Better Crops WITH PLANT FOOD

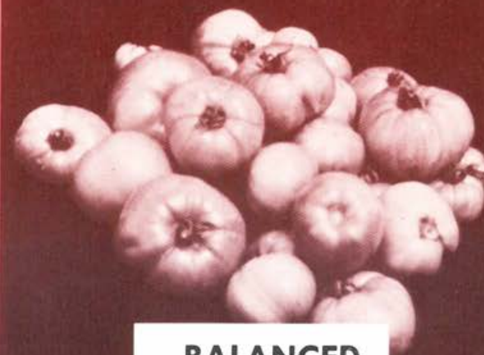
NUMBER 3—1973 25 CENTS

Key To No. 1 Tomatoes

N	0 lbs	80 lbs	80 lbs
P_2O_5	0	100	100
K_2O	0	0	300

INADEQUATE

IMBALANCED



BALANCED

	INADEQUATE	IMBALANCED	BALANCED
NO. 1 FRUIT	5.0 TONS/A	2.7 TONS/A	17.5 TONS/A
RETURN	$1,050/A	$658/A	$4,334/A

Potash (K_2O) Helps Boost Fresh Market Tomatoes 1970-1972

	POUNDS PER ACRE APPLIED N	P_2O_5	K_2O	pH LEVEL	TONS/ACRE No. 1 TOMATOES
K_2O At Work With N . . .	0	—	0	—	4.7
	40	—	0	—	3.5
	80	—	0	—	3.0
	120	—	0	—	3.6
	0	—	150	—	13.0
	40	—	150	—	13.7
	80	—	150	—	12.8
	120	—	150	—	12.4
	0	—	300	—	14.7
	40	—	300	—	15.7
	80	—	300	—	16.1
	120	—	300	—	14.8
K_2O At Work With P_2O_5	—	0	0	—	4.1
	—	100	0	—	3.3
	—	0	150	—	12.3
	—	100	150	—	13.6
	—	0	300	—	14.0
	—	100	300	—	16.6
K_2O At Work With Lime	—	—	0	5.5	4.3
	—	—	0	6.0	3.2
	—	—	150	5.5	13.2
	—	—	150	6.0	12.7
	—	—	300	5.5	15.2
	—	—	300	6.0	15.4

Avg. of all P_2O_5 levels (beside the P_2O_5 column of "K_2O At Work With N")

Average of all pH levels (beside the pH column of the first two sections)

Avg. of all N levels (beside the N column of the last two sections)

Average all P_2O_5 (beside the P_2O_5 column of "K_2O At Work With Lime")

Potash applications in 1970 were 0, 100 and 200 lbs/A

JAMES W. PATERSON
RUTGERS STATE UNIVERSITY

MORE THAN $250 per ton for good quality fresh market tomatoes makes the few dollars spent per acre for fertilizer rather insignificant.

Yet, the fertilizer program can be the most important in a grower's overall operation, especially if he doesn't use enough potash on low-potash soils. Rutgers work has shown how much potash can influence fresh market tomato production.

Beginning in 1970, we applied before planting each year 4 rates of N, 2 rates of P_2O_5, and 3 rates of K_2O on a Sassafras sandy loam soil testing low K, low pH, and very high P. We applied lime (hydrate form) to the lime plots in early spring of 1970 and 1971 to get a 6.5 pH. But we averaged a 6.0 pH over the 3 years and added no lime to the low pH plots.

The table shows how potash (K_2O) altered yields of No. 1 tomatoes at different rates of nitrogen (N), phosphate (P_2O_5), and lime (pH level). The table features key areas of potash influence.

ADDING NITROGEN (40, 80, 120 lbs N/A) to no-potash (0 K_2O) plots depressed yields. Then adding 150 lbs K_2O to the 40 lb N plot boosted yields 10 tons over the highest N treatment without potash. Adding 300 lbs K_2O to the 80 lb N plot boosted No. 1 fruit 12.5 tons over the highest N treatment without potash.

ADDING PHOSPHATE (100 lbs P_2O_5/A) to no-potash (0 K_2O) plots depressed No. 1 tomato yields almost one ton per acre. Then adding 150 lbs K_2O to the 100 lb P_2O_5 plot boosted yields more than 10 tons over the no-potash plot. Adding 300 lbs K_2O to the 100 lb P_2O_5 plot boosted No. 1 tomatoes more than 13 tons over the no-potash plot.

LIMING PLOTS (to 6.0 pH) actually depressed yields one and a half tons on the no-potash and 150 lb K_2O plots. The 300 lb K_2O rate eliminated the depressive effect of liming.

THE COVER PICTURE shows how important a balanced fertility program is to growing top quality fresh market tomatoes.

INADEQUATE fertility (no added N, P_2O_5, K_2O) produced a low yield of No. 1 tomatoes.

IMBALANCED fertility (no added K_2O) produced more total tomatoes but actually less No. 1 fruit.

BALANCED fertility produced 4 to 6 times more return from No. 1 fruit than inadequate and imbalanced fertilizer did.

Lack of potash caused a very small, unusable fruit. Barely a quarter of the fruit harvested from these low-yield plots was marketable, while well over half the fruit from the potash-treated plots was **No. 1 quality.**

The road to more yield and money is paved with balanced fertility. Test the soil. Know the signs. Follow the recommendations. **The End**

Better Crops WITH PLANT FOOD

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Precision farming keeps a close eye on nutrient uptake . . .

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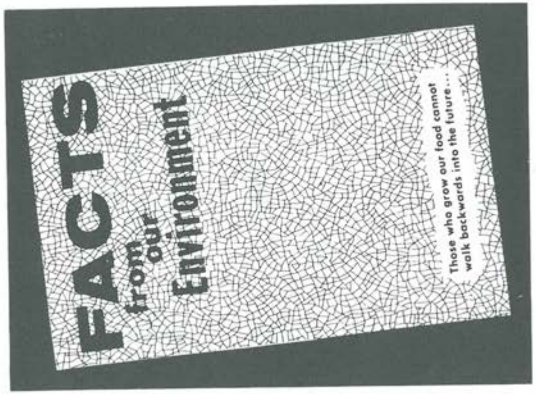

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Are we entering a "new era" for forages?

VICTOR JACOBS
UNIVERSITY OF MISSOURI

In the
University of Missouri's
FARM MANAGEMENT Newsletter

THE ON-FARM application of improved technology to forage—especially to pasture—often has seemed to proceed at two paces: S-L-O-W and NOT-AT-ALL.

Periodic examination of census data generally discloses far less fertilizer used on pasture than on other crops, rather small percentages reported as "improved" pasture, and large acreages of "wooded" land from which little timber is harvested.

To be sure, the use of yield increasing practices has increased, but even this has often been negated or offset by a shift from more intensive forage production for a dairy cow to a less intensive production for the beef cow that replaced her. For example, a shift from alfalfa hay to stock-piled permanent grass often meant a shift from perhaps 10 cow months per acre down to only 3 to 4. All of which raises the fundamental question of WHY?

THE REASON? It wasn't needed! Beef cow numbers have indeed quadrupled since 1940—and doubled since the early 50's.

In contrast, all other major forage consuming livestock peaked out in numbers from ⅓ to ½ a century ago!

Horses and mules, for instance, peaked out in 1918 at 26.7 Mil. head and then declined to 3 Mil. in 1960 (the last year the U.S.D.A. reported an estimate).

Small wonder agriculture entered a long period of burdensome farm surpluses. We created our own surplus by eliminating a vast market (horses and mules) that had absorbed a fourth of our total production—and perhaps 29-30% of our forage product!

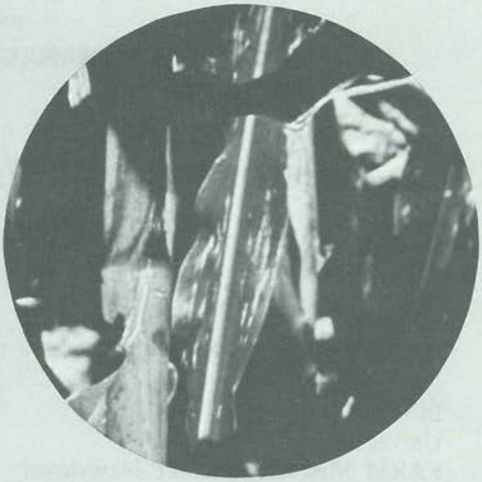
Dairy cows peaked in 1945 at 27.8 Mil. head. We have since reduced them by 16.1 Mil. head down to the present inventory of 11.7 Mil. cows. Sheep and lamb numbers peaked at 56.2 Mil. in 1942. The post-1942 period has seen a precipitous decline by ⅔ of that number to only around 17 Mil. head today.

In short, the dramatic increase in numbers of beef cows has been matched by equally dramatic declines in each of the other forage-consuming species. **In fact, for every beef cow added since 1920, one horse, mule, or dairy cow has disappeared and left its forage to feed the added beef cow.** This statement is true even assuming horse numbers have doubled since the last U.S.D.A. inventory in 1960.

Thus, expansion of beef cattle over

TO PAGE 9

"Potassium may increase resistance to certain leaf diseases (such as northern corn leaf blight) and to rusts and powdery mildews. It appears an adequate level of potassium decreases the incidence of corn stalk and root disease."



Soil Fertility And Disease Development

DISEASES VARY in severity from year to year and field to field. The severity depends on three factors: ***(1) the environment, (2) the resistance or susceptibility of the host, (3) the presence and virulence of the causing organisms.***

If environment favors a disease and the causing organism is present, there will be little or no disease when the host is highly resistant. If the causing organism is present and the host susceptible but the environment unfavorable, the disease may not be serious.

Soil fertility is an important part of the plant's environment. It may affect the severity of a disease by influencing overwintering and survival of pathogens, pathogen reproduction and buildup, and host susceptibility.

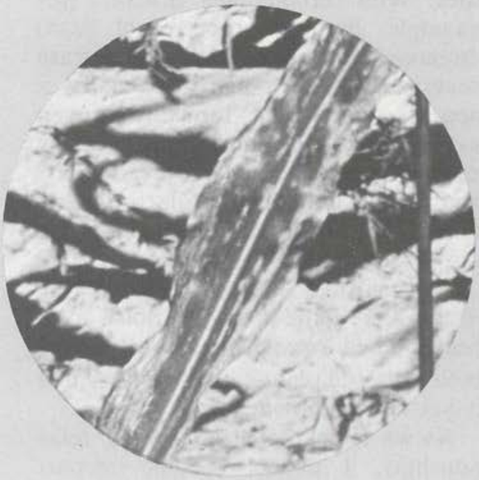
KNOWN EFFECTS of nutrients on disease development have varied so much it is difficult to generalize.

First, some disease-causing organisms can attack only slow-growing or weak hosts, while others do better on thriving plants. So, the disease itself will determine the effect nutrients have.

Second, the relative amounts of other elements may influence the effect of individual nutrients. For example, nitrogen alone produces certain effects, but these effects may be quite different if there is proper balance with other elements, especially potassium and phosphorus.

Third, the form in which the nutrient is supplied may also bring a different effect. For example, ammonium nitrogen tends to make soil more acid but sodium or calcium nitrate tends to make it alkaline. Alkaline soil favors a disease like potato scab but may suppress club root of cabbage and certain wilt diseases.

It is true that high nitrogen fertilization has led to more cases of apparent and real disease susceptibility than



"A deficiency of potassium may result in an increase in severity of many diseases. Potash fertilizers have probably alleviated damage from more diseases than any other nutrient treatment. Potassium thickens outer walls of epidermis and promotes firmer tissue generally."

C. WAYNE ELLETT
PLANT PATHOLOGY
OHIO STATE UNIVERSITY

resistance. The reverse—more disease resistance—is true for phosphorus and potassium.

Nitrogen is essential for vigorous growth. In balanced combination with other elements, it often enables seedlings to grow fast enough to escape seedling blights caused by various soil-borne organisms of the "low grade" type.

NITROGEN-PHOSPHORUS BALANCE is very important in such diseases as take-all, foot rot, and Pythium root rot of wheat.

Since phosphorus promotes good root development, proper phosphorus-nitrogen balance insures rapid regrowth of roots from the crown of diseased plants. This promotes quick recovery from loss of diseased roots.

NITROGEN-POTASSIUM BALANCE influences wilt diseases more than nitrogen-phosphorus balance. Wilt diseases affect movement of water and essential mineral salts in plants.

High nitrogen rates increase severity of a disease such as bacterial wilt of corn. And nitrogen deficiency reduces wilting. But a plant with optimum nitrogen resists wilt better when additional amounts of potassium are provided. In carefully controlled trials, cabbage yellows (a wilt disease) and tomato wilt hit the potassium deficient plants much more severely than the plants receiving balanced nutrition.

Potassium deficiency may increase the severity of many diseases. ***Potash fertilizers have probably alleviated damage from more diseases than any other nutrient treatment.***

Potassium aids structural development of plants, promoting thicker outer walls of the epidermis and firmer tissue structure generally. Therefore, potassium may increase resistance to certain leaf diseases such as northern corn leaf blight and to rusts and powdery mildews.

Stalk and root rot diseases are the most important corn diseases, causing 8 to 15% annual losses throughout the corn belt. Inadequate potassium reportedly hastens tissue aging, stalk and root breakdown. Then, fungi (such as *Diplodia* and *Gibberella*) can more easily invade these aging tissues and decay the stalk.

Although many factors affect the incidence of stalk and root rot, it does appear that adequate potassium level decreases the incidence of stalk and root diseases.

LEVELS AND ACTIVITY of soil-borne and crop-residue-borne disease-causing organisms may be directly affected by fertilizer applications. Also, the saprophytic or non-disease-causing soil organisms are affected by soil nutrients.

So, microbial competition in the soil under certain soil fertility and pH levels results in desirable changes in soil microbial populations. For example, known disease-causing fungi such as **Fusarium** species may be reduced in numbers, while certain beneficial fungi increase.

The influence of various organic soil amendments and forms of nitrogen fertilizers on diseases have been studied. Work in Michigan and elsewhere has demonstrated how nitrogen form affects the potato scab disease. Ammonium sulfate form of nitrogen, when applied in soils low in available nitrates, led to less potato scab and significantly greater yields of No. 1 potatoes. In these studies, a nitrogen stabilizer was applied with the ammonium sulfate to prevent rapid conversion of the NH_4 fertilizer. This nitrogen stabilizer is specifically active against ***Nitrosomonas,*** a soil bacterium responsible for the rapid conversion of ammonium nitrogen.

Similar effects of nitrogen form have shown up with the take-all disease on wheat and Verticillium wilt on potatoes. With certain other diseases (for example, Fusarium root rot of bean) ammoniacal nitrogen increased disease severity. Without going into details, it appears that specific form of nitrogen available to the plant (influenced by crop rotations, organic amendments, and type of nitrogen fertilizer) greatly affects the severity of certain soil-borne diseases.

Mechanisms to control soil-borne diseases are quite complex. Some have been studied extensively by soil microbiologists and plant pathologists. Much is yet to be learned.

As we learn more about these relationships, I expect specific recommendations of types of organic and inorganic fertilizer practices may greatly alleviate some root disease problems.

It is difficult research, at least to interpret, because of the interaction of nutrients, weather conditions, kinds of disease-causing organisms, and kinds and levels of various species of bacteria, actinomycetes, and fungi in the soil which are not pathogens of crop plants.

THE END

Temporary shortages of plant food should never create a shortage of educational efforts . . .

Pages 3 and 4 help keep the message flowing . . .

FORAGES—FROM PAGE 5

the past half century has required very little increase in total forage production. Almost all the additional forage needed was made available by reduction in numbers of horses, dairy cows, and sheep.

Demand for forage has remained rather static—and the price structure has historically **not** provided vigorous incentives to expand output. While vast yield improvement has been **technologically** feasible for a quarter century, **economic** incentives have been only modest at best.

ARE WE APPROACHING a turning point and a new era? It is hazardous at best to forecast an imminent turnover in a situation that has existed for over 50 years. Yet, such a conclusion seems suggested.

It is patently impossible to decrease horses by 22.6 Mil. (as in 1920-60) when present numbers are only of the order of 6-7 Mil. and increasing.

It is equally impossible to decrease dairy cows by 16.1 Mil. (actual 1945-73 decline) when the starting point is less than 12 Mil. Similarly, no 35 Mil. reduction in sheep and lambs is possible when they presently total only around 17 Mil.

In brief, the sources of additional forage used in the past to increase beef production are no longer available. While further reductions in dairy, sheep, and horses are still possible in the near future, they cannot approach the magnitude of the past in absolute numbers—and they must be still smaller relative to total beef cattle numbers.

WHAT ABOUT an incentive price structure? If further increases in beef cattle cause increased derived demands for forage, a more favorable price structure must develop to call it forth.

Looking beyond the cyclical overexpansion of beef cattle that now appears to be in progress, the longer term price outlook would appear to be improved. It is common knowledge among economists interested in forage that pasture rental rates have been well below the total cost of production.

Few ways exist to produce pasture—or additional pasture—at the $3 per cow per month rates so commonly cited in Missouri up to the last year or two.

Full cost of production in most instances would have been well over twice the common rental rates (unless a sizeable credit is made annually against ownership costs for the increase in value of the land). Most yield increasing practices will cost $5 or more per additional cow month.

Thus, if substantial increases in forage supply are to be called forth to meet an abruptly increased demand, it seems likely that market prices (and/or derived values of forage) must move up—at least to a point much closer to the actual cost of producing the forage.

A new era? Maybe. And a more profitable one—hopefully! **The End**

The need for continuing education grows even greater in times of pressure and crisis . . .

Pages 3 and 4 help keep the message flowing . . .

"Cotton needs potassium fertilizer . . ."

A BETTER CROPS condensation of a report by Joe V. Pettiet, Delta Branch Experiment Station Agronomist of Mississippi State University . . . in RESEARCH HIGHLIGHTS.

INADEQUATE POTASH
Many small bolls . . . many that don't open . . . that can't be harvested mechanically.

NITROGEN HAS BEEN the primary nutrient used for cotton production in the Mississippi Delta. Common usage of nitrogen alone has led many farmers to believe it is the only nutrient needed for high cotton yields.

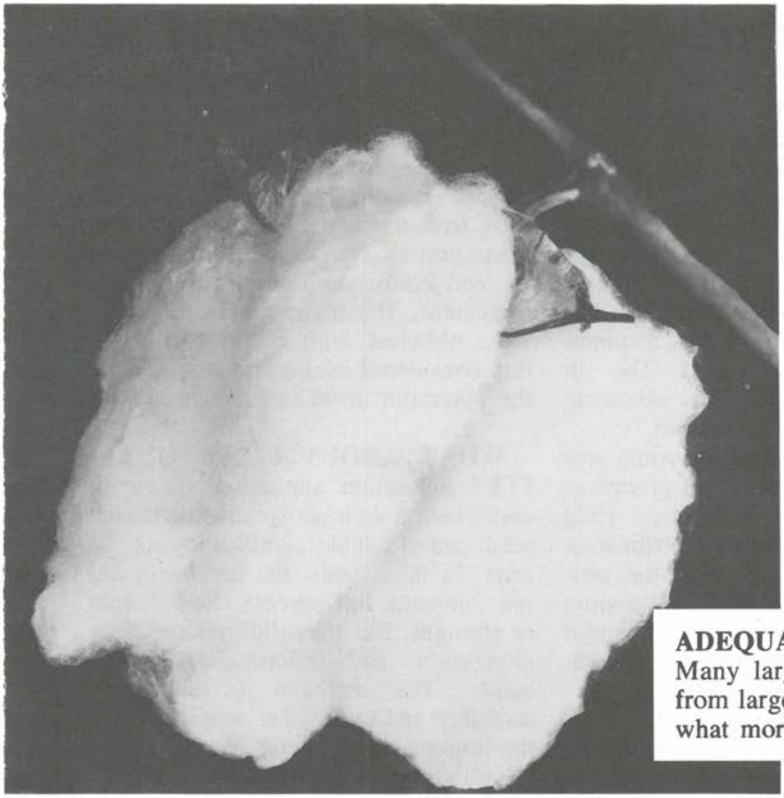
But recent studies by the Delta Branch Experiment Station have shown potassium ranks second to nitrogen in importance as a cotton fertilizer. Potassium has been slowly depleted from soils where nitrogen has been the only nutrient used for cotton production.

FIELD STUDIES. Fertilizer experiments were established on a number of large commercial fields over a five-year period. Sandy loam and silt loam soils with a wide range of extractable potassium by soil test were specially selected to represent the major cotton soils in the area. Other than fertilization, the production practices used in the studies were conducted by farm cooperators. The large plots extended the length of fields and were managed under normal farm conditions.

We observed growth differences between fertilizer treatments—changes in **size, shape, appearance, and fruiting of plants**—throughout the season.

Cotton plants responding to potassium grew larger and were somewhat more vegetative. At harvest, these plots had more large mature bolls.

On soils lowest in potassium, yellow to reddish brown chlorotic areas developed near the edges of mature leaves by mid-September. Later, the leaves tended to curl and shed prematurely. A number of the bolls were small and



ADEQUATE POTASH
Many large, mature bolls . . . from larger plants that are somewhat more vegetative.

COTTON'S NEED FOR POTASH is not limited to one season or one area. These bolls go back many years in Georgia work. They show what potash hunger could do then . . . AND NOW . . . because potash hunger is always possible.

failed to open. Many immature locks within the smaller bolls stuck in the bur and could not be mechanically harvested.

Sixty pounds of potassium (K_2O) per acre increased seed cotton yields an average 204 lb/A in 24 field tests. The estimated value of increase was $18.97. This represented a $4.60 return per dollar of fertilizer and application costs.

Differences in **texture, internal drainage,** and **soil compaction** between soil types appeared to influence growth and yield response to potassium. The soils seemed to fit into two responsive groups: (1) Deeper sandy loams. (2) Moderate to shallow silt loam soil types.

Response to potassium was similar for soils within each group, but was considerably different between soil groups. In 11 **sandy loam** tests, potassium increased seed cotton yields an average 103 lb/A, representing an estimated $2.30 return per dollar investment. In 13 **silt loam** tests, potassium increased seed cotton yields an average 290 lbs/A, representing a $6.50 return per dollar investment.

CALIBRATION OF THE SOIL

TEST. The relationship of soil-test potassium and yield response from potassium fertilization was evaluated by plotting data from the individual field tests on a single response curve currently used for potassium by the State Soil Testing Laboratory.

Within the yield response range for potassium (0-240 lb K/A), the curve generally separated the two soil groups. The sandy loams were plotted above the response line, indicating less response to potassium than expected. The silt loams fell below the line, indicating greater response than expected.

A new calibration for potassium was prepared, using the two soil groups as a basis for calibration. To make yield response to potassium fertilization comparable in both groups, the proposed calibration decreases potassium soil test level required for maximum yields on sandy loam soils and increases K level on silt loams.

Farmers must recognize and designate the soil groups when submitting samples for testing—sandy soils as group one, all other soils as group two.

Adequate soil moisture during the growing season directly influences cotton yields, of course. Soil drainage and compaction influence root development and the plant's ability to take up moisture and nutrients. Without adequate root development, the plant may need added fertilizers to reach higher yields.

In this study at a given potassium soil test level, larger yield increases from potassium came on moderate to shallow soils that tend to compact badly. Soil texture in the rooting zone influences amount and intensity of compaction. Internal drainage, moisture availability, and tendency of soils to compact are all described by differences in soil type. These characteristics have been utilized in the proposed calibration.

WHAT ABOUT RATES? Seven field tests were conducted in 1971 to determine optimum rates of potassium fertilizer for maximum cotton yields. Various rates had a similar effect on yields on both sandy loam and silt loam soil types. Significantly higher yields were obtained in six of the seven tests.

Seed cotton yields increased 129 lb/A with the first 30 lb increment of potassium (K_2O), an additional 146 lb of seed cotton with the second 30 lb increment. The highest average yields were obtained with 60 lb K_2O/A—a rate considered adequate for supplying the potassium level in soils.

WHAT ABOUT FIBER QUALITY? Potassium applied alone or in combination with phosphorus increased seed cotton yields significantly in 14 tests. In these tests, the fertilizers did not influence lint percent, fiber length or strength. But they did increase fiber elongation and micronaire significantly. The increase in micronaire probably indicates fiber maturity, but the larger fiber diameter has little economic significance.

WHAT ABOUT DELTA SOIL K LEVELS? In July and August of 1971, eight soil types were selected to evaluate potassium fertility status of major soils in the Mississippi Delta. Standard soil surveys were used to locate typical soil types in 10 all-Delta counties and the Delta portion of Tallahatchie County.

The State Soil Testing Laboratory recommends potassium fertilizers for cotton on all soils testing medium or below in potassium. Using the proposed soil test calibration, this survey showed 59 to 66% of the silt loam samples needing potassium, up to 12% of the sandy loam soils needing potassium. Forestdale silt loam had the lowest levels, with 28% of the samples in the low and very low K range.

Using the proposed calibration, potassium would be recommended on 19 to 30% of the silty clay loam acreage. All this acreage tested medium in potassium. No fertilizers would be recommended for the clay soils, since 87 to 98% of the samples tested in very high range.

Soils needing potassium fertilizer represent 30% of the sandy loam, silt loam and silty clay loam acreage—and 8.9% of the total acreage of all soils in the Delta. The majority of soils needing fertilizer has a medium potassium level. This level, however, represents a 2 to 10% increase in yields from fertilizer use and a gross cash return from $3 to $20 per acre.

WHAT ABOUT K's ECONOMIC IMPORTANCE? Calculations suggest silt loam soils offer the greatest potential for potassium use in the Delta. The 231,000 silt loam acres needing potassium could produce an estimated annual gross return near $3.7 million, and a net return to the farmer of 1.7 million dollars. Returns from the silt loams represent 89% of the total potential net returns from all responsive soils.

Less returns are expected from the sandy loams. The near 20,000 acres needing fertilizer make up less than 2% of the total net income that could be derived from potassium. Possible net returns from fertilizer use on 92,000 acres of silty clay loam soils represent $186,000 or near 10% the total for all soils.

USING POTASSIUM FERTILIZER efficiently on 343,000 acres of cotton in the Delta could boost the economy $4.68 million. The practice could contribute $1.07 million to the fertilizer industry, $0.9 million to the harvest equipment industry, and **return $1.92 million to the farmer annually for a number of years.** These evaluations were included in this report to highlight the need for potassium on cotton in the Delta.

For complete details of this study, order Technical Bulletin 65 from the Mississippi Agricultural and Forestry Experiment Station, Mississippi State University, State College, Mississippi 39762. **The End**

From NEW fertilizers kit (7 ways fertilizer influences):

Fertilizer influences crop maturity.

It speeds up maturity so plants don't waste energy on leaves, stalks, and stems during vital grain developing days. High phosphate and potash helped corn reach silking stage 7 days earlier in one trial—then, between silking and maturity, the potash kept the corn plants working longer to fill fatter ears. In another case, potash brought 67% of the corn plants to silk on target date compared to only 14% not receiving potash.

Fertilizer helps crops meet summer stresses.

Plants actually use less water to produce each bushel of grain or pound of dry matter. In hot summer, right balanced fertility "cuts off the plant's faucet" to reduce moisture loss, slows down the plant's breathing rate to save energy.

Bigger root systems can reach 4 or more feet deep for hidden moisture. Leaf-stalk growth covers the soil and reduces evaporation, slows raindrop impact, and decreases surface packing.

Order FERTILEGRAMS Page 4

Is there a pollution hazard from nitrogen fertilized forage grasses?

S. J. Donohue, C. L. Rhykerd, C. H. Noller, J. E. Dillon, J. R. George, K. L. Washburn, Jr.

PURDUE UNIVERSITY

ALFALFA, alfalfa-grass or pure grass forages fertilized with N are important sources of protein in livestock rations. Hay yields of 6 to 8 tons/acre, or more, have been obtained where grasses were liberally fertilized with N. With increased fertilizer rates, questions have been raised about the danger of nitrate pollution of the groundwater.

When determining pollution potential of N fertilizer, we must consider the actual amount of N taken up by the plant. Where N application equals N removal by the forage, there is little chance for pollution to occur.

A FIVE YEAR STUDY was conducted in central Indiana on the effects of various N rates on orchardgrass. The six treatments (0, 75, 150, 300, 600 and 1200 lbs of N/acre) were applied each year in four equal applications—

Table 1. Nitrogen removal increased as nitrogen fertilization increased up to 600 lbs N/A.

N applied lbs/acre/year	Nitrogen Removed By Orchardgrass lbs/acre/year					
	1964	1965	1966	1967	1968	Average
0	53	111	61	119	140	97
75	85	166	111	163	218	149
150	108	235	159	221	289	202
300	159	302	247	244	365	263
600	211	359	251	306	453	316
1200	222	309	244	316	396	297
average	140	247	179	228	310	

Table 2. Rainfall was below average 4 of the 5 years during growing season, April-October

	Total Inches	Deviation from average
1964	18.9	−5.8
1965	23.7	−1.0
1966	18.6	−6.1
1967	19.3	−5.4
1968	25.6	+0.9
30 year average	24.7	

one fourth in early spring and one fourth after each of the first three cuts.

Soil type was a Crosby silt loam. Plots were liberally fertilized each year with phosphorus and potassium to insure adequate amounts of each. Earlier studies have shown harvested forage grasses remove about the same amounts of N and K.

HAY YIELDS (12% moisture) during the study ranged from a low 1.5 tons at 0 N rate in 1964, to a high 7.8 tons per acre at the 600 lb N rate in 1968.

Table 1 shows nitrogen removal by orchardgrass increased as treatment rates increased up to about 600 lbs applied N per acre. Above this rate, stand reduction appeared to limit N removal.

Average N removal over the six treatments varied from year to year, affected mainly by differences in precipitation. **Table 2** shows rainfall was below average four of the five years.

Greatest N removal by orchardgrass occurred where rainfall was ample. High N removal values for 1967 were due to lower than normal temperatures during July and August, which stimulated orchardgrass, a cool-season grass.

Over the five year period, average N removal by orchardgrass (over the six treatments) was approximately 220 lbs/acre/year.

Considering the average N removal in a year with ample rainfall, one should be able to apply at least 250 lbs of N/A/year on Crosby silt loam with little concern for nitrate pollution in areas where 6 to 8 ton/acre yields are possible.

A split application of the fertilizer is recommended to minimize N loss.

Similar experiments with smooth bromegrass, tall fescue and reed canarygrass, as well as orchardgrass have given similar results on Chalmers silty clay loam near Lafayette, Indiana.

The End

FACTS from our Environment

• Would insects really threaten man and other parts of nature if man did not work constantly to control them?

Some startling answers to this question were recently featured in the Suffolk County Agricultural News:

Insects were present on earth 250 million years ago; man has been on earth only a million years.

Yellow fever and malaria have been nearly eradicated in the United States through the use of insecticides.

There may be as many as 2 million different kinds of insects.

More trees are lost to insects each year than are destroyed by forest fires.

Insects probably outweigh all other animal matter on the land.

About 200 million insects and mites may live in one acre of rich pasture soil.

The total flight distance covered by honey bees in producing a pound of honey would be equal to twice the distance around the world.

One aphid and its offspring, if none died, could produce 1,560,000,000,000,000,000,000,000 individuals in a single season.

Insects are found in a greater variety of places and surroundings than any other class of animals in the world.

Potato production in the United States has been increased one-third by control of insects.

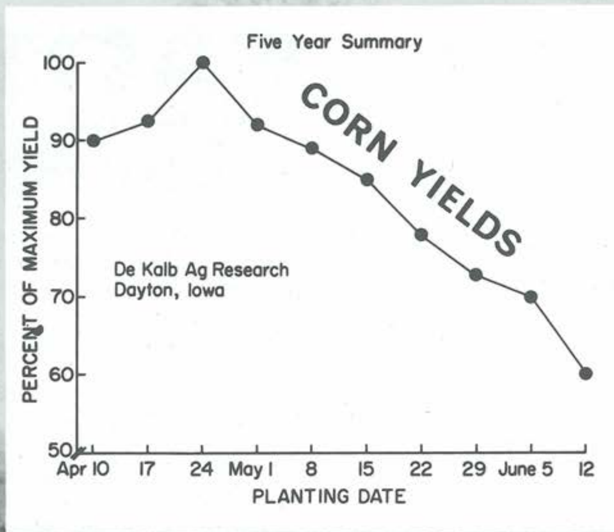
An outbreak of the spruce budworm in 1919-20 destroyed a 40-year supply of pulpwood based on rate of use at that time.

Insects have as many as 4000 different muscles, man less than 500.

The average annual bill we pay for insect losses and insect control in the United States amounts to 6 to 10 billion dollars.

A termite colony may contain 3 million individuals.

A single pair of house flies starting in April theoretically can produce enough flies by August to cover the earth to a depth of 47 feet.



Fertilizer is short, but there is ONE thing we can encourage farmers to do . . .

PLANT ON TIME . . . to boost yield potential . . . to help fertilizer do a better job . . . without adding cost.

The Corn Belt farmer is a miracle worker. The late 1973 season proved this. Illinois and Iowa farmers planted 50% of their corn acreage in ONE WEEK! Think of it—in a state with 11 million corn acres, such as Iowa.

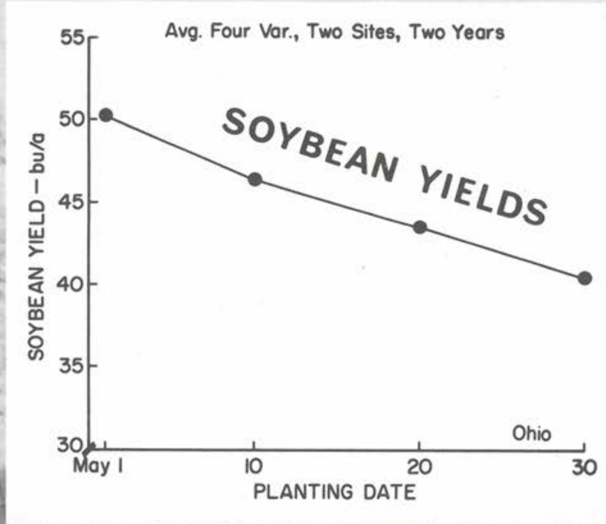
In 1972, Iowa averaged 116 bushels per acre corn. The 1973 estimates run 110 bushels—even with late season and nutrient shortages.

What would happen to our corn and soybean yields if we ever got our fertilizer on, basic tillage done, and 50% of our corn planted in the week of April 22—and all of it planted by May 5? Would we boost the national average to well over 100 bushels per acre?

Years of research charted above shows what right planting time means.

WITH CORN, April 24 gave best yields in Central Corn Belt. A week earlier or later reduced yields 8% or more . . . and the longer they waited to plant the more yields declined.

Early May was fine for corn a few years ago. But new developments—more cold-tolerant germ plasma, extra nutrients in



ROBERT D. MUNSON
ST. PAUL, MINNESOTA

starter, fall plowing, higher fertility—have put profit into early planting.

How early? Yield tests have given some tips: North of Central Corn Belt, April 22 . . . Eastern Corn Belt, March 20 to April 1 . . . Farther South, February and March . . . Farther North and West, first week in May.

Missing the best date can cost 15 bushels with 150 bu/A potential . . . 20 bushels with 200 bu/A potential . . . many dollars per acre.

WITH SOYBEANS, yield goes steadily down from May 1 to May 30—9.4 bushels lost per acre. Changing from last half to first half May might add 3 to 6 bushels . . . from June to late May, 6 to 17 bushels per acre.

Most 80+ bushel soybean yields in the Midwest have come from late April to May 1 planting in close rows—as far North as Oakes, N. D. that got 82 bushels from May 1 planting in 12-inch rows.

Improved herbicide control for soybeans makes early planting and closer rows practical.

REMEMBER: Early planting requires a close eye on planting depth—about 1½″ for corn, about 1″ for soybeans.

RIGHT TIMING can interact with other practices, as these 3 populations of 6 soybean varieties showed in 12-inch rows. With low stands, planting date became important to high-yield varieties. With a 3-week delay in planting—April 27 to May 18—the two low stands of high-yield varieties DECLINED 10 bu/A. Lodging was a problem at the high 260,000 plants/A.

(Iowa) SOYBEAN YIELD

	Planted April 27		Planted May 18	
Soybean Stand	Yield Avg.	Variety Yield Range	Yield Avg.	Variety Yield Range
1,000 ppa	bu/A	bu/A bu/A	bu/A	bu/A bu/A
105	67.1	77.4—59.8	64.8	70.2—58.8
183	66.7	81.1—59.5	63.0	68.8—58.4
260	63.1	71.3—56.9	63.3	68.7—59.0

RIGHT TIMING can pay off in cold northern areas. Spring barley in the Dakotas and central Canada responded to early planting. Here nitrogen (N) teamed up with early planting to add 10 bushels MORE per acre. Best dates were early April or May.

Seeding Time	N lb/A	Barley Yield (Avg. 12 trials) bu/A
Early	0	44.3
	60	55.3
2 weeks later	0	38.0
	60	45.7

RIGHT TIMING can fatten the pocketbook—like timing foliar-applied manganese (Mn) for soybeans.

Here the right number of applications at the right time added $30/A above check, even when initial yield was respectable.

FOLIAR APPLICATION

Manganese* rate	Number	Date	Soybean Yield	Net increase above check
lb/A			bu/A	$/A
0	–	–	56.5	–
0.15	1	6-19	62.7	13.35
0.15	1	7-2	66.1	22.70
0.15	1	7-17	66.5	23.80
0.15	2	6-19, 7-2	68.6	25.90
0.15	3	6-19, 7-2, 7-17	71.4	29.90

*Mn EDTA chelate applied—Wisconsin

RIGHT TIMING can get more out of irrigation and other practices. Here 100 lbs nitrogen (N) applied 4 TIMES through irrigation nearly equaled the yield of 200 lbs all applied at planting. But 200 lbs N applied 8 TIMES in 25 lb lots on the sandy soil got 192 bushels—the best.

This is using right timing to get maximum yield with minimum pollution—a big goal today. On finer textured soils in lower rainfall areas, the relationships would be different.

HOW TIMING, APPLICATION METHOD, AND N RATE AFFECTED CORN YIELDS
(Hubbard loamy coarse sand—Minn.)

Nitrogen Applied	Application Number	Application Time	N Rate Per Application	Corn Yield
lb/A			lb/A	bu/A
0	–	–	–	43
100	1	5-11 (at planting)	100	92
100	4	5-11, 6-11, 7-11, 8-11	25	154
200	1	5-11 (at planting)	200	158
200	8	5-11, 5-26, 6-11, 6-26 7-11, 7-26, 8-11, 8-26	25	192

RIGHT TIMING always plans ahead, so we don't shortchange our corn and starve our soybeans in the rotation. After corn received potash 4 years, soybeans responded to carryover and soil K—on what Illinois scientists called HIGH-K soil.

Total K_2O Applied On Corn 1967-70	K Soil Test Sept. 23, 1971 (air dry)	Soybean Yield 1971	% Increase Over Check
lb/A	lb/A	bu/A	%
0	272	50	–
240	287	57	14
360	307	63	26
1,200	448	70	40 (Ill.)

AND DON'T FORGET timing means little if you let your high-yield crops exhaust your soil. It can happen. Look at the removals JUST IN THE GRAIN of this corn-soybean rotation.

	P_2O_5	K_2O
	lb/A	lb/A
150 Bu CORN GRAIN:	50	42
50 Bu SOYBEAN GRAIN:	40	73
	90 P_2O_5	115 K_2O

(JUST IN THE GRAIN)

The End

The County Extension Agent For Agriculture

A BETTER CROPS Condensation Of The Talk By County Agent A. M. Warren, Logan County, Ky. To The Kentucky Extension Workers Conference

WHAT A MARVELOUS VEHICLE the Extension Service is for helping people help themselves. The County Extension Agent for Agriculture helps organize the human, natural, and financial resources in the county.

The overall object in agriculture is to increase farm income in the county and to work on urban-agriculture related problems such as lawns, insects, shade trees, and gardens.

We also work with the farm family on organizing the farm business, using the income for a more satisfying life. We need to remember that our programs must satisfy *their* needs.

WE INCREASE responsibility and productivity of much of our population by a program of motivation and education. In many major agriculture counties, a rather high percentage of the population is in production agriculture. Although only five percent of the national population is in agriculture, people who make tractors, chemicals, oil, etc. bring the national percent to 12 for production agriculture. This does not include processing and marketing of agriculture products.

The County Extension Agent for Agriculture provides an information service but this is only part of it. The overall function is to provide educational leadership in planning and executing programs in agriculture. This is accomplished by collecting, disseminating, and teaching factual information pertaining to agriculture to all people in the county as a part of the overall program supported by the state's Land-Grant University, USDA, and the local governing agencies.

WITH UNIVERSITY SPECIALISTS, the Agent must also evaluate state and national trends and see what effect this may have on his county.

For example, it would be poor judgment to encourage increased production of a commodity under declining usage or to encourage rapid increase in cattle numbers without a program for increasing pasture and hay.

With specialists, he must help the county leadership determine not only where they are now, but where they want to be in 5 or 10 years from now. This makes long-range program planning essential.

He must also devise programs or practices where resources fall short in his county to try to strengthen that area, if possible.

For example, in many of our

A working professional and active citizen . . .

counties with more rolling land, the no-till practice for row cropping has made these counties more competitive with the corn belt.

There should be a statement of broad program objectives and strategies for obtaining these objectives. Since it is impossible to do everything at one time, we must place priorities on more specific needs. The Agent links the extension organization to the local people by involving leaders in analyzing need . . . in identifying target audiences and their leadership. This is done through advisory councils, commodity groups, special interest groups, Ad Hoc Committees, etc.

For example, the Agent will work with as many as 14 or 15 organizations, such as Feeder Calf Association, D.H.I.A., County Fair Board, Livestock Improvement Association, Agriculture Council, and general farm organizations, as well as the Extension Council and many Ad Hoc Committees.

He must also search out expertise in his county and use these resources to further agriculture.

For example, close working relationship with agri-business to get them to give the College's recommended practices is important so we will all tell the same story. The agri-business person is the last one to see the farmer before he makes a final decision.

We plan with our people and we activate the plans. Then from time to time, we must revise and redirect our activities as feedback suggests. We often become so busy planning, activating the plan, and serving as an information source that we may be weak on evaluation. We must evaluate to determine how far we have come and where we need to go.

ARE WE GOING in the right direction? Are we using the best Extension methods? How effectively are we using our leaders in getting the vast storehouse of technology across to people and developing better citizens?

The County Extension Agent for Agriculture is responsible to two groups: the college and the people in the county. The Agent is the last link between tremendous college resources and the people.

The Area Director is Extension's closest line of supervision for the County Extension Agent, and this goes on through channels to the Assistant Director, Associate Dean for Extension, and the Dean.

It is essential to know Extension organizational structure for administrative and communication purposes.

The Agent must know and recommend only those things recommended by the College **based on research.** Since the amount of research information is so great, we must depend on area and state specialists to provide much of it in a condensed, simplified form. We must also rely on specialists for answers to many technical questions.

The Agent must be in contact with area and state Extension Specialists for training, subject matter content, recommendations, assistance with carrying out county programs, research interpretations, visual aids, and other helpful materials. He must be willing to take advantage of in-service training and work constantly to keep up-to-date.

THE INTERRELATIONSHIP between Research, Instruction, and Extension is important. The County Extension Agent is the eyes and ears of the Land-Grant University . . . to help determine areas needing research . . . to pass along research information . . . to serve as a catalyst for needed changes.

Many people provide information to farmers. The Agriculture Agent provides an objective, unbiased source of facts because he has nothing to sell. The key difference between Extension and other agencies is our association with the College. This is a two-way strengthening effect. It also helps the College relate to the needs of the people.

IN CONCLUSION, a good Extension Agent for Agriculture should always practice "professionalism" . . . should actively participate as a citizen of the community . . . should establish and maintain good public relations.

What a dynamic industry we are associated with as Agriculture Agents—our nation's agriculture. It is more exciting today than ever before because we have accumulated more knowledge, we have more answers. **The End**

Most profitable mistake he ever made . . .

HAMPTON, ARK.—"Temporary winter pasture will return a dividend to the livestock producer," C. M. Duncan of Calhoun County told L. W. Swaim, county Extension agent.

He cites as a prime example the 15 acres of properly fertilized and seeded Aubade rye grass he had in the fall of 1972. This 15 acres was seeded on November 1, on closely grazed Bahia grass, with 25 lbs. of Aubade rye grass and 300 lbs. of 12-12-12 fertilizer per acre at planting. Duncan then used a sharp harrow to lightly cover the seed.

Fertilizer recommendations were 600 lbs. of 12-12-12 per acre, so Duncan returned late in December, 1972 to apply the remaining 300 lbs. The commercial applicator made a mistake and applied 600 lbs. Duncan told Swaim that the mistake made by the driver returned him more money than any mistake he had ever made before.

Twenty heifers were pastured on this 25-acre field which had 15 acres of rye grass from November 10 to February 20, 1973. During this time, each of the heifers received 2 lbs. of supplement per day—and no hay. On February 20, excessive grass allowed Duncan to turn on 10 more mature cows which he grazed until March 15, 1973.

At this time, growth was such that he could turn on 22 more cows, making a total of 52 head which grazed on the rye plus the 10 acres of Bahia until June 26.

Duncan has been using rye grass as a temporary pasture for about 20 years and normally has been seeding 10 to 15 acres. He has already seeded 32 acres in 1973 and plans to seed more.

"Truly, farmers are the Genie that has made our nation prosper . . ."

A Golden Age is coming for farmers everywhere. The world market gives us a new frontier . . . but generally farmers are afraid of that with which they have no experience. Farmers need price supports, not price ceilings; encouragement (praise will help more than boycotts); and more assurance if they are to make their greatest contribution.

DAVID GARST
COON RAPIDS, IOWA

In Agri-Industry NEWS
Of The Corn Refiners Association
Washington, D. C.

MANY PEOPLE don't realize the progress made in corn growing. Still more are not aware of the factors that brought it about. This often leads to mistakes in predicting the future.

Before 1930, the average yield of corn in the United States was only 26 bushels per acre. We raised 2.6 billion bushels on about 100 million acres. For the last three years we averaged 90 bushels per acre and grew more than twice as much corn on ⅔ as many acres.

Before 1930, it took more than half an hour of labor to produce a bushel of corn. For the last few years farmers have produced a bushel of corn with less than three minutes of labor. Thus, in the 40-year period between 1930 and 1970 farmers have come more than 90% of the way from where we were to Aladdin's lamp. Truly, farmers are the Genie that has made our nation prosper.

HYBRID CORN came first. It took about 15 years to transfer the great bulk of the corn acres from open pollinated hybrid seed. As this transfer took place, yields rose 50%—from 26 bushels to approximately 39 bushels per acre in 1945.

Then corn yields leveled off. Relatively no progress was made for the next 10 years . . . but these were years of discovery and constant improvements in production techniques. There were continued improvements in genetics. The value of nitrogen and other input tools were demonstrated, although most were in short supply and too costly to be rapidly adopted. It was a period of hotter and drier than normal weather in the early 1950's that held yields down.

The real explosion started in 1955 when nitrogen fertilizer first became plentiful. Between 1955 and 1970 corn yields doubled, going up from 39 bushels to 78 bushels per acre for the period between 1966 and 1970. During this 15 years, hybrid sorghum was perfected and sorghum yields increased from only 20 bushels to about 55 bushels per acre.

This dramatic progress in crop production was predictable. It had already been demonstrated that synthetically fixed nitrogen was as effective as the nitrogen fixed by legumes. It also was common knowledge that nitrogen worked best when balanced with phosphate and potash . . . and all became available in increased quantity.

THIS LED TO continuous cropping. We abandoned rotations of low income crops in the mid-forties . . . and by 1950 were planting continuous corn. But it was not until the mid-fifties when soil insecticides were available that it became possible to grow continuous corn with real success.

Soil insecticides were effective—and inexpensive compared to other crop investments in land, labor, machinery, fertilizer and seed. With the fertilizer to feed the crop, insecticides made it possible to grow continuous corn . . . and rotations using less adapted land and low income crops an unnecessary expense.

This brought a fantastic expansion in irrigation across the Western Plains. Irrigation required continuous high income crop to cover costs. Nebraska increased its irrigated land from less than 2 million acres in 1955 to about 5 million acres in 1970.

New irrigation methods were also perfected in the mid-fifties. Fully automatic self-propelled center pivot sprinkler systems made it possible to irrigate unleveled land and porous, sandy soils. The first system of this type was patented in 1956.

ANOTHER INPUT—the widespread use of herbicides—closely followed increased fertilizer use. Any farmer who fertilized quickly found that fertilizer stimulated weed growth as much as crop production . . . and since 1960 effective pre-emergence herbicides became available in increased quantity.

The seed industry also was able to move ahead with these new cultural tools. With fertilizer to feed the crop, herbicides and insecticides to protect against weeds and insects, it became possible for the first time to produce single cross seed from low yielding inbred varieties.

Discovering male sterility and restoring parent lines by eliminating detasseling further reduced the high cost of single cross production . . . and higher yielding single cross seeds rapidly replaced the great bulk of standard double cross hybrids formerly used.

Simultaneously, artificial crop drying replaced the corn crib, the combine replaced the corn picker, and planting rates increased.

FOUR THINGS CONTRIBUTED to the fast adoption of these new tools: (1) Rising yields, of course. (2) Cooler, wetter climate than normal—giving farmers optimum crop conditions and widest advantage from new input tools. (3) Declining acreage (as yields went up) . . . limiting corn planting to choicest land. (4) More money available to pay for new input tools.

As the last remaining farmers adopt these corn production tools, yields should continue to go up . . . but it is doubtful if yield can go up as fast or as far as past achievements suggest. My guess is that corn yields, between 1970 and 1980, will not go up at all—that corn acreage, especially in the Western Corn Belt, will need to be substantially increased.

LOOK AT THE SITUATION corn farmers face today. We didn't get last year's crop harvested until mid-winter. Practically no fall plowing was done. No fertilizer was spread . . . and then it rained all spring. Only 80% of the intended corn acreage was planted in May. There was not enough manpower or machinery to make a good seed bed or plant the crop in a timely manner. Less fertilizer was used per acre.

Shortages are showing up. We are running out of the gas to fuel our tractors, dry our crops or even more important, to manufacture the fertilizer so badly needed to maintain high yields.

Irrigation has expanded to such an extent that many areas are drawing out water faster than it can be replenished . . . and water, like oil, is hard to pump out of a dry hole.

In 1970 Southern Corn Leaf Blight, previously unknown, violently attacked corn plants with male sterile cytoplasm, drastically cutting yields . . . and the seed industry now is no longer able to hold costs down with seed from male sterile plants.

ECOLOGISTS ARE ALSO adding to the problem. D.D.T.—the first really effective insecticide—has been withdrawn from the market, and pressure is now great to eliminate all chlorinated hydrocarbons. These make the best broad spectrum soil insecticides on the market today.

D.E.S. can no longer be used as a growth stimulant for livestock . . . **despite the fact that a person would have to eat more than a ton of liver to consume as much stilbestrol as is contained in a single birth control pill.**

Tractors, combines and other field implements have gone up in price far more than they have been improved, and with the present inflationary spiral this relationship is getting worse.

The rapid progress in agricultural production over the last 15 years has depressed farm prices. This, along with acreage restrictions, has forced many farmers to leave. Thus, the farm labor force is at an all-time low . . . at the very time when acreage and agricultural production must be expanded.

Without a doubt, it will be more difficult to reduce the labor required to produce a bushel of corn below three minutes than it was below the 30 minutes required in 1930.

This spring American consumers tried to boycott meat . . . when they no longer can expect the depressed prices they are accustomed to. Demand for meat is worldwide . . . and increasing.

LOOK AT JAPAN. Per capita consumption of beef is only $^1/_{25}$ as much as in the U.S.A. The average worker there earns less than a third as much as we . . . and they pay three times as much for the beef they eat. This means they must work nine times as long to buy as much.

But the protein crunch is also soybeans. With the present high priced soybeans and meal (the U.S. supplies nearly 90% of all soybeans used in international trade) chickens, turkeys, hogs and cattle, all will consume corn and other feed grains with less efficiency . . . and need for corn to produce the same amount of meat will substantially increase.

FOR MANY YEARS farmers have wanted a farm program that allowed them an opportunity to produce at full capacity . . . and price supports that would guarantee a profit. Seeing the perils that lay ahead, they asked the U.S.D.A. for such a program this winter.

By contrast, the U.S.D.A. gave them price supports so far below the market that they only guaranteed a loss . . . and restricted production at a cost to taxpayers of several billion dollars despite the highest price levels since the Second World War.

For this reason, we will not raise sufficient corn in 1973. In fact, it is questionable whether farmers ever again can grow enough corn to keep up with the demand for meat.

If U.S.D.A. economists don't flatten yield projection to reflect the most probable situation . . . and raise incentives to cover the risk of higher costs, farm prices may stabilize at a higher than needed level. **The End**

"Of all legumes, alfalfa is best. Once sown, it lasts 10 years. It can be mowed 4 times, even 6 times a year. It improves the soil and all lean cattle grow fat by feeding on it. It is a remedy for sick beasts."

Columella
Roman scientist, 60 A.D.

Legumes boost animal performance and health . . .

"It is very possible that properly fertilized legume-grass pastures, where no commercial nitrogen fertilizer has been used, actually makes it possible for the animal to develop its own resistance to disease and infection."

Henry Mayo
American scientist, 1973 A.D.

BEEF CATTLE PRODUCERS looking for a new opportunity may find it in permanent pasture improvement in the Corn Belt.

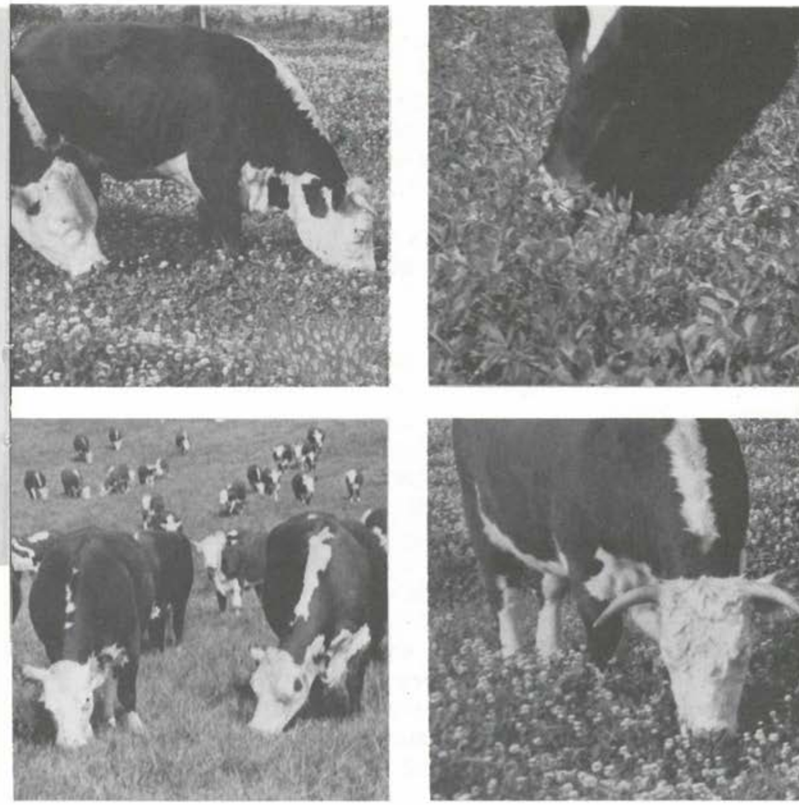
On some farms that manage and fertilize pastures properly, cattle thrive and calf weights average as much as 600 lbs at weaning time without supplementary crop feeding.

On other farms in the same community, many health problems may hit: first calf heifers going dry, cows failing to conceive, animals developing watery eyes, infected eyes, pink eye, even blindness, and grass tetany striking some.

Many permanent pastures carry no legumes—just bluegrass or fescue. Many get no lime, fertilizer or even manure beyond natural recycling through animal grazing. They are not clipped or rotated. And very often many of these grass pastures are unproductive during July and August—especially fescue, which becomes very unpalatable and contains an alkaloid (perloline) in July and August.

There are two ways to remedy this condition: (1) Mix legumes with permanent grass to sustain more mineral and protein balance in the rumen regardless of season or weather. (2) Fertilize the pastures liberally.

LEGUMES IN PASTURE indicate the soil is not acid and has a well balanced fertility program. Legumes are more sensitive, less adaptable than the more aggressive grasses. The grasses will often crowd out the leg-



. . . in permanent pastures

**HENRY MAYO, CONSULTANT
TO THE PURDUE SCHOOL OF VETERINARY SCIENCE**

umes—so much so the legumes simply starve to death.

Anyone wanting to establish legumes in a grass pasture (such as fescue or bluegrass) can take some key steps:

1—Test the soil. Apply plenty of lime so the pH is at least 6.5. Apply plenty of phosphorus and potassium, but no nitrogen.

2—Get rid of top growth. Clipping is not enough. Turn in a herd of hungry cattle. Rub it off.

3—Damage the sod 50-80% by discing, harrowing or using chisel plow, or a field tiller. This can be done most effectively in the fall or winter.

4—Inoculaté the legume seed and drill or broadcast the seed in February, March, or April. Better still, put on half the seed in February, going one way

The author acknowledges the assistance of Dr. Eldon Hood, Dr. M. P. Plumlee, Professor M. E. Heath, and Professor L. H. Smith, all of Purdue University.

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across the field and the other half in late March, going the other way.

SUGGESTED LEGUMES AND SEEDING RATES:

Mixture	Species	Rate/Acre (lbs)
1	Red clover	8-10
	White clover	1/2-1
2	Alfalfa	10-12
	Red clover	2-4
3	Annual lespedeza	20-25
4	Red clover	6-7
	White clover	1/2-1
	Annual lespedeza	8-10
5	*Empire birdsfoot Trefoil	5

*In the northern ⅔ of Indiana

Much pasture will often be produced the first year. This should be grazed. At the same time, watch the new seeding carefully. Clip out all competitive weeds and grasses. Manage to favor the legumes. If the animals graze certain areas too closely, cover them with a light coating of barnyard manure.

FERTILIZE LIBERALLY, because a 6-ton crop of legume-grass removes 90 lbs of phosphorus (P_2O_5) and 360 lbs of potassium (K_2O) per acre. This equals 200 lbs of 0-46-0 and 600 lbs of 0-0-60 per acre.

The first step is to take a small pasture and do everything to get top production. *It will cost money.* Assume pasture fertility is below average and you add enough plant food to make an outstanding pasture. The cost on one acre might run about like this:

180# - 0-46-0 @ $100/ton	$ 9.40
500# - 0-0-60 @ $60/ton	$15.00
	$24.40

Add to this the cost of lime (if needed), seed, inoculation, and labor.

Any interested farmer should take a small acreage (even one acre), give it top treatment, and FULLY USE the pasture with cattle and/or sheep. Check the carrying capacity per acre. Check the health and response of your animals. When each acre starts carrying more than a cow and calf or more than 5-6 sheep, then sufficient soil fertility is being recycled through the animals to make a top-profit pasture.

Large amounts of phosphorus, potassium, and lime can be applied any time of the year. It is very possible that properly fertilized legume-grass pastures, **where no commercial nitrogen fertilizer has been used,** actually make it possible for the animal to develop its own resistance to disease and infection.

Any pasture improvement program must include efficient utilization. We must utilize what we fertilize or we fail to make profits from the pasture. Careful stocking and/or rotation is the key.

Plant Food Utilization in Forage Crops—1b/A

	Alfalfa	Clover grass	Coastal bermuda	Orchard grass	Timothy	Brome-grass
	8 tons	6 tons	10 tons	6 tons	4 tons	5 tons
N	450	300	500	300	150	166
P_2O_5	80	90	140	100	55	66
K_2O	480	360	420	375	250	254
Mg	40	30	45	25	10	10
S	40	30	45	35	16	20

MEASURE PERFORMANCE and keep good records. Every herd of cows has certain ones that get along better than others. Weigh the calves at weaning or at one year of age. Check the regularity of conception, calf rearing, and freedom from trouble. A cow that does not settle regularly is less profitable than one that raises a good calf every year.

Performance testing is the key to a good cow and calf program because it spotlights the hard working, regular producers. How much do the calves weigh at 205 days? That's a good measure. The slow-gaining heifers should go to slaughter.

The health of the herd is a big key. **The only profitable animals are the healthy animals.** The road to profit avoids disease. As cow population grows, we must work harder to eliminate internal parasites and provide adequate forage with legumes.

PREVENT GRASS TETANY. Many areas report epidemic proportions of this problem. Grass pastures fertilized heavily with nitrogen and corn stalk refuse often test low magnesium for the lactating cow. Providing magnesium in a supplement has been the most successful preventive treatment.

Magnesium oxide, given to prevent grass tetany, is somewhat unpalatable to cattle. They don't consume it too readily. To help solve this problem, the following formula has been widely and successfully used:

40# Dicalcium phosphate
40# Magnesium oxide
20# Trace mineral salt
(Feed free choice)

Another popular mineral supplement consists of:

40# Magnesium oxide
60# of a 10-12% phosphorus complete mineral mix containing Vitamin A.
(Feed free choice)

If grass tetany is not a problem, then a simple mineral mixture consisting of 60 percent dicalcium phosphate or defluorinated phosphate and 40 percent trace mineral salt can be fed free choice. **The End**

From NEW double crop kit (10 questions and answers):

Can Soybeans be double cropped successfully after small grain?

Yes—very profitably as far north as Central Illinois and Indiana and even northwest Ohio, researchers and farmers have shown. This helps increase your soybean acreage without reducing corn or other crops.

What yields can I expect?

Some get 20 to 40 bushels. Purdue calls about 10 bushels breakeven. But don't plant in soils too dry for germination. If you don't get rain by July 15, forget double cropping that year.

Why remember double cropped soybeans when fertilizing fall seeded grain?

Because you'll rush to plant those soybeans right after harvesting wheat or barley—and rarely take time to fertilize the soybeans. **So—include next summer's soybeans in this fall's wheat fertilizer.**

Order FERTILEGRAMS Page 4

7 years of

Table 1. — Soil Test Phosphorus Values

Year	Fertilizer treatment, lb. per acre					
	None	P, 132	P, 264	K, 747	P, 132 K, 747	P, 264 K, 747
	P_1, lb. per acre					
1963	14.6	91.0	161.0	22.0	119.0	256.0
1964	12.5	62.7	104.7	16.5	60.0	186.0
1965	9.8	59.3	132.3	14.6	59.3	146.0
1966	8.2	30.0	87.0	11.2	45.7	78.7
1967	8.5	31.3	74.7	10.8	47.0	86.7
1968	8.5	20.0	52.0	9.0	31.0	62.0
1969	7.7	15.3	35.0	9.0	21.7	43.0

Table 2. — Soil Test Potassium Values

Year	Fertilizer treatment, lb. per acre					
	None	P, 132	P, 264	K, 747	P, 132 K, 747	P, 264 K, 747
	K, lb. per acre					
1963	185	176	178	716	725	702
1964	168	166	164	616	506	580
1965	134	131	128	448	322	350
1966	130	117	121	296	224	210
1967	134	114	113	220	163	165
1968	127	124	125	179	135	152
1969	122	111	116	166	132	138

W. M. Walker
J. A. Jackobs
T. R. Peck

In
ILLINOIS RESEARCH
University of Illinois

SEVERAL SUCCESSIVE alfalfa crops can rapidly use large applications of phosphorus and potassium fertilizers.

This fact became readily apparent during a seven-year experiment to determine how rate, method, and timing of fertilizer applications affect alfalfa yields. The study was conducted on a Blount silt loam at the Northeastern Illinois Research Center near Elwood.

We are concerned here with just one aspect of the larger study—the fertility status of the plots where phosphorus (P) and potassium (K) were incorporated into the seedbed.

(Results of the total study have been published in Illinois Agricultural Experiment Station Bulletin 738.)

Seedbeds were prepared in August, 1962. Fertilizer was incorporated into the soil at the following rates per acre: **(1) 132 pounds P; (2) 264 pounds P; (3) 747 pounds K; (4) 132 pounds P plus 747 pounds K; (5) 264 pounds P plus 747 pounds K.**

Control plots received neither phosphorus nor potassium.

Every year the soil was sampled in early spring and after each clipping. Values reported for each year in **Tables 1** and **2** are thus averages of several samples.

alfalfa harvests deplete soil P & K

SOIL PHOSPHORUS. As would be expected, rather large values for soil P were obtained in 1963 on plots receiving high rates of P fertilizer **(Table 1).**

Even on plots receiving only K fertilizer, available soil P was considerably higher than on the untreated plots. A similar effect has been noted by other research workers. Probably the high rate of potash salts increased solubility of the native soil phosphorus.

Between 1963 and 1969, soil P decreased markedly on all plots. Yield and phosphorus content of alfalfa were highest on plots receiving P fertilizer.

So, soil phosphorus declined fastest on these plots. Even so, the effects of fertilizer P on the soil levels of available P were still apparent in 1969.

Since 1965, decline in soil P on plots receiving no fertilizer has been rather limited. Probably the soil is approaching an equilibrium where a relatively constant level of available phosphorus will be maintained by soil minerals.

But, it is unlikely high alfalfa yields can be produced on these plots without fertilizer.

SOIL POTASSIUM. The increase in soil K due to fertilizer K is shown in Table 2.

With continued removal of alfalfa forage, soil K values decreased on all plots.

After 1965, only a slight decline in soil K occurred on plots receiving no K fertilizer. Evidently, an equilibrium is being approached in soil K values, with only slight annual decreases occurring as the alfalfa utilizes K released by native soil minerals.

As was observed for low soil P values, it is unlikely that high alfalfa yields can be obtained at these low soil fertility levels. Soil K values from plots receiving both P and K fertilizers indicate that all the fertilizer K had been used by the end of the growing season in 1966.

RESULTS FROM this experiment show that soil test values declined rather rapidly as nutrients were removed from the soil by alfalfa.

Low soil test values were probably maintained by the release of nutrients from native soil minerals.

This maintenance level is related to soil characteristics, and a specific value would only characterize a particular soil for a specific crop. **THE END**

An open letter

Dear Wise Men:

I hope your code people can translate this. I call you Wise Men because you must be very wise to travel from the heavens to our little ball . . . and reveal your ships to so many earthlings . . . and even play tag with our primitive craft . . . while eluding our best understandings.

I have no idea why you are looking in on our planet, but you must bring amazing knowledge with you. To that knowledge I address this letter. Something keeps telling me you will ultimately bring great benefits to our planet . . . in a common language.

Language is one of our problems. We earthlings speak in so many different tongues millions of us cannot understand each other. So we depend on a handful of leaders to communicate and try to keep us from destroying the planet. In a sense, we are at the mercy of the character—or lack of character—in our leaders.

We have been killing each other since the beginning of our records. Someone once said we have enjoyed just 222 years of peace in the thousands of recorded years. I can't guarantee that figure. But I do know we have had 3 major wars in my 51 brief years here and countless smaller ones, including a recent one in an area some earthlings call the Holy Land.

It is called Holy because 2,006 years ago a force many believe to be the creator of the universe—a power we call God—sent his Son into that area as an example to us. Earth has never had more wisdom to come out of one creature than the truth that came out of this Son.

Yet, He was an enigma by earth standards. Most earthlings looking for Him expected a king . . . or certainly the president of the biggest bank in Jerusalem . . . or, at least, one of the more mature vice presidents of the university up at Athens or Rome.

Instead, this power we call God chose a stable for the birth of His Son and carpentry for his career. In his last 3 years, the Son became a wandering teacher with dusty roads and hillside pastures for a classroom.

Many earthlings were bitterly disappointed. In their thwarted lives of watching richly dressed men and women come and go in well draped carriages to finely furnished institutions, they wanted a mighty king to come and bring all that splendor to its knees . . . and transfer it to THEM.

They couldn't see how any power could come from a Carpenter who had walked into a river with an oddball named John and out of it to become a country preacher. Yet, a handful of them sensed something different about Him. They did not know why He had come as a humble Carpenter but their instincts told them to follow Him. And they did . . . and have . . . down to this day . . . a handful.

I mention them because I have heard they sometimes wonder if you are advanced squadrons surveying for the Carpenter's return to this planet. They allegedly believe He will return and convert the planet into eternal peace and prosperity. Not to outdo or outcunning each other—but to enjoy the planet as the Creator first meant.

Most earthlings call such thinking fuzzy idealism. It is done usually by simple teachers in remote classrooms. I suspect you know little about such things . . . except the word that must have reached the heavens when the Creator's Son was killed after rejecting the fortune and power to buy his freedom from a crucifixion cross.

Through much of our history, we earthlings have tended to respect the cunning of the mind—that can wheel and deal itself to top power. We have tended to suspect the compassion of the heart—that can love an enemy and forgive a scoundrel. When we have a choice, we seldom ask great hearts to lead us—except out of great tribulations. We prefer the well organized mind.

Indeed, well organized minds have brought our planet to its present remarkable stage. If our planet was an individual earthling, our doctors might call it

to the UFO crews . . .

schizophrenic . . . that's a split personality. Today one side of our planet lives a life called capitalism, the other side a life called communism.

It would drive your code people crazy if I tried to explain the difference in detail. In a nutshell, the difference involves the Creator and property.

Communism does not claim to believe in the Creator we call God and does not allow earthlings to own property. The state owns virtually everything and the individual earthling works for this state. Yet, you'll find many little bands of earthlings on that side of the planet meeting quietly, secretly to worship the Carpenter . . . and some managing to sell personal items for personal profit now and then. But you don't hear them talk or debate or question too much.

Capitalism claims to believe in the Creator we call God and allows earthlings to own all the property their energy and inclinations can acquire. Theoretically this system thrives best with a minimum of government, but realistically it seeks as many government contracts as it can get. When a man gets down and out and seeks aid from this government, he becomes a welfare case. When a large business seeks help from this government, it becomes a subsidy case.

But a key difference between the two systems is personal freedom of the average earthling. If you want an idea of this freedom, send your wiser pilots to hover-study our capital city. But don't let them hover too closely . . . they may get what we call "Potomac Fever."

This fever can do strange things to those who are susceptible to it. And you don't know if you are susceptible until you expose yourself. Fortunately, it strikes only a few and it can be cured. But while it lasts, it can make you think you are a king . . . hearing trumpets blown just for you.

It can send you out to buy clothes and dwellings and vehicles you can't afford but feel compelled to get. It can make you drop names of "top leaders" who wouldn't know you if they saw you. It can make you imply much wealth in a "close friend" who couldn't raise 100,000 inflated bucks if pressed. It can make you suggest brilliant talents in a "close colleague" who may be a third-rate bond peddler.

Diagnosticians say the fever makes you do these things to feel secure in all this hurricane of freedom . . . hot debate . . . tough questioning . . . unlimited tale carrying . . . and plain old-fashioned orneriness that only a free people can tolerate and thrive on.

In the eye of this hurricane you will find creatures who call themselves reporters. They strike sparks . . . and sometimes nerves. But their presence is not to be feared nearly so much as their absence. They cannot always be right, but they must be free to be wrong and corrected, if freedom is to survive.

Your pilots will not find these kinds of reporters on the other side of our planet. They are the biggest difference between our two systems. They constantly probe the tendency in many earthlings to become kings . . . with remarkable minds that never seem to sleep.

Your minds must also be remarkable . . . to reach us through a universe our little brains cannot grasp. Your hearts must be from heaven . . . to come and watch and listen and not lose your patience with our puzzling pretenses. You may have your own foibles and understand us well.

In any event, I look forward to meeting you some night on a quiet road when you dip down to inspect our auto. Please don't let my fear insult you. We earthlings usually fear what we don't understand. And we have never understood divine power.

Sincerely, SWM

P.S. Merry Christmas to you . . . one and all . . . especially your hard-working pilots! Christmas is the birthday of the Carpenter I mentioned. We have celebrated it ever since He rose from a borrowed grave to return to the heavens.

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3—What are the best ways to apply potassium and when?

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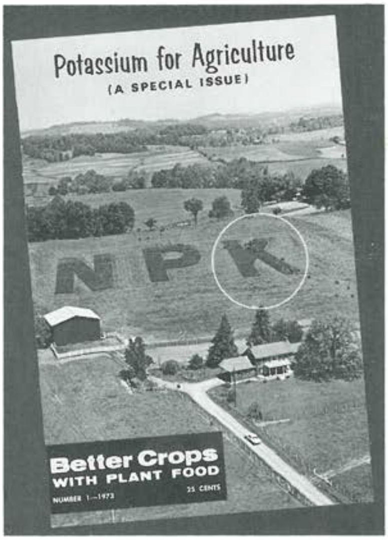

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