BETTER CROPS with plant food

SUMMER 1978 25 CENTS

CORN
ROOT
ENEMY

SEE
PAGE 3

BETTER CROPS with plant food

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Contents

"Worst nematode damage we ever saw," said several nematologists of this field near Springfield, Illinois in 1977. Yield loss of this spot was total even after replanting.

NEMATODES
Emerging Problem In Midwest Corn

GEORGE JOHNSON
Inter/Agriculture
Chicago, Illinois

NEMATODES HAVE NOW been identified as a definite cause of widespread yield losses in Midwest corn—not in every field, but enough infestations to be a concern to everyone involved in growing corn or conducting research on corn.

For example, nematodes can severely affect yield test data in a plot.

In the south, nematodes have been a major problem in corn for many years, and diagnosis and control programs are well developed.

In the Midwest, we are finding that nematodes can be even worse yield reducers than high populations of corn rootworms or European corn borers.

A PRIME EXAMPLE of an extreme

Stalk disease often comes in behind nematodes . . . may actually reduce yield more than nematode root damage.

problem was a field near Springfield, Illinois in 1977. The first planting began to fade a week after emergence.

They replanted. The crop loss was still 100 percent in some areas of the second planting. The field made 90 bushels per acre overall. It should have averaged 150. The cause was identified as **lesion nematodes.**

In 1976, a late season sample of corn roots from a Waverly, Iowa low-yield field contained **4,100 lesion nematodes per gram of dry root tissue. Even 1,000 is considered cause for concern.**

Other nematode species — **needle, lance, stunt, and dagger** — have been found in damaging numbers in some midwest fields.

A growing body of University test data and assays indicate frequent yield losses in the **5 to 20-bushel range** everywhere. Dr. Don Norton, Iowa State University nematologist, estimates a **5 to 10 percent overall loss** to nematodes in Iowa.

NO AREA AND NO SOIL type seem free of possible buildup. Formerly thought to be a light soil, poor land problem in the south, we now know nematodes can reach damaging levels on our deepest, blackest, highest fertility soils.

No place where corn is grown can feel secure. Soil and root assays indicate a probability of problem numbers, just about everywhere.

Small numbers of pathogenic nematode species are present in every field. It's just that they usually don't build to numbers that reduce yields.

When they do, it is often early in the season and plants never quite recover. Root and stalk diseases often find their way in through the nematode damaged cells. Some nematode species are known carriers of certain virus diseases.

DRY WEATHER LATER in the season accentuates nematode damage. The weakened root system can't bring in enough moisture—or nutrients. The

Soil assay is usually made in midsummer. Soil is dug or probed close to the plants to assure plenty of roots for testing.

visible symptoms of nematodes are therefore signs of drought stress and nutrient deficiency.

But, more commonly, **nematode injury can't be seen.** There may be a certain unevenness of yield across a field **—and 15 bushels less corn than expected.**

Early in the season, you can sometimes identify nematode damage as weakening of the young plants after emergence. Areas of a field turn sickly. It may grow out of it—or may stay behind all year.

Miniature corn plants, less than a foot tall are often found in September in severe nematode damage areas.

What is the probability of an individual corn grower having a yield cutting nematode problem? No one knows for sure. The 5 to 10 percent yield loss to nematodes estimate adds up to a lot of corn.

Many fields suffer little or no damage, so that means others are in trouble. Any farmer who covers a fair amount of geography probably will have some spots of nematode buildup.

ZEROING IN ON NEMATODES as a problem usually means **first eliminating the possibility of other problems** like herbicide carryover, a poor job of applying fertilizer, or any number of other causes of spotty corn growth.

A nematode assay can be taken to get species identification and population counts anytime the ground isn't frozen, but midsummer is the best time.

An assay will give you counts of different nematodes living free in the soil, plus the numbers in the roots. The assay will also help indicate damage thresholds and suggested treatments.

Assaying is available from plant pathology departments of most agricultural colleges and several private labs are now offering them.

ANOTHER MEANS of identifying a nematode problem field is the **field strip test.** A nematicide can be applied

It wasn't hard for North Carolina researchers and growers to tell where this nematode infected corn stopped and the Furadan treated corn started in the background.

on marked rows alongside untreated rows.

If done on first year corn where rootworms are not a problem and other insects do not build up to reduce yields, any yield difference is in all likelihood due to nematodes.

What else about risk and control?

Rotations do not prevent corn nematode buildup. Plowing seems to inhibit them some. Poorer soils may suffer more damage because they tend to produce weaker plants. Corn following wheat seems to carry a higher nematode risk. Fast nematode buildups seem to happen more often in no-till corn.

If you have a suspected nematode problem, you can apply a granular nematicide in the row at planting. Treatments have led to yields up to 30 bushels higher than the untreated areas.

NEW AIDS—PAGE 32

This corn root (blowup) is suffering from lesion nematodes.

ALFALFA

FRANK W. SCHALLER
Iowa State University

ALFALFA IS the highest yielding, top quality perennial forage grown in Iowa for hay or haylage.

Six tons hay or 12 tons haylage supplying 2300 lbs of protein per acre are grown frequently. Eight tons hay or 16 tons haylage per acre supplying 3000 lbs of protein are grown occasionally.

The following are guidelines for achieving 6 to 8 tons/acre of alfalfa or alfalfa-grass.

1. **Select a deep, well drained soil.**
2. **Lime the soil to near neutral, pH 6.9 to 7.0,** at least six months in advance.
3. **Fertilize according to soil test before seeding.** See table below. These rates are based on the removal of oats and alfalfa in the seeding year as hay or haylage plus maintaining a high soil test level or raising the test toward that level.
4. **Establish a thick stand of high yielding variety with disease resistance.**
5. **For straight stands of alfalfa seed 12 to 15 lbs/acre of innoculated seed.** If an alfalfa-grass mixture is desired seed 8 to 10 lbs innoculated alfalfa with 8 lbs bromegrass or 4 lbs orchardgrass. For the oat companion crop seed 2.5 to 3.0 bu/acre of oats.
6. **Highest forage yields in the seeding year will be obtained from a seeding which includes an oat companion.** If desired a straight stand of alfalfa can be seeded using an herbicide for weed control.
7. **Harvest in the seeding year when oats are in the late boot stage or just starting to head.** A second cutting can be made in about 6 weeks. In some years a third cutting may be possible in the fall after a temperature of 24° kills the leaves.
8. **Topdress annually after the seeding year with 80 lbs P_2O_5 and 300 lbs K_2O per acre for a 6-ton yield, and 100 lbs P_2O_5 and 400 K_2O per acre for an 8-ton yield.** Apply one-half the fertilizer after the first cutting and one-half after the third cuting.
9. **Follow insect control recommendations in ISU publication IC-328 (Rev.).** If alfalfa weevils are a problem and cause 25% of alfalfa tips to be damaged, harvest the crop if within about 5 days of normal harvest time. Otherwise spray with a recommended insecticide. Watch for potato leaf hoppers after the first cutting and spray at first sign of damage.
10. **Start the first harvest in the late bud stage and complete the harvest by one-tenth bloom.** Make second, third and fourth harvest at 30 to 35 day intervals thereafter.
11. **The fourth harvest should be completed by September 10 to 15.** This will allow a recovery period for building root reserves before frost.

Soil Test Level			Rate To Apply Lb/A*	
Class	P	K	P_2O_5	K_2O
Very Low	15	70	80	170
Low	16-25	71-125	70	160
Low-Medium	26-35	126-150	60	130
Medium	36-45	151-200	50	100
High	46-75	201-300	30	80
Very High	75	300	0	0

*Apply 20 to 60 lbs/acre nitrogen to increase oat yields.

Are You Getting FULL VALUE From Your Soil Test?

T. R. PECK
University of Illinois

D. W. DIBB
Potash & Phosphate Institute

A BASIC GOAL of a good soil testing program is to provide the kind of information that will help the grower manage the whole field for optimum economic production.

Maybe we need a soil test that provides more information. That's a possibility. But just by better understanding what a soil test does, a simple pH, P, K soil test can become more valuable.

UNDERSTANDING A SOIL TEST. A specific soil sample, when analyzed, gives information on that soil which is used in the test.

If soils are sampled properly, so that a representative sample is taken, the test can accurately describe a relatively large area.

But a composite sample over a very large area can hide variation, a knowledge of which would be potentially useful in making recommendations that will provide for maximum economic returns.

AN EXAMPLE. Soil tests from a 40 acre field can show the potential advantages of a more intensive sampling program. In **Figure 1,** the soil test results have been placed on a diagram of a 40 acre field in the approximate location from which they were taken.

VARIATION IDENTIFIED. A quick survey of the data does not show large differences from top to bottom or side to side which could lend themselves to prescription fertilization.

These differences could occur because of consolidation of smaller differently managed fields for a larger management unit. Including an area which previously existed as **a feed yard, a farmstead,** or **a field that had heavy manure** applications over a number of years, or **a severely eroded area** could also cause these differences.

These data show a large degree of random variability throughout the field. This information, along with the potential for spot treatment with prescription fertilization, may be one of the greatest values of a more intensive soil sampling program.

The arithmetic average of these 12 soil samples, which would essentially represent a single composite sample across the 40 acre field, is pH, 5.9; P_1, 49; and K, 344. These values are determined by adding the tests together and dividing by the number of samples.

INTENSIVE VS COMPOSITE SAMPLING. An ordering of the data from the more intensive sampling gives

Figure 1. Soil tests from a 40 acre field.

pH 5.8 P_1 86 K 248	6.8 20 216	6.4 26 560
5.6 46 280	5.6 34 280	6.2 30 340
5.5 42 268	5.1 115 270	6.8 28 212
6.0 28 300	5.7 35 310	5.7 92 840

Average pH—5.9, P_1—49, K—344

another perspective of the "average" soil fertility condition in the field based on soil sample area when compared with the arithmetic average which would be analogous to a composite sample, shown in **Table 1.** The mid-point of such an ordering of the data is called the median.

The arithmetic average pH (5.9) is quite close to the median of the soil tests in the more intensive sampling.

A knowledge of this range of pH tests might be especially useful to a farmer planning to plant a legume such as soybeans or alfalfa.

A high percentage of the field might

Table 1. Distribution of soil samples from a 40 acre field

pH	P_1	K
5.1	20	212
5.5	26	216
5.6	28	248
5.6	28	268
5.7	30	270
5.7	34	280
5.8	35	280
→ Avg. 5.9		
6.0	42	300
6.2	46	310
	→ Avg. 49	
6.4	86	340
		→ Avg. 344
6.8	92	560
6.8	115	840

still be well below what is normally considered the optimum point for the production of these crops, even after a relatively modest adjustment as indicated by the average (5.9) was made through the liming program.

The P and K test distribution in the more intensive sampling of the field is not well represented by the arithmetic average test (composite). At least 75% of the samples fall below the average in each case.

The median values are a better choice for guiding lime and soil fertility decisions than are arithmetic average values or composite samplings.

EFFECTS ON PRODUCTION AND ECONOMICS. In terms of production, this disparity could be very costly to the farmer. About 75% of the field would be underfertilized for P and K by using the composite sample as a basis for recommendations.

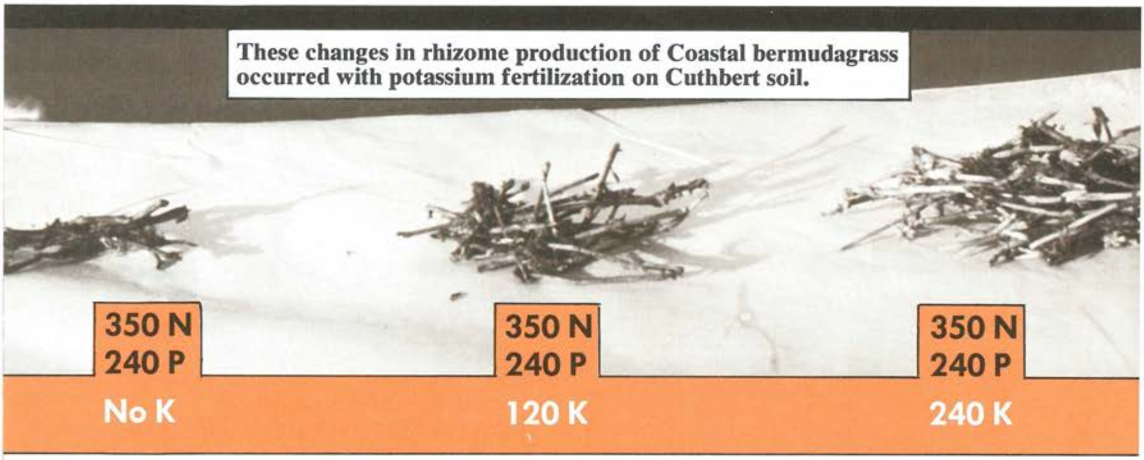
Because of the nature of the yield response curve and fertilizer use economics, a farmer is generally better off to over-fertilize than to under-fertilize. This is especially true with P and K which are held tightly in the soil.

Any excess applied will show up as residual in future soil samples. For optimum return, a farmer could benefit from a more intensive sampling and fertilizing so that the most infertile areas are brought up to optimum levels. The result would be the whole field at a higher net return level.

SUMMARY. To get the fullest value from a soil test program, a farmer should map his field and sample in a systematic pattern with enough intensity so that fertility variation is identified.

The benefits of the more intensive sampling occur not only in cases where prescription fertilization can be practiced, but also where significant areas of less fertile soils exist randomly in the field.

Because of the nature of the yield response curve and fertilizer use economics, the farmer can then fertilize so that the least fertile areas of the field are producing at optimum economic levels.



These changes in rhizome production of Coastal bermudagrass occurred with potassium fertilization on Cuthbert soil.

POTASSIUM HELPS

MAINTAIN STAND
PREVENT WINTER KILL
PROMOTE STRONG ROOT GROWTH
on

COASTAL BERMUDAGRASS

TERRY KEISLING
Texas A&M Agricultural Research And Extension Center

COASTAL BERMUDAGRASS is an important hay crop in the southern United States—a high producer from Texas to the Atlantic ocean and as far north as winter temperatures do not "winter kill" the rhizomes.

The hay yield has been shown to increase when the stand increases — so stand maintenance is important in maintaining good yields. An important facet of stand maintenance is rhizome production **and** quality since temperatures as low as 26 to 28°F kill all above ground plant parts.

At the Texas A&M University Agricultural Research and Extension Center at Overton, some stand characteristics were observed on two different soils. A previous **Better Crops** article (February, 1977) gives details of the studies. Stand, rhizome production, rhizome regrowth reserve, and root vigor were studied. Stand characteristics are shown in **Table 1.** Note the influence of K on the early stand obtained.

OTHER RESEARCHERS have shown that yield is reduced directly as stand is reduced. Perhaps K influences

These rooting characteristics of Coastal bermudagrass were influenced by potassium fertilization on Cuthbert soil.

Lb/A FERTILIZATION: 350 N, 240 P, 240 K

Lb/A FERTILIZATION: 350 N, 240 P, 120 K

Lb/A FERTILIZATION: 350 N, 240 P, No K

Table 1. Visual Stand Ratings and Rhizome Production as Influenced by Potassium Rates.

Potassium Rate lbs K_2O/A	Visual Stand Ratings Spring*	Late Summer**	Rhizome Production Spring*	Fall*	Regrowth Reserve***
	%		lbs/acre		%
0	43	17	1073	112	23.3
120	73	59	1797	172	23.7
240	69	88	1938	1540	22.3
LSD_{05}	11	9	680	898	9.2

*Darco soil, **Cuthbert soil, ***Average of Darco and Cuthbert soils.

concerning rhizome productivity are more important. Note on the Darco soil in the spring, the increase in stand is almost the same as the increase in rhizomes.

Another aspect of K deficiency is shown **on page 11.** Potassium deficiency results in decreased root vigor and growth.

Reducing root vigor and growth results in plants less able to exploit the soil and to extract water and nutrients. This is shown dramatically **on page 11** where the Coastal bermudagrass actually died during a summer drought on those areas receiving zero K.

"WINTER KILL" has been observed in the past to be reduced with adequate K fertilization. Bermudagrass has also been "hardened" to lower temperatures by increasing K fertilizer used.

The importance of rhizomes in regenerating spring growth is general knowledge but the influence of K fertilization on rhizome production has not been shown.

Data in **Table 1** and **page 10** for the Cuthbert soil demonstrate reduced rhizome production during the growing season without an equivalent reduction in stand.

Winter kill should be severe for the middle K rate, because there are not enough rhizomes to regenerate the stand in the spring.

REGROWTH RESERVE in the rhizomes measures those parts of the rhizomes which may be used to provide energy and cellular components needed for growth of new shoots.

The percentage regrowth reserve in the rhizomes was found to be about the same regardless of K fertility. This indicates that what rhizomes are produced under a given level of K fertility are as effective as those produced under any other K fertility levels in providing material for regrowth.

The major factor, then, concerning the influence of rhizomes on the stand is the amount of rhizomes present.

MANY GROWERS caught in a price-cost squeeze tend to reduce their K fertilizer rates.

Depending on soil K reserves, forage production levels, and previous fertility practices, many Coastal bermudagrass hay meadows are showing some of the characteristics of inadequate K illustrated in this article.

Reducing K applications under these conditions can do nothing but further complicate the problem for the grower, since he is reducing his chances to operate at a profit.

Potassium Fertilization In CENTRAL ALBERTA

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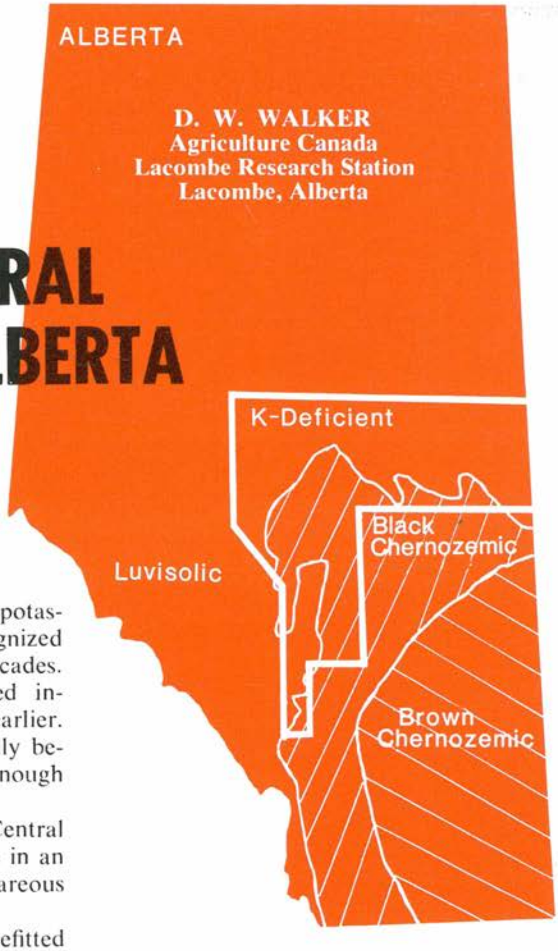


SIGNIFICANT AREAS of potassium deficient soils have been recognized in Alberta during the past two decades.

There had been some isolated instances of potassium response earlier. Yet Alberta soil scientists generally believed the soils of Alberta had enough plant available potassium.

But a group of farmers in Central Alberta felt otherwise. They were in an area of imperfectly drained, calcareous chernozemic soils.

When barnyard manure benefitted their crops more than nitrogen-phosphorus fertilizers, they were convinced potassium supplies were inadequate.

In response to their requests, small plot field studies were placed on these soils. They confirmed potassium deficiency.

POTASSIUM DEFICIENCY was so extreme on some of the soil areas that no grain yield was obtained when potassium was not added with the nitrogen and phosphorus. The soil conditions resembled those encountered in Iowa several decades ago.

The problem in Alberta was thought first to be confined to the imperfectly drained calcareous soils. But as the Alberta Soil and Feed Testing Laboratory expanded soil testing in the province, it became clear that other (non-calcareous) soils had relatively low levels of exchangeable soil potassium.

Consequently field testing for response of barley and rape to added potassium was expanded to include a great variety of soil conditions and exchangeable soil potassium levels.

During the past 15 years the field testing combined with soil testing has confirmed that some 2.5 million acres of agricultural soils in Central Alberta probably contain insufficient available potassium for maximum yield of cereal crops or rapeseed.

The soils range from calcareous to acidic and include gray wooded luvisolic, black chernozemic, and organic.

ANALYSES OF SOIL SAMPLES collected from the individual field sites were used to "calibrate" exchangeable soil potassium (neutral in ammonium acetate extractable) and the probability of obtaining a yield response from the addition of potassium fertilizer.

Table 1 shows the "calibration" for barley based on 115 field tests. The probability of obtaining a yield increase from potassium fertilizer is 2/3 or more when soil exchangeable potassium is 150 lbs per acre or less in the 0-6" depth.

But the probability decreases rapidly when soil potassium level rises above 150 lbs per acre. Essentially there were no responses when the soil potassium level exceeded 250 lbs per acre.

Similar data for 44 field tests on rapeseed showed very low probability of yield response from potassium fertilizers when soil exchangeable potassium levels exceeded 150 lbs per acre. **Table 2** shows percentage yield increase tended to be less than for barley.

THE MAIN AREAS of potassium deficient soils straddle the border of the black chernozemic and gray wooded luvisolic soils of central Alberta, shown on the map. Smaller pockets of K deficiency occur in the Peace River Region of Northern Alberta.

The field tests studied potassium fertilizer rates and placement for both barley and rape. Rates up to 80 lbs K_2O per acre were tested in some years. **Figure 1** shows data for 15 and 30 lbs K_2O on barley.

Table 1. Yield Response of Barley to Added Potassium Fertilizer at Different Levels of Exchangeable K.

Lbs./A Exchangeable K 0-6" Soil Depth	% of Test Sites Giving Yield Response	% Increase in Yield From K Fertilizer*
<50	100	>1000
51-100	75	242
101-150	66	47
151-200	24	30
201-250	18	34
>250	3	11

*% yield increase calculated for those field sites that gave yield increases from potassium fertilizer.

Table 2. Yield Response of Rapeseed to Added Potassium Fertilizer at Different Levels of Soil Exchangeable K.

Lbs./A Exchangeable K 0-6" Soil Depth	% of Test Sites Giving Yield Response	% Increase in Yield From K Fertilizer
51-100	50	39
101-150	19	28
151-200	6	25
201-250	0	—
>250	0	—

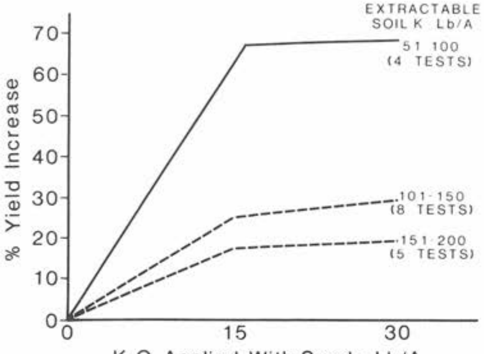
The additional yield increase by going from 15 to 30 lbs per acre was relatively small regardless of whether the original deficiency was slight, moderate, or severe. Similar results occurred with rapeseed.

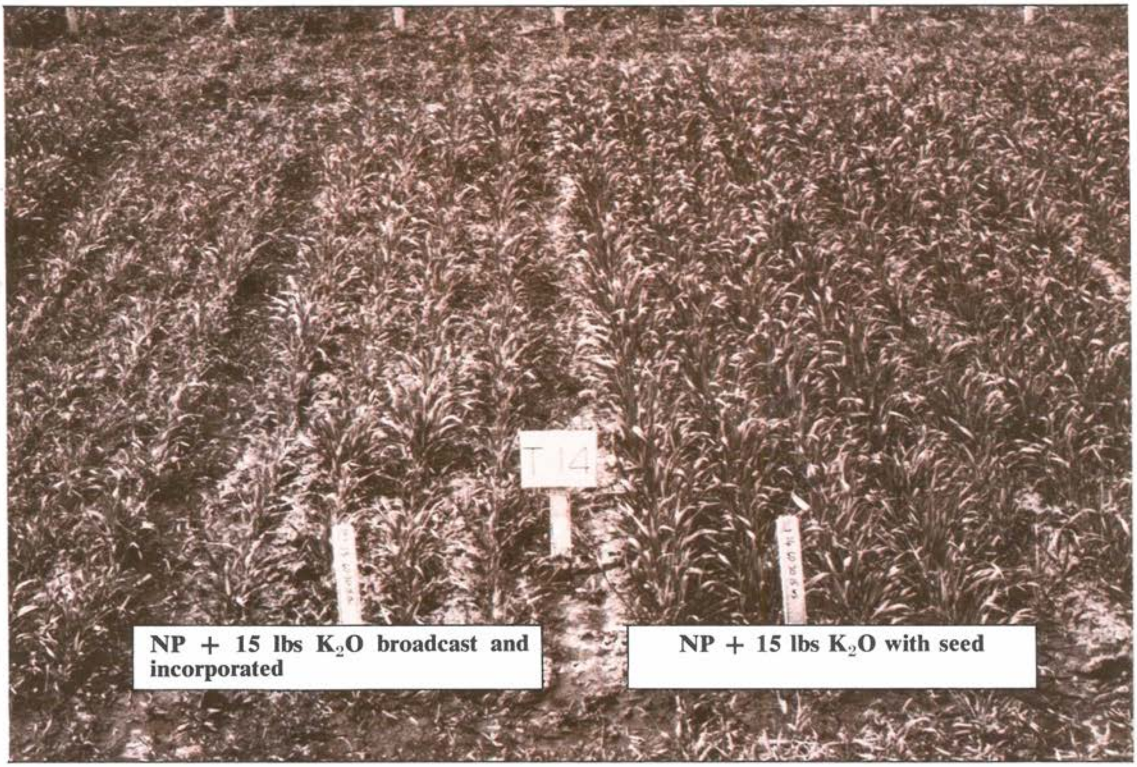
POTASSIUM PLACEMENT was more critical for barley than for rapeseed. Both crops matured 3 to 10 days later when potassium fertilizer was broadcast and banded 1 inch to the side and 1 inch below the seed than when placed with the seed. But yields were essentially the same for rape regardless of how the potassium fertilizer was applied.

Barley yields were greatest when the potassium was placed with the seed and

FIGURE 1

K INCREASES BARLEY YIELD





BARLEY

least when broadcast and incorporated as **Table 3** shows.

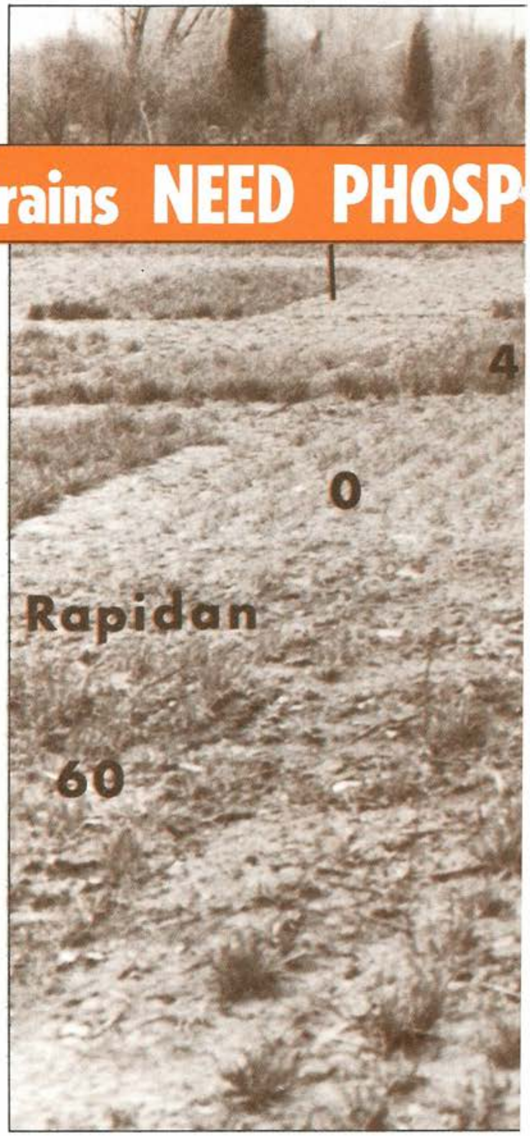
Table 3—Effect of Potassium Placement Method On Yield Increases (Bu/A) of Barley Grown on Potassium Deficient Soils.

		1974 6 Tests	1976 13 Tests
	Broadcast	8.6	
15 lbs. K_2O/A	Banded	12.8	6.2
	with seed	18.8	10.7
	Broadcast	17.0	
30 lbs. K_2O/A	Banded	18.8	8.0
	with seed	21.0	12.2

The field tests were located on farmers' fields and served as valuable extension agencies. The need for potassium fertilizer is now being accepted by many of the farmers in the potassium deficient area. And potassium fertilizer usage increased 7 times between 1970 and 1976.

More information is needed, especially on forage crop needs of potassium and refined interpretation of the soil test. But the need has been firmly established and usage will continue to expand.

Fall-Seeded Small Grains NEED PHOSP



W. R. KNAPP and J. S. KNAPP
Cornell University

WINTER SURVIVAL of fall planted small grains is a major concern in regions having fairly severe winters.

Improved winterhardiness in newer varieties has helped, but winterkilling continues to take its toll under some environmental conditions. So during the past several years studies have been underway at Cornell University to determine how fall fertilization affects winterhardiness and grain yield of winter wheat and barley.

THE RELATION between planting date and fall fertilization was studied three different years in experiments at the **Aurora Research Farm** in Central New York.

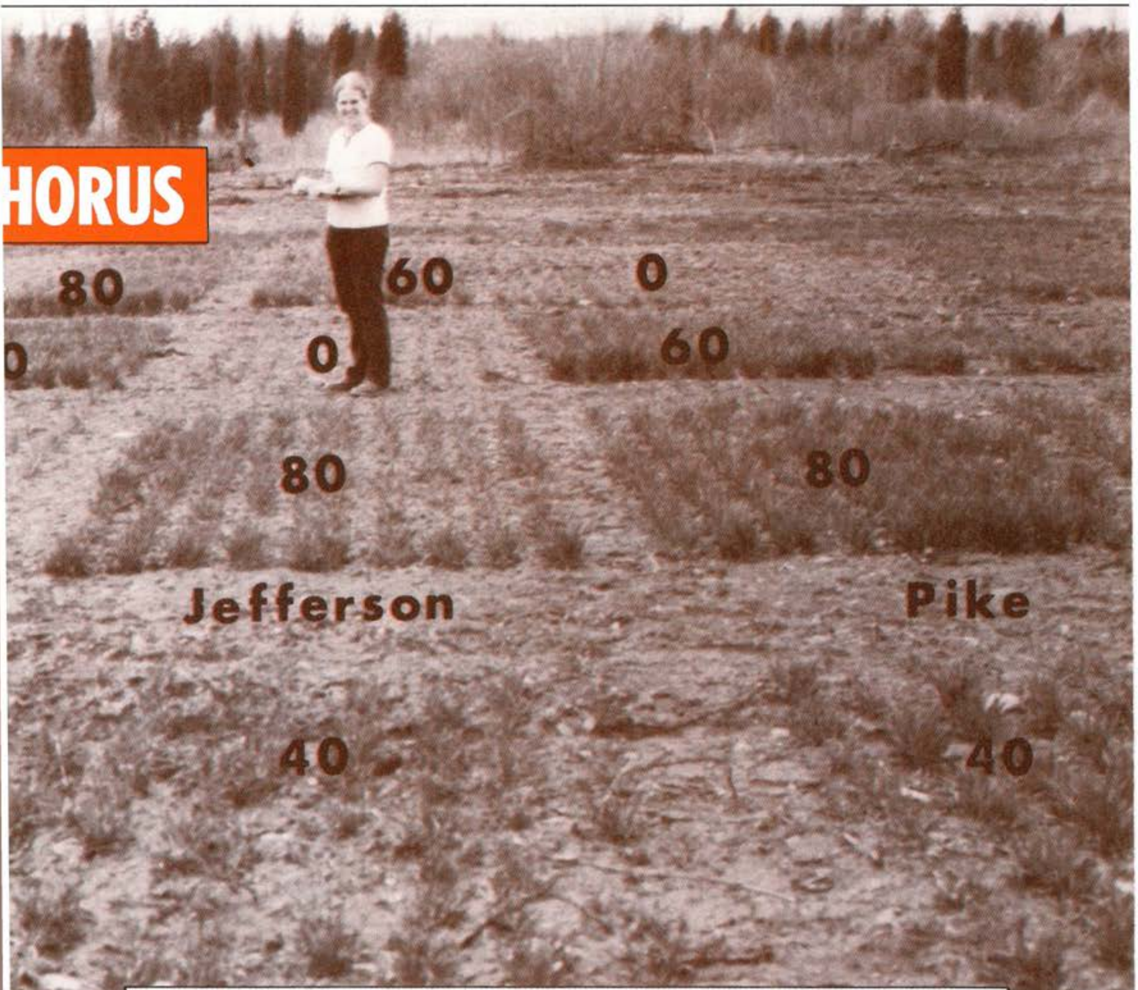
Late planting is sometimes unavoidable. We were trying to find if proper fertilization would offset the detrimental effects of it. These experiments planted Arrow and Yorkstar wheat and Barsoy, Jefferson, and Schuyler barley at one to two week intervals from late August to late October.

On each date, four fertilizer treatments were applied:

- 0 nitrogen and 0 phosphorus.
- 20 lb N/A and 0 phosphorus.
- 0 N and 40 lb P_2O_5/A.
- 20 lb N and 40 lb P_2O_5.
- Plus 200 lb KCl/A disced in before planting and 40 lb N/A topdressed on the grain in the spring.

The experiments were located on a Honeoye-Lima silt loam soil (Glossoboric Hapludalf, f. loamy, mesic) having a pH of 7.2 and containing about 40 lb/A of available phosphorus.

Additional experiments to examine the effect of planting date and fall fertilization with nitrogen were also conducted in northern New York at **Canton** and in the Hudson Valley region at **Valatie.**



Phosphate helps barley survive winter. This picture of winter barley plots on low P soil was taken on April 21. Note the improved winter survival and spring growth of barley receiving 40 or more lbs P_2O_5/A at planting.

Table 1 summarizes the resulting yields from the Aurora experiments. In this table **early planting** is up to September 10, **medium dates** are September 10-20, **medium-late** are September 20-October 5, and **late** is after October 5.

PHOSPHORUS WAS very necessary for highest wheat and barley yields in these trials.

Fall applied nitrogen had little or no effect on yields compared to no fertilizer. Treatment with both P and N produced essentially the same as P alone. In these experiments, significant interactions between planting date and fertilization were also measured.

As planting was delayed past the optimum time, P became increasingly important for maintaining yield levels. Barley planted very early also showed increased response to P.

The studies in northern and eastern

Table 1. Effect of planting date and fall fertilization on winter barley and wheat grain yields.

Planting Time	Fall Fertilization (Lb/A)			
	0 N-0 P_2O_5	20 N-0 P_2O_5	0 N-40 P_2O_5	20 N-40 P_2O_5
	(bu/ac)			
Winter Barley—average of 10 experiments				
Early	56	57	68	64
Medium	64	64	74	72
Med-Late	50	51	66	66
Late	43	39	50	52
Winter Wheat—average of 6 experiments				
Early	37	40	47	46
Medium	38	38	47	44
Med-Late	32	35	47	46
Late	31	26	37	35

New York also failed to show any value of fall applied N, and in cases of late planting, the N applications actually decreased yields significantly.

As **Table 2** shows, the major reason for increased yield with P fertilization was **an increase in the number of spikes per unit area.** The values are averages for all planting dates. But there were significant interactions between date and fertilization.

With later planting, phosphorus actually doubled the number of fertile tillers. At optimum planting times, increase from P averaged about 15 percent.

THESE DIFFERENCES in spike number were the direct result of less winterkilling in grain receiving phosphorus.

Again the value of P was particularly noted with delayed planting.

After plant growth resumed in spring, stands of late planted wheat or barley not receiving P were 20 to 50 percent less than the P-fertilized stands. The

Table 2. Phosphorus effects on winter barley and wheat grain moisture content, test weight, and components of yield.

Phosphorus Rate	Grain Moisture	Test Weight	Spikes/ Meter^2	Kernels/ Spike	1000-Kernel Weight
(Lb P_2O_5/A)	(%)	(Lb/Bu)	(No.)	(No.)	(g)
Winter Barley—average of 4 experiments, all planting dates					
0	22.1	38.6	228	41.7	33.7
40	18.2	39.6	264	42.6	33.5
Winter Wheat—average of 4 experiments, all planting dates					
0	14.9	51.5	216	36.6	33.7
40	14.1	52.5	268	38.3	34.7
Winter Barley—average of 3 experiments					
0	17.1	42.0	163	36.6	34.8
40	16.1	42.4	222	37.8	34.8
60	16.1	42.5	235	39.5	34.2
80	16.2	42.8	245	38.8	34.6

Fall-applied phosphate speeds maturity and increases barley stand on a medium P soil. Plots in foreground received no phosphorus.

differences were particularly great with barley.

Throughout the fall growing period P-fertilized plants were more vigorous with better developed root systems. This evidently helped increase winter survival. Spring recovery and growth were also faster for the plants receiving P.

Other measurements showed the number of kernels per spike and kernel weight were not greatly affected by fall fertilization. **But both wheat and barley receiving P had significant increases in test weight and matured earlier.** The delay in maturity due to late planting was particularly offset by phosphorus application.

Late planted wheat or barley fertilized with P headed 2 weeks earlier than that not receiving P. This earlier maturity feature would be important in double-cropping systems or other situations needing early harvest.

IN COOPERATION with Dr. W. Shaw Reid of Cornell, other studies have examined the response of different winter barley varieties or genotypes to phosphorus fertilization.

These studies have involved 12 different varieties. They have been on both soils testing low (about 10 lb/A) and medium (40-60 lb/A) in phosphorus.

In these experiments, P rates ranging from 0 to 80 lb P_2O_5/A have been band applied at planting.

Varieties differed in their response to P. Varieties such as Hudson, Paoli, Pennrad, and Schuyler had increased yield with each addition of P on a low P soil. But on a medium P soil, there was no response to P applications greater than the 40 lb/A rate.

Other varieties such as Jefferson, Catskill, and Pike responded to only the low P rate, regardless of soil test level.

Finally, varieties such as Rapidan, Barsoy, and Hanover had increases in yields with each added increment of P on both low and medium P soils.

The yields shown here for the low P soil are quite low from very wet soil conditions.

THE VALUE OF P in increasing yields was associated with increased winterhardiness. For less winterhardy varieties (such as Rapidan, Hanover, and Barsoy), winterkilling was severe when P was not applied.

The difference in inherent winterhardiness probably contributed to the different response curves obtained for the different varieties. The hardier varieties generally showed less response to increasing P levels than the less hardy ones.

Table 2 also shows that increasing P levels increased the number of spikes per area as a result of the increased winter survival.

The other yield components were not affected, but again phosphorus fertilization hastened maturity and increased test weight.

THESE VARIOUS STUDIES suggest fall applied phosphorus can play a very important role in increasing winter survival and grain yields of winter wheat and barley.

The effects are especially striking if the crop initially is more susceptible to winterkill because of late planting or less inherent winterhardiness in the variety.

LOW K WINTER RANGE CAN LIMIT BEEF PRODUCTION

JAMES F. KARN*
DAVID W. DIBB

NATIVE WINTER RANGE GRASSES grown on relatively high K soil have tested very low in K at the University of Nebraska North Platte Station.

Such potassium deficient forage can cause excessive weight losses in cows and lower weight gains in yearling steers, if they aren't provided with adequate K in their supplements.

The **National Research Council** recommends **0.6 to 0.8%** K in growing-finishing rations for beef cattle. The North Platte forage samples contained **0.3% K or less.**

Experiments with weanling steers and dry bred cows at the Sandhills Agricultural Laboratory near North Platte showed **the importance of adding K to some of the range supplements.**

The supplements contained recommended levels of crude protein, phosphorus, and vitamin A during the four winter tests conducted between 1973 and 1976.

THE WEANLING STEERS received 1.5 lbs of 40% protein supplement per day while grazing range that contained as little as 0.1% K. The three steer experiments showed lower daily gain when K level tested less than the K in the positive control soybean supplement treatment (2+%)—shown in **Tables 1, 2 and 3.**

When urea and corn replaced part of the soybean meal, common practice in range supplements, potassium declined and weight gains were depressed. Adding K from KCl increased daily gains sharply in two of the three experiments.

COWS ON WINTER RANGE lost weight but K in the supplement slowed down the loss, shown in **Table 4.** Experimental cows received 2 lbs of supplement every other day, their weight improved at each level of additional K. The smallest weight loss came from the highest K supplement, 6.6%.

These studies do not establish K levels needed in range supplements for maximum weight gain. They do not determine the effect on cow rebreeding rates or calf weaning weights.

But the data clearly shows low K levels in winter forage and range supplements can severely restrict weight gains of yearling steers and cows.

*Dr. Karn was formerly District Extension Animal Scientist, North Platte, Neb. and is currently Research Animal Scientist, ARS, Great Plains Research Center, P.O. Box 459, Mandan, North Dakota 58554.

Table 1. Increased K improves calf weight gain. EXP I.

SUPPLEMENT[1]	% K in supplement	Average Daily Gain (lbs)
Corn + Soybean meal + 12% biuret	0.92	0.15
Corn + Soybean meal + 12% biuret + 2.90% KCl	1.92	0.28
Soybean meal + Corn + 5% urea	1.69	0.35
Soybean meal + Corn + 5% urea + 1.47% KCl	2.08	0.55
Dehydrated Alf + Corn + 12% biuret + Soybean meal	1.89	0.37
Soybean meal	2.45	0.57

[1] Ingredients listed in order of concentration.

Table 2. Supplemental K concentrations and average daily gains of calves. EXP II.

SUPPLEMENT	% K in supplement	Average Daily Gain (lbs.)
Soybean meal + Corn + 5% urea	1.69	0.57
Soybean meal + Corn + 5% urea + .60% KCl	1.87	0.55
Soybean meal + Corn + 5% urea + 1.2% KCl	2.25	0.66
Soybean meal + Corn + 5% urea + 1.8% KCl	2.26	0.59
Soybean meal + Corn + 5% urea + 2.4% KCl	2.72	0.57
Soybean meal	2.22	0.74

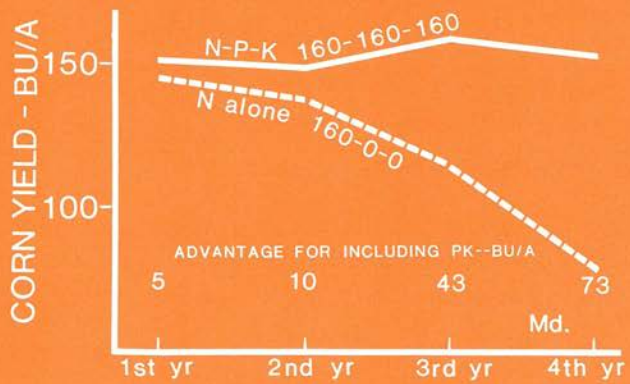
Table 3. Increased K improves calf weight gain. EXP III.

SUPPLEMENT	% K in supplement	Average Daily Gain (lbs.)
Soybean meal + 5% urea	1.35	0.09
Soybean meal + 5% urea + 1.2% KCl	1.85	0.20
Soybean meal	1.90	0.34

Table 4. Increased K decreases average daily weight losses of cows. EXP IV.

SUPPLEMENT	% K in supplement	Average Daily Loss (lbs.)
Corn Gluten Meal	0.48	0.53
Corn Gluten Meal + 4.02% KCl	2.74	0.38
Corn Gluten Meal + 8.08% KCl	4.02	0.28
Corn Gluten Meal + 12.16% KCl	6.57	0.12

BALANCED FERTILITY



Key To Higher Corn Profits

V. ALLAN BANDEL
UNIVERSITY OF MARYLAND

MOST FARMERS are searching desperately for ways to cut costs. They sometimes convince themselves higher fertilizer rates are excessive, though successful farmers apply high rates as a routine part of good management.

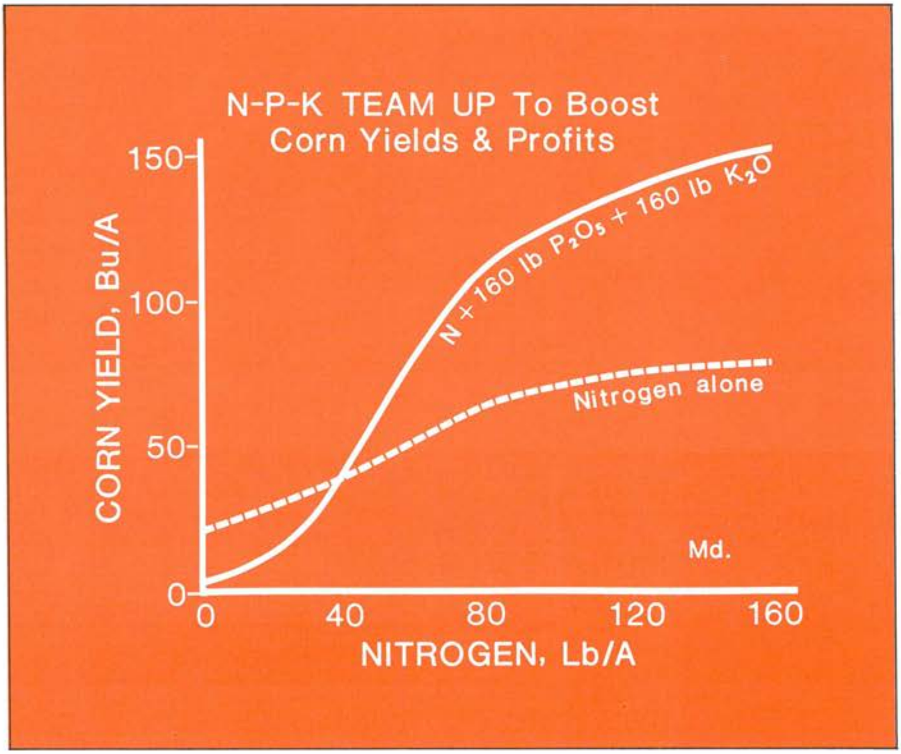
Farmers who put "balance sheet" ahead of scientific data are flirting with low crop yields and little, if any profits.

Let's say, for example, a certain crop removes "X" lbs of nutrients. So, the grower decides his fertilization rate for that crop is not to exceed "X" lbs/A. A 100-bushel corn crop removes only 35 lbs of P_2O_5 and 25 lbs of K_2O in the grain. Then, won't about the same fertilizer rate help maintain top yields? The answer is NO.

Farmers who follow such reasoning will soon harvest less corn—because crops do not take up fertilizer with anything like 100% efficiency.

Growers must allow for soil losses, fixation, and other forms of nutrient immobilization. The wise farmer applies enough fertilizer to build AND maintain his soils in a high state of balanced fertility.

AGRICULTURE IS CHANGING. On many farms, the traditional 5-year crop rotation of corn-small grain-hay-hay-hay has been replaced by 2-year corn-small grain-soybean (double crop) rotations or by a strictly single crop system such as continuous corn in some cases.



To determine potential effects of inadequate or unbalanced fertilization practices, test plots were established on a Mattapex silt loam at the University of Maryland's Wye Institute Research Farm near Queenstown—in the heart of a very intensive agricultural area on the Eastern Shore Coastal Plain.

The Mattapex soil series is moderately well drained on silty material underlain by a sandy substratum. These soils are extremely important agriculturally and are used for nearly all crops. The test area was in soybeans several years before these experiments were launched in 1974.

TWO N FERTILIZATION tests showed corn's long-term need for a complete fertilizer, in **Table 1.** One test applied a complete NPK fertilizer. The other test applied only nitrogen.

The nitrogen boosted yields significantly each year. But during the first two years, it made no big difference on average whether the plants received a complete fertilizer or just nitrogen. During this early period, the plants were obviously living on residual soil fertility, but depleting available supplies of P-K which had been built up in past years.

By the third year (1976), previous crop removal had depleted soil nutrients so much that nitrogen alone would not produce maximum grain yields. The complete fertilizer boosted grain 10 to 50 bu/A more than N alone, depending on the N rate. By the fourth year (1977), the complete fertilizer with highest N (160-160-160) was pro-

Table 1—Influence of nitrogen alone vs. nitrogen in a complete fertilizer on corn yields over a 4-year period, 1974-1977.

		N—lb/A					
Year	**Fertilization**	**0**	**40**	**80**	**120**	**160**	**Avg.**
1974	N-0-0[1]	62.2	116.2	131.4	121.4	145.8	115.4
	N-160-160[2]	41.8	110.7	157.6	157.6	150.8	123.7
1975	N-0-0	40.9	78.3	86.1	123.4	138.7	93.5
	N-160-160	37.9	56.6	102.6	124.6	149.2	94.2
1976	N-0-0	41.6	84.6	84.4	105.2	115.7	86.3
	N-160-160	51.7	107.8	134.2	153.5	159.1	121.3
1977	N-0-0	21.3	40.5	65.8	76.8	80.0	56.9
	N-160-160	2.6	41.1	114.8	139.8	153.4	90.3

Source: Maryland Agricultural Experiment Station, Dept. of Agron.

[1] Initial soil test values: pH-6.9, Mg-high, P-medium, K-low

[2] Initial soil test values: pH-7.1, Mg-high, P-high, K-high

Table 2—Influence of P and K fertilization on soil test values of a Mattapex loam after four years of corn, 1973-1977.

	Soil Test K_2O (lb/A)		Soil Test P_2O_5 (lb./A)	
Year	**N-0-0**	**N-160-160**	**N-0-0**	**N-160-160**
1973	54 L	237 H	125 M	240 H
1974	60 L	282 H	140 H	290 VH
1975	33 VL	301 H	79 M	239 H
1976	44 VL	412 VH	102 M	342 VH
1977	39 VL	325 VH	68 M	245 H

Source: Md. Agricultural Experiment Station, Department of Agronomy.

Table 3—Influence of nitrogen alone vs. nitrogen in a complete fertilizer on extra returns over a 4-year period, 1974-1977.

		N - lb/A				
Year	**Fertilization**	**0**	**40**	**80**	**120**	**160**
1974	N-0-0	0.00	116.20	143.16	112.16	160.28
	N-160-160	−91.72	58.75	158.62	150.62	126.98
1975	N-0-0	0.00	78.02	87.96	165.75	192.94
	N-160-160	−51.70	−16.69	81.11	123.71	172.29
1976	N-0-0	0.00	90.90	82.44	122.28	138.43
	N-160-160	−21.57	99.46	152.18	188.57	193.45
1977	N-0-0	0.00	36.16	86.35	103.65	103.01
	N-160-160	−87.81	−7.26	154.25	203.75	250.03

Corn = \$2.30/bu, N = \$.20/lb, P_2O_5 = \$.18/lb, K_2O = \$.10/lb.

ducing over 70 bu/A more than the nitrogen alone.

ANNUAL SOIL TEST results help explain these yields, in **Table 2.** Soil test P and K remained constant or even declined a little when no potash or phosphate was applied, but increased sharply when more than adequate P_2O_5 and K_2O (0-160-160) was applied yearly.

This shows a very important, basic principle all successful farmers recognize: "high crop yields are more likely to occur on soils of high fertility than on soils of low fertility."

Most farmers know and agree high yields are desirable. But maximum yields are not as important as maximum profits. And maximum yields and profits do not always happen at the same fertilizer rate.

So, the successful farmer must be a "top-notch" manager. Able to select the most efficient fertilization levels for HIS soils and growing conditions.

Yields in **Table 1** show the need for **regular** applications of a complete fertilizer. When extra dollar returns were calculated for any given year in **Table 3,** maximum returns came most often after the N alone as long as residual soil fertility could meet crop needs.

As each succeeding crop depleted soil fertility, the complete fertilizer program began paying higher dividends and would be expected to continue paying off.

In the first two years (1974-75), the top nitrogen rate (160 lb N/A) yielded more extra returns alone than with the complete fertilizer. But by 1977, maintaining adequate P and K returned almost $150 MORE per acre than the 160 lbs of N alone. On 100 acres, that would mean about $15,000 EXTRA dollars from maintaining adequate phosphate and potash levels.

THE BEST ROAD to top yields and maximum profits is a regular balanced fertility program that maintains soils in a relatively high state of fertility, guided by soil tests. **The End.**

I'm urging farmers to cut costs. Not cost per acre. But cost per bushel. This requires more bushels per acre. More bushels per acre require optimum fertilizer rates.

John F. Marten
Staff Economist
FARM JOURNAL

BEST COST CUTTER...

WEST LAFAYETTE, IN—With today's narrow crop profit margins, adequate fertilization can become a key cost-cutting tool in 1979, Dr. John Marten believes.

Dr. Marten, Staff Economist for FARM JOURNAL, considers fertilizer's role in producing extra bushels per acre a major cost-cutting tool. He explains it this way:

> **"Extra bushels from fertilizer give more bushels to pay fixed costs that stay about the same with low and high yields. More bushels per acre can mean less cost in each bushel. Less cost per bushel can mean more profit from each acre. The goal is lower costs PER BUSHEL, not costs per acre. The key is high yields. Fertilizer is basic to such yields."**

In a candid discussion, Dr. Marten and Dr. Werner Nelson, senior vice president of the Potash & Phosphate Institute, tackled some tough agro-economic questions facing today's growers. The widely known agronomist and economist did not hedge in their answers:

1. What can farmers do about today's lower grain prices?

Individual decisions cannot change the market price of grain or forage. So a sharp farm manager must look carefully at USDA set aside and grain reserve programs, Dr. Marten advises, to see if they fit his situations. Then he should plan his best strategy and move ahead.

2. But what can farmers do when production costs exceed market price?

Not much. Just try to keep losses to a minimum in periods of depressed prices. This means managing for higher yields.

3. Do average or below farmers have the same production costs as top farmers?

About 90% of all production costs are the SAME for top, average, or below average farmers. Gross returns are in direct proportion to yield. So top-yield managers net more. For example, 150-bushel corn grosses 50% more than 100-bushel corn.

Even sloppy farming can make money with \$3 corn and \$9 soybeans. But with \$2 corn and \$6 soybeans, the farmer must do everything just about right to make money.

4. Some farmers may be thinking about reducing their fertilizer rates this year. What do you advise them?

Don't cut off your nose to spite your face, Dr. Marten warns. A one-third cut in grain prices may mean only **5% cut** in the most profitable fertilizer rate for your farm. For example, when corn prices drop from \$3 to \$2, the optimum N rate falls only 5 to 10 lb/A, closer than most applicators can be set. The optimum K_20 rate only 20 lb/A. These Illinois and Iowa tests prove the point.

Corn Price	Optimum N Rate 12¢ N	Optimum N Rate 18¢ N	Optimum K_20 Rate 9¢ K_20-LM Soil Test
\$/bu	lb/A	lb/A	lb/A
3.00	192	184	145
2.50	189	180	135
2.00	182	174	125
1.50	178	163	100

How many farmers apply 192 lb N/A, 145 lb K_20/A? Remember: A higher fertilizer price affects most profitable application very little.

When falling grain prices increase the urge to reduce fertilizer rates, look at fertility trials across the nation.

Everywhere you look they spell one word—profit—not from less fertility, but from adequate fertility wherever and whenever the crop needs it.

Most lenders will gladly provide loans to buy fertilizer, because they know fertilizer is one of the highest return inputs in farming today.

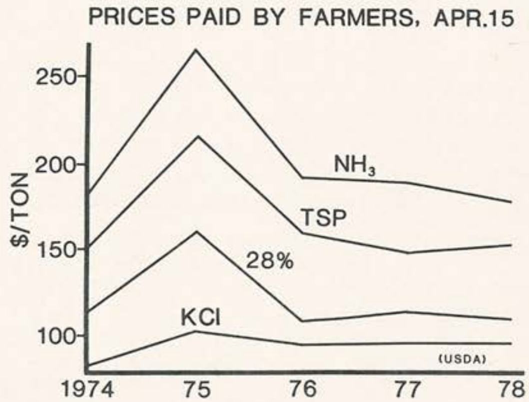
5. Do you mean farmers should forget about cutting costs?

Not at all. I'm urging farmers to cut costs. Not cost per acre. But cost per bushel. This requires more bushels PER ACRE. And more bushels per acre require optimum fertilizer rates. The profit-wise farmer will use adequate fertilizer as a major cost-cutting tool in 1979, despite narrow crop profit margins. The reason is shown here:

	100 bu	125 bu	150 bu
Fixed costs/A	$146	$146	$146
Variable costs	101	115	129
Total	247	261	275
Cost/bu	$2.47	$2.08	$1.83

6. Can farmers afford to buy fertilizer at today's prices?

Compare what farmers paid for fertilizer in 1975 with what they paid last April (1978). Less in 1978 than in 1975—and levels are now fairly stable.



Fertilizer is an excellent buy today. In most cases an even better buy than it was 10 years ago, relatively speaking. For example, in the late 1960's, 80 bushels of $1 corn would buy one ton of NH_3. Today 80 bushels of $2 to $2.25 corn will buy a ton of $160 to $180 NH_3.

7. Does yield level affect return much?

Very much! When it costs $250 to grow an acre of corn that sells for $2.50 per bushel, the farmer must produce 100 bushels per acre before profits begin. When crop price drops to $2, he must grow 125 bushels per acre before profits start. A look at a 10-year average in Ohio tells the story:

N	Yield	Gross Return	Production Cost	Net Return
lb/A	bu/A	$/A	$/A	$/A
0	67	$134	$225	−$91
60	100	200	240	− 40
120	135	270	255	15
180	158	316	268	48
240	169	338	279	59
300	171	342	289	53

Corn $2.00 bu, N 15¢/lb, 18¢ per bu for harvest. A typical guideline for the $225/A production cost includes about $20 for P_2O_5, K_2O, lime, $20 pesticides, $35 machine operation, $15 store, dry, $10 seed, $10 interest, $25 labor, and $90 land.

With $2.00 corn, 60 lb N/A gave a net loss of $40/A. At 120 lb N, the grower would realize $15/A profit. And successive increments of N to 240 lb N on this soil increased net return to $59/A. Increasing N from 180 to 240 lb/A increased net return $11/A. A $1.00 return per dollar invested for the last increment—or a 100% return.

8. Exactly how does fertilizer's effect on yield help get best returns per acre or reduce losses?

Higher yields reduce production cost per bushel—by giving more bushels to pay costs that are the same with low or high yields. Less cost per bushel leaves more profit per bushel.

This example shows how the 240 lb N rate produced enough yield (169 bu/A) for lowest production cost and highest profit per bushel with $2 corn and lowest loss **with $1.50 corn.**

N	Yield	Cost of Prod.	Profit with $2.00 corn	Loss with $1.50 corn
lb/A	bu/A	$/bu	$/bu	$/bu
0	67	$3.35	−$1.35	−$1.85
60	100	2.40	− .40	− .90
120	135	1.88	.12	− .38
180	158	1.69	.31	− .19
240	169	1.65	.35	− .15
300	171	1.69	.31	− .19

Soybean fertilization has proved the same point—higher potash rates increased net return and decreased production cost PER BUSHEL. Higher yields spread fixed costs over more bushels. Even more K_2O/A might have returned even more profit on these Ohio soybeans:

K_2O	Yield	Gross Return	Prod. Cost	Net Return	Cost
lb/A	bu/A	\$/A	\$/A	\$/A	\$/bu
0	49	\$294	\$200	\$ 94	\$4.08
40	52	312	204	108	3.92
80	54	324	208	116	3.85
120	57	342	213	129	3.73

Soybeans \$6.00/bu, K_2O 9¢/lb, 24¢ per bu for extra yield harvested. Med. K soil.

Phosphate on Kansas wheat shows how higher phosphate rates increased net return and decreased production cost per bu. On this low P soil, the optimum rate was 40 lb P_2O_5/A.

P_2O_5	Yield	Gross return	Prod. cost	Net return	Cost/bu
lb/A	bu/A	\$/A	\$/A	\$/A	\$/bu
0	35	\$96.25	\$120	−\$24	\$3.42
20	44	121.00	125	− 4	2.84
30	49	134.75	128	7	2.61
40	57	156.75	131	26	2.29
50	57	156.75	133	24	2.33

Wheat \$2.75/bu, P_2O_5 17¢/lb, 20¢ per bu for extra yield harvested. Low P soil.

Dr. Nelson reports most corn and wheat fields are short in nitrogen. Many corn and soybean fields are short in phosphate and potash. Practically all alfalfa fields are short in P and K.

Dr. Marten reminds growers to fertilize for maximum **profits,** not maximum yield. And, providing adequate fertilizer is still an excellent investment, even with reduced grain prices.

One of the best ways to stay in business with \$2 corn, \$2.75 wheat, and \$6 soybeans is through adequate fertilizer, Dr. Marten concludes.

BIFOCALS

S.W. Martin

DO YOU GET the feeling that many of today's problems have been blown into bigger balloons than they really are?

Maybe it's time to call back Diogenese, the old Greek teacher who lived in a tub in Athens. When Alexander the Great came to ask him what he might do for him, the teacher said five words to the most powerful man on earth: **"Get out of my light."**

His light was a lantern he carried in daylight, looking for a man who could face facts head-on.

If the old gentleman could be called back today, I would hand him a big, sharp pin and ask him to find all the giant balloons he could with one word printed on them: **Problems.**

If he asked me why, I would tell him the one that stays up after he sticks his pin into it will have the man who faces facts somewhere nearby. **The guy who inflated it with truth instead of hot air.**

I would also tell him there are many such men around, working to save and improve the free enterprise life thousands risked their lives to reach on these shores over 200 years ago.

Patrick Ross, President of B. F. Goodrich Tire Division, seems to be such a man. His comments were recently quoted in the American press:

"Men build empires as naturally as spiders spin webs. The law of kingdoms and government bureaucracies is simply this: Unchecked, they grow at alarming rate and sap the energy of the nation's population."

Then he cites some startling examples of government's appetite for regulations:

- **A 247-page regulation that made pension administration so costly, complex, and confusing that 13,000 small companies immediately canceled their pension plans.**
- **A long-respected railroad that waited 10 years for required merger approvals which came through two weeks after the road went under.**
- **A great company that spent $4 million trying to clear 65 government approvals for a half-billion dollar complex only to abandon the idea after securing just 4 of the approvals in 2.5 years.**
- **A state that turned down 3 environmental grants when auditors proved the paperwork would cost more than the grants. Another that turned down $60,000 for the elderly because it would cost $45,000 to administer.**
- **A great company that spends $5 million a year to fill out 27,000 government forms, consuming more man-hours than the company's cancer and heart research.**
- **A federal register of regulations that now consume 60,000 pages.**

Mr. Ross reminds us the most meaningful regulations ever to come to man for running the human race "required only two stone tablets."

Then why this blizzard of regulations in the last quarter of the 20th century? I must confess. I'm the culprit.

When I'm employed to tackle a problem, I work to make it look as big and crisis-filled as possible. Yep, I'm human.

Problems can be big business. And risky business. Quick, efficient solutions with few memos and even less talk can put the whole business out of business fast. So, I always recommend a study. A million buck one, if possible. Yep, I'm human.

That'll keep the old tub afloat for a spell. A study. I didn't say research. I said study. There is a difference.

This has big potential—the study. It can take several years, if we do it in depth. And we certainly don't want the people to get anything less than our dead level depth.

If I'm smart, I can lapel-stroke the study into "funds" for a major report. And the report? Well, gentlemen, we all know history is full of "reports" that sired bureaus with a speed and volume that would make my first wife's tom cat blush with envy.

If we develop this report right, we might even "uncover" some sub-problems. The original study may turn up a simple, single-gauge problem. But if we look at it carefully—well—sharp writers can put "zing" into it.

The morning arrives. The report flows in bulky splendor from the press. Even the AP is on hand, warily, for the Report Chief to announce the Problem Chief has decided the people need a new department to tackle this hairy problem.

My mind leaves that press conference FAST.

My mind is already carpetizing, draperizing, and sofaizing my new office for future conferences on formalizing, optimizing, and finalizing hardcore problems into softcore formula only the bureau can understand — and therefore solve.

Yep, I'm hu--stay home, Diogenes! Don't bring that *!*! lantern around me!

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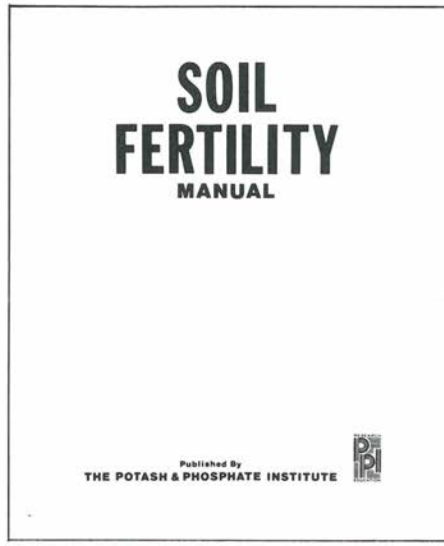

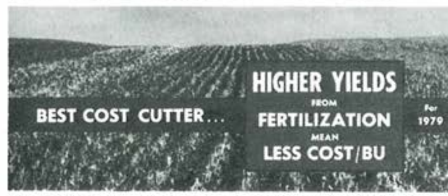

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