulfate ion. The sulfate in K_2SO_4, $(NH_4)_2SO_4$ or $K_2SO_4{:}2MgSO_4$ can be used immediately. But elemental S

Table 1. Effect of rate of S application and S carriers on the yield of alfalfa.

		Treatment [1]							
		Potassium sulfate			Elemental S			Potassium magnesium sulfate	
Location	Control	25#/A of S	50#/A of S	100#/A of S	25#/A of S	50#/A of S	100#/A of S	50#/A of S	lsd.05
				Yield, T/A [2]					
A									
1st	1.36	1.75	1.86	1.67	1.36	1.20	1.56	1.95	.41
2nd	0.98	1.41	1.39	1.48	1.00	1.06	1.32	1.49	.34
Total	2.34	3.16	3.25	3.15	2.36	2.26	2.88	3.44	.72
B									
1st	1.90	2.26	2.67	2.24	1.94	2.02	1.79	2.40	.39
2nd	.79	1.32	1.38	1.29	.89	1.00	1.13	1.38	.12
Total	2.69	3.58	4.05	3.53	2.83	3.02	2.92	3.78	.45

[1] All plots received 210 lbs/A of K.
[2] Hay yield at 15% moisture.

must be converted microbially to the sulfate form. This microbial conversion occurs only when the soil is warm enough for good microbial activity.

In this trial, the elemental S obviously was not being converted to sulfate S fast enough to correct the S deficiency.

Sulfate is a major constituent of protein. So, supplying S to S-deficient alfalfa increases protein content of the plant, as **Table 2** shows.

At both cuttings, K_2SO_4 increased the protein content more than elemental S.

Part of the increased protein content shown in Table 2 may have been due to the improved stand from S fertilization. Plots receiving K_2SO_4 or $K_2SO_4{:}2MgSO_4$ had more alfalfa and less grass than check plot or elemental S plots.

Figure 2 compares growth between K_2SO_4 and elemental S on corn about 60 days after planting. **Table 3** shows yield response to both K_2SO_4 and $(NH_4)_2SO_4$ at this location.

The 25 lbs./A rate of S from these two soluble sources gave best yield. Applying elemental S did not increase yield significantly over the check even at the 100 lbs./A rate of S.

Table 2. Effect of rate of S application and S carriers on the protein content of alfalfa.

		Treatment [1]							
		Potassium sulfate			**Elemental S**			**Potassium magnesium sulfate**	
Location	**Control**	25#/A of S	50#/A of S	100#/A of S	25#/A of S	50#/A of S	100#/A of S	50#/A of S	lsd.05
				% Protein					
A									
1st	12.6	15.3	15.2	15.3	12.3	13.6	14.3	15.5	1.1
2nd	15.4	16.1	16.8	17.0	15.6	15.4	15.1	17.0	1.4
B									
1st	8.7	9.9	10.4	10.9	9.8	9.1	10.4	10.7	2.0
2nd	13.6	14.0	15.0	15.2	12.9	15.0	13.6	15.4	2.2

[1] All plots received 210 lb/A of K.

Table 3. Effect of S carriers and rate of S on the yield of corn.

Treatment[1]	Yield bu/A (15% moisture)[2]
Control	133 a
Elemental S	
25 lbs/A of S	135 a
50 lbs/A of S	134 a
100 lbs/A of S	139 a
Potassium sulfate	
25 lbs/A of S	143 b
50 lbs/A of S	144 b
100 lbs/A of S	142 b
Ammonium sulfate	
25 lbs/A of S	142 b
50 lbs/A of S	142 b
100 lbs/A of S	147 b

[1] All plots received 210 lbs/A of K and 150 lbs/A of N

[2] Numbers followed by the same letter are not statistically different at the 95% level of probability

This research indicates:

- **25 lbs./A of S as K_2SO_4 will correct S-deficiency of alfalfa in application year.**
- **K_2SO_4 and K_2SO_4:$2MgSO_4$ are equivalent in correcting S-deficiency.**
- **25 lb./A of S as K_2SO_4 or $(NH_4)_2SO_4$ will correct S-deficiency of corn in application year.**

THE END

How Much Do Soybean YIELDS Vary With Leaf Composition?

W. M. WALKER, T. R. PECK
P. E. JOHNSON, L. V. BOONE

In ILLINOIS RESEARCH

TOPMOST FULLY DEVELOPED leaves were taken at random from soybean plants growing on experimental plots at three agronomy research fields—Brownstown, Oblong, and Toledo.

The plots had received varying rates of agricultural limestone, phosphorous, and potassium. Soil type at all locations was Cisne silt loam.

TABLE 1 shows how crop yields and chemical composition of the leaves varied widely. This variation facilitated the job of calibrating yield and leaf composition.

Since soybeans are expected to get their nitrogen supply largely by fixation of atmospheric nitrogen through their nodules, the wide range in percentage of nitrogen might be surprising.

But some of the experimental plots were very acid, and nodulation of soybean plants on these plots would probably be poor. Thus, lower nitrogen levels would be expected in the leaves.

Some variations in micronutrient levels

shown in **TABLE 1** may be due to the effects of applied nitrogen, phosphorus, potassium, and lime.

It is almost impossible to set leaf levels of plant nutrients as exactly as levels of applied fertilizers. But we can determine the levels of observed variables on each plot and their effects on yield, then adjust all these factors to some common level.

This technique is sometimes called simulation or systems analysis. It was used in preparing **FIGURES 1 AND 2.**

The levels of all variables except those under study were adjusted to the mean values shown in **TABLE 1.**

In the same kind of study with corn, an association was observed between yield and leaf levels of phosphorus and zinc. The possibility of a similar relationship for soybeans was therefore investigated.

TABLE 1—Yields and Leaf Analysis Average of Three Experiment Fields

Variable	Mean	Range
Yield, bu./A	36.4	12.9-49.2
Leaf Analyses		
Nitrogen, %	4.86	3.26-6.78
Phosphorus, %	0.36	0.09-0.70
Potassium, %	1.87	0.46-2.67
Calcium, %	0.94	0.55-1.36
Magnesium, %	0.32	0.07-0.74
Boron, ppm	49	24-108
Copper, ppm	14	6- 21
Iron, ppm	156	90-268
Manganese, ppm	74	35-350
Zinc, ppm	40	18-116

FIGURE 1 shows how varying phosphorus level had little effect on yields when the leaf level of zinc was 20 ppm. But at a zinc level of 60 ppm, yield increased with increasing levels of leaf phosphorus.

These results suggest critical level of phosphorus in the soybean leaf somewhat depends on leaf level of zinc. They also suggest high zinc levels in soybeans may be undesirable, since yields were decreased at these levels.

Soil potassium levels are often low on Cisne soils, resulting in low leaf levels of potassium in soybean plants. Under highly acid soil conditions, leaf magnesium may also be low.

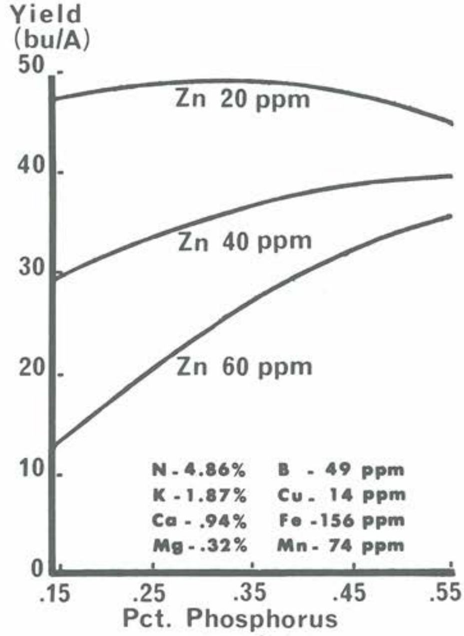


FIGURE 1

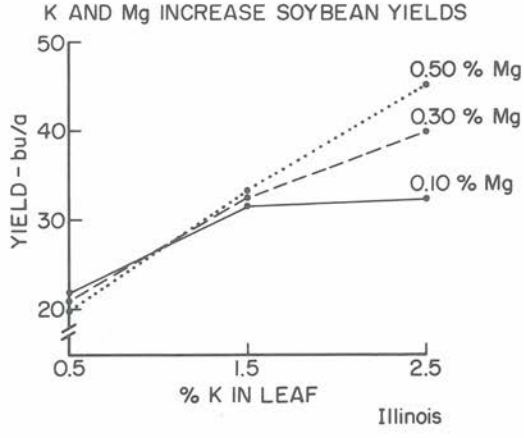
FIGURE 2 shows relationship between leaf potassium, leaf magnesium, and soybean yields. At all levels of magnesium, there was a yield response to leaf potassium. This response was greatest at high magnesium levels.

At the lower potassium levels, varying the level of magnesium had little effect on yield. But increasing magnesium did increase yields at a leaf potassium level of 2.5 percent.

Results presented here are based on one year's data, and might be affected by varying conditions in other years. But they do illustrate an interesting approach to interpretation of plant analyses. **THE END**

FIGURE 2

K AND Mg INCREASE SOYBEAN YIELDS



Illinois

TIPS FOR SUMMER STRESS

soil for a time before sampling may cause low leaf P or K. A crop rotating after a heavy potash eater may show low plant K. Certain corn hybrids may use nutrients more efficiently than others. Short N or P may cause your field tissue test to show adequate K even when the plant does not get enough potassium for GOOD growth. If the plant had gotten enough N or P, the K test would have shown low or very low. Many interactions occur in today's high-yield varieties getting high-yield fertilizer rates. It's a complicated picture. It demands a sharp eye on nutrient balance at all times.

5—Some folks swear by quick tissue tests in the field. Why?
Let a crop tell you what it needs on the spot and you'll understand. With a kit of test papers, chemical solutions and powders, vials, extracting pliers and knife, the tester gets results you can SEE right beside the crop. He can re-check results that "don't seem right." If no NPK problems show, he and the farmer can probe further. Such tests fascinate many farmers making them better crop watchers and high-yield chasers.

6—When is the best time to sample a plant for field tissue tests?
Several times. If possible, test field 5 or 6 times to follow nutrient uptake through the season. If you can run only one test, do it when the plant is under greatest stress—flowering and seed-setting time in mid-season. Don't test in early morning, on cloudy days, during drouth, or right after a rain. Tests during these periods tend to show nitrate accumulations, even when deficiency exists. Watch for higher nutrient levels in early season when plant is not pushed. Don't let effects of starter fertilizer fool you. A plant can "run out of gas" later if basic soil fertility is not up.

THE END

Please send me the following:

		Quantity
EDUCATIONAL KIT		
Trouble Shooting Tips For Summer Stress (20 Question-Answers)		______ 10¢ Ea.
PAMPHLETS	**Sample Copy**	
Fight Hidden Hunger With Chemistry	______	______ 10¢ Ea.
Ask The Soil	______	______ 3¢ Ea.
Be A Diagnostician	______	______ 3¢ Ea.
SLIDE SET	**10-Day Loan**	**Purchase**
Field Diagnosis And Tissue Testing, 51 Slides	______	______ $7.35

Total Payment Enclosed $______

Name ______________________ Address ______________________

City______________________ State ______________ Zip Code ______________

Organization ____

American Potash Institute, 1649 Tullie Circle, N.E., Atlanta, Ga. 30329

FERTILEGRAMS

HAVE YOU PUT THEM TO USE YET?

The latest educational kit of fertilegrams on tips for summer stress is offered on the inside of this cover.

This marks 6 Fertilegram Kits (answers to key questions) that the Potash Institute has issued in 9 months. In those months, thousands of the kits have been ordered:

ON Year-Round Fertility

Forages

Corn

Soybeans

Lawns

Trouble Shooting Summer Stress

When you order the new SUMMER STRESS kit on cover 3, you can write in the key (corn, soybeans, etc.) to any of the other kits you may want at the same rate and we'll gladly send them.

Better Crops
WITH PLANT FOOD

Controlled circulation postage paid at Washington, D. C.

AMERICAN POTASH INSTITUTE, INC.
1649 Tullie Circle, N.E., Atlanta, Ga. 30329