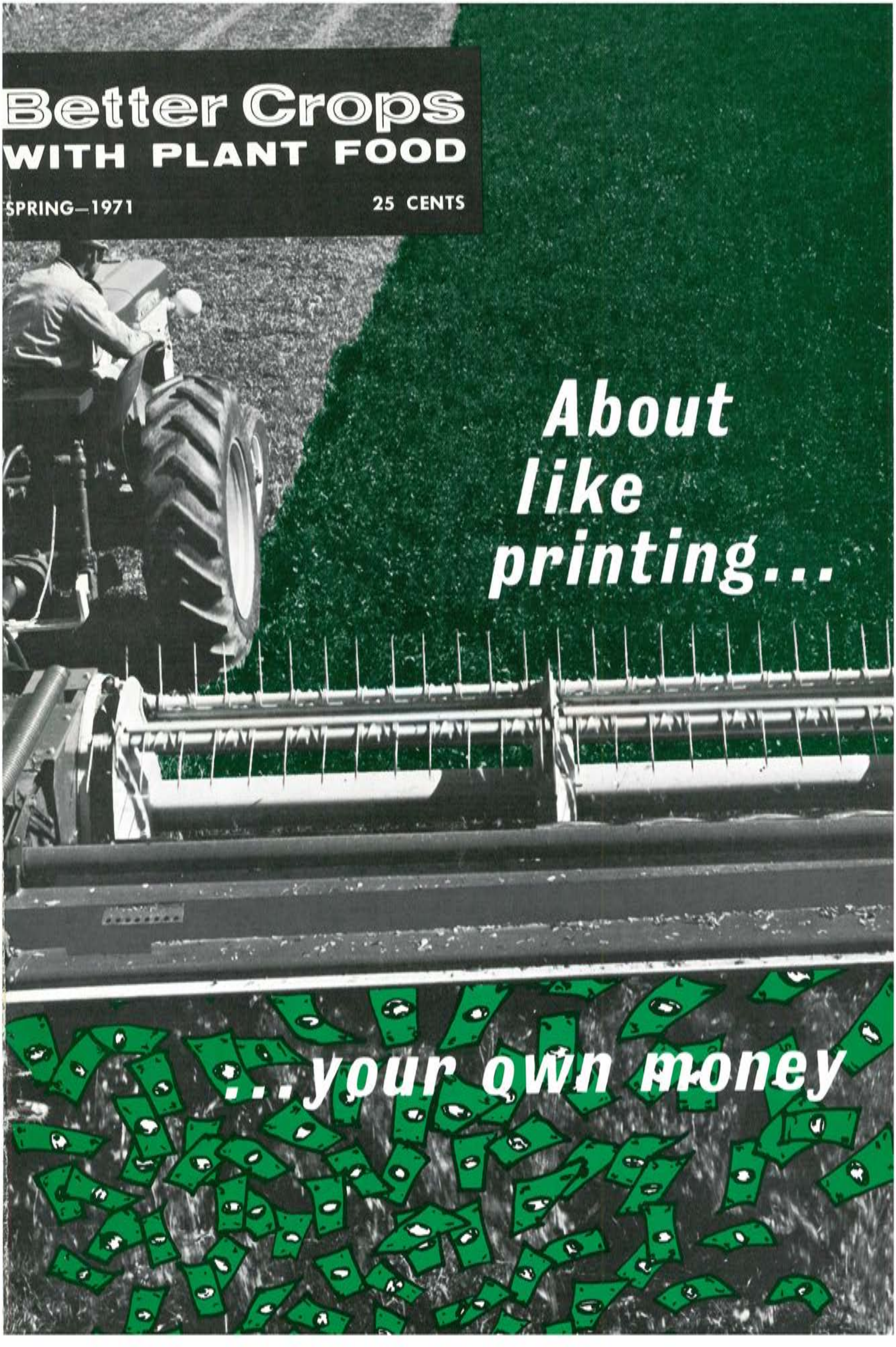
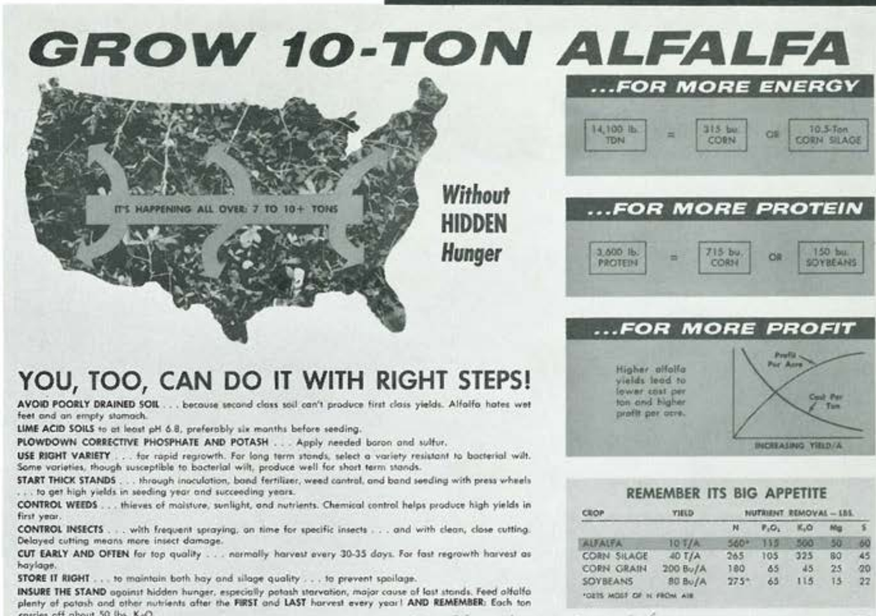
Better Crops
WITH PLANT FOOD

SPRING—1971 25 CENTS





GROW 10-TON ALFALFA

IT'S HAPPENING ALL OVER: 7 TO 10+ TONS

Without **HIDDEN** *Hunger*

...FOR MORE ENERGY

14,100 lb. TDN = 315 bu. CORN OR 10.5-Ton CORN SILAGE

...FOR MORE PROTEIN

3,600 lb. PROTEIN = 715 bu. CORN OR 150 bu. SOYBEANS

...FOR MORE PROFIT

Higher alfalfa yields lead to lower cost per ton and higher profit per acre.

Profit Per Acre

Cost Per Ton

INCREASING YIELD/A

YOU, TOO, CAN DO IT WITH RIGHT STEPS!

AVOID POORLY DRAINED SOIL . . . because second class soil can't produce first class yields. Alfalfa hates wet feet and an empty stomach.

LIME ACID SOILS to at least pH 6.8, preferably six months before seeding.

PLOWDOWN CORRECTIVE PHOSPHATE AND POTASH . . . Apply needed boron and sulfur.

USE RIGHT VARIETY . . . for rapid regrowth. For long term stands, select a variety resistant to bacterial wilt. Some varieties, though susceptible to bacterial wilt, produce well for short term stands.

START THICK STANDS . . . through inoculation, band fertilizer, weed control, and band seeding with press wheels . . . to get high yields in seeding year and succeeding years.

CONTROL WEEDS . . . thieves of moisture, sunlight, and nutrients. Chemical control helps produce high yields in first year.

CONTROL INSECTS . . . with frequent spraying, on time for specific insects . . . and with clean, close cutting. Delayed cutting means more insect damage.

CUT EARLY AND OFTEN for top quality . . . normally harvest every 30-35 days. For fast regrowth harvest as haylage.

STORE IT RIGHT . . . to maintain both hay and silage quality . . . to prevent spoilage.

INSURE THE STAND against hidden hunger, especially potash starvation, major cause of lost stands. Feed alfalfa plenty of potash and other nutrients after the **FIRST** and **LAST** harvest every year! **AND REMEMBER**: Each ton carries off about 50 lbs. K_2O.

REMEMBER ITS BIG APPETITE

CROP	YIELD	NUTRIENT REMOVAL – LBS.				
		N	P_2O_5	K_2O	Mg	S
ALFALFA	10 T/A	560*	115	500	50	60
CORN SILAGE	40 T/A	265	105	325	80	45
CORN GRAIN	200 Bu/A	180	65	45	25	20
SOYBEANS	80 Bu/A	275*	65	115	15	22

*GETS MOST OF N FROM AIR

ON THE COVER . . .

. . . look for your mower to start turning out EXTRA dollars from a top alfalfa crop.

The cover is adapted from a popular brochure issued by Purdue's Departments of Agronomy and Animal Sciences in cooperation with the Certified Alfalfa Seed Council, Inc.

This valuable report concludes, "SUPER-yield alfalfa can be almost like printing money." And it proves it by showing why alfalfa is such a major key to good animal nutrition.

The secret of alfalfa's value is the amount of crude protein and digestible dry matter it will give you per acre—especially a super yield of 8 tons/A, for example.

Alfalfa really is a big key to animal nutrition when you spend around $60 to get the same amount of protein you would pay $240 to get out of soybean meal.

See what recent research has turned up on the feeding value of alfalfa . . . for dairy cows . . . beef cattle . . . sows . . . and sheep. It starts on page 2. It may save you money.

(Cover artwork courtesy Certified Alfalfa Seed Council)

There are many ways to challenge people to do better than average.

One way is through colorful place mats at dinner meetings . . . mats like the one above, pictured in miniature.

It challenges folks to grow 10-ton alfalfa . . . and tells how to do it. You can order sample at the address below.

Sample Alfalfa Place Mat
Potash Institute of North America
1649 Tullie Circle, N.E.
Atlanta, Georgia 30329

Better Crops WITH PLANT FOOD

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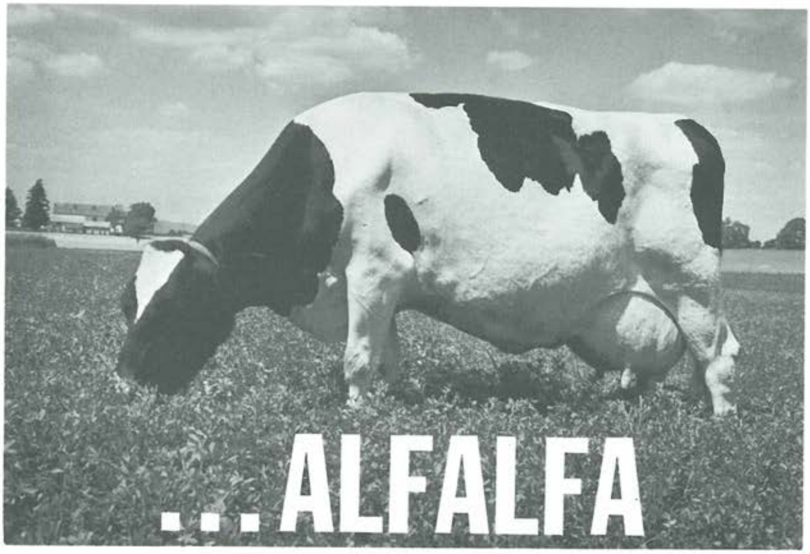


Key To Animal Nutrition

From the popular brochure produced by the Departments of Agronomy and Animal Sciences of Purdue University in Cooperation with the Certified Alfalfa Seed Council, Inc.

ALFALFA IS THE BEST source of natural protein because its amino acid balance meets the needs of ruminant animals.

Alfalfa produces more high quality protein per acre than any other forage crop. This high quality protein from alfalfa is a potential source of essential amino acids for humans and may be needed to meet the nutritional needs of tomorrow's expanding population.

With this background, let's consider recent research on the feeding value of alfalfa for livestock.

ALFALFA FOR DAIRY COWS . . .

Forage fertilization and harvesting management research in Indiana confirm that high quality low moisture alfalfa silage can be used to reduce ration costs

Almost like printing MONEY!

AN AVERAGE BUSINESS of any kind just about breaks even. Alfalfa is no exception.

An average acre of alfalfa costs about \$60. An average yield of 2.5 tons per acre just about breaks even.

But with advance planning and proper management, alfalfa can leave the average and move into the super-yield class.

And super-yields don't just about break even. They produce big profits! Profits marketed directly as hay or through animal products.

Or to look at the \$60 acre of alfalfa another way. An 8-ton yield of alfalfa may produce up to 3,000 pounds of crude protein per acre and 10,000 pounds of digestible dry matter.

This amount of protein purchased as soybean meal would cost about \$240. The considerable extra energy from alfalfa is a bonus. Where else can you get \$150 to \$250 for a \$60 investment?

That's what we mean when we say that Alfalfa is almost like printing money.

for dairy cows.

Yield and cost data comparisons were made to evaluate the probable efficiency of substituting alfalfa forage protein for corn silage and soybean meal or urea.

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

The value of low moisture alfalfa silage as an alternative feed source for dairy cows varies with its crude protein content.

In the following table is shown the changing protein value of 12 tons of low moisture alfalfa silage at 50 percent dry matter when compared with 20 tons of 30 percent dry matter corn silage as a forage source in a corn grain-soybean oil meal ration.

Feed Value of low moisture alfalfa silage in ration-mixture with corn silage, soybean oil meal, and ground corn.

Crude Protein alfalfa silage	Tons/ 50% D.M.		Value/ Ton	Total Value alfalfa silage
13	12	×	$ 4.73	$ 56.76
15	12	×	10.68	128.16
18	12	×	13.86	166.32

These figures were obtained in a linear programming analysis to calculate a complete least cost ration for the dairy cow using corn and soybean oil meal as the main source of concentrates and low moisture alfalfa silage (50% DM) and corn silage (30% DM) as a forage source.

Assuming corn silage production of 20 tons/A (note on a dry matter basis 20 tons corn silage equivalent to 12 tons LMAS).

Under these pricing conditions and ration requirements, average quality corn silage income/A was worth $97.20.

Therefore, it behooves the dairyman to produce at least 12 tons of highest quality low moisture alfalfa silage or hay equivalent per acre.

And technology is now available that

Alfalfa's SUPER-Yield Plan

THE SOIL—Alfalfa should be sown on well-drained and fertile soils.

MEET LIME requirements—Maintain the soil pH at 6.5 or above.

VARIETIES—Seed varieties with high yield potential. Extension agents or seed company representatives will help you select the best varieties adapted to your area.

INOCULATE SEED—Inoculation is essential for healthy productive stands.

FERTILIZER PROGRAM—Use enough fertilizer to bring soil to a high state of fertility at seeding time. Top dress each year with phosphorus and potassium. Large amounts of potassium are the key to high yields.

PREPARE FIRM SEEDBED—A firm seedbed holds moisture over a longer period than a loose one and helps to assure germination.

SEEDING RATE—Check your seedsmen or extension agent for seeding rate and mixtures adapted to your area.

BAND SEEDING boosts early growth—And better stands. This practice is especially helpful if your soil is low in available phosphorus.

FOUR TO FIVE TONS the first year—Yields like this are possible if you practice chemical weed control and seed without a companion crop. If a companion crop is used for weed control, harvest it for forage.

WEED CONTROL—Control weeds by herbicides and good management practices. Check with your extension agent or supplier for recommended practices.

INSECT CONTROL—Leaf hoppers, aphids and alfalfa weevils reduce yields if not controlled. Insecticides and early harvesting help.

CUT EARLY—Make first cutting at late bud stage. Second cutting should be made 35-40 days after the first. Frequent harvests not only assure high quality feed, but contribute to higher yields. **THE END**

makes it possible for practically any dairyman to achieve or surpass this goal.

ALFALFA FOR BEEF CATTLE . . .

Dehydrated alfalfa meal is an essential component for formulating a high-urea (64%) supplement to make it comparable to natural protein.

In carefully controlled nitrogen balance studies, nitrogen retention was increased 66 percent by feeding 5 percent dehydrated alfalfa meal in a corn and cob meal-urea-mineral mix.

By combining urea and dehydrated alfalfa meal into a pellet, a higher level of urea could be fed without causing any depression in feed intake or milk production.

Supplementary nutrients most needed in beef cow rations under Midwest feeding conditions are salt, protein, vitamin A, unidentified factors furnished by high quality legumes, (dehydrated alfalfa meal or green pasture) cobalt, iodine, phosphorus, calcium and in some areas, zinc.

PASTURE FOR SOWS . . .

High quality forage such as alfalfa pasture, silage and haylage are well adapted for modern brood sow nutrition.

These forages are well suited for the sow in gestation.

The sow should receive a limited amount of energy at low cost but be well supplied with a high quality digestible protein feed rich in vitamins and minerals.

An economical method of meeting the nutritional needs of sows during pregnancy is by using high quality pasture.

An alfalfa pasture will supply most of the daily nutritional requirements.

Energy, phosphorus and salt requirements may be slightly deficient from pasture.

These needs are easily met by feeding approximately 2 pounds of corn per sow per day and providing a free choice mineral mixture containing equal parts of dicalcium phosphate and trace mineralized salt.

The total daily cost for feed and pasture per sow is about 7¢ if 10 sows are pastured per acre and the daily pasture charge is 25¢ per acre. This compares with a dry lot complete mixed ration cost of about 12¢ to 15¢ daily.

High quality corn and legume grass silages, properly supplemented, may constitute a major part of the gestation ration for sows and gilts.

Corn silage requires a protein supplement. Legume grass silage requires an energy supplement. Both silages need supplemental minerals.

High quality low moisture alfalfa silage is a third forage which can be used in sow rations. Nutritionally, energy is the limiting factor in the use of alfalfa silage for feeding swine.

The energy requirement can be met by feeding 2 pounds of corn per sow daily.

ALFALFA FOR SHEEP . . .

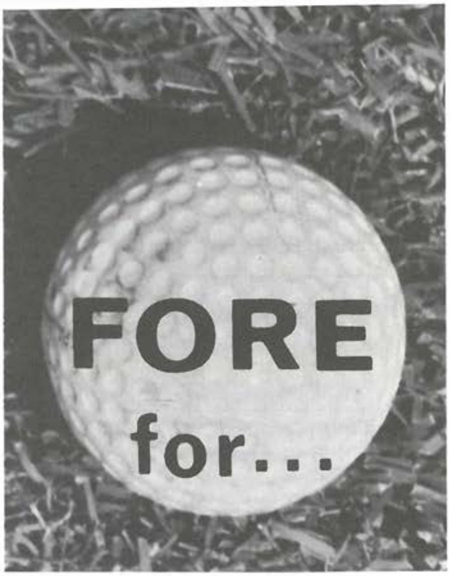
The basis of a good wintering ration for the ewe flock is high quality sun-cured legume hay. High quality alfalfa hay will furnish all of the proteins, minerals and vitamins needed by the pregnant or lactating ewe with the exception of carbohydrates needed for energy.

It is usually necessary to supplement alfalfa hay with from one-half to one pound of a concentrate, such as shelled corn, during the latter part of the lactation period to supply a source of energy.

If a poor quality hay is used, it should be supplemented with sources of protein, minerals and vitamins. The normal consumption of a good quality hay will be from 4 to 5 pounds per day for 150 pound ewe.

The Purdue 58 pellet which contains 20 percent of dehydrated alfalfa meal has been excellent for feeding lambs. In spite of modifications in the pellet no improvement in utilization has been obtained.

What About Reprints?



The latter would favor initial leaf burn and later dew dissolving and redistribution. **NO BURN OCCURRED** when prilled—even at 3 x normal rates—on any treatment, as **Table 1** shows.

High rates, non-prilled and not watered, caused 10% burn at overlap and turn around, which was actually carelessness in technique.

So, where traffic is continuously occuring (golf carts), it pays to water in immediately as a safety factor.

On Newport and Delta bluegrass the best color response to nitrogen was between 8-12 days.

At higher N rates (1-2 lb. N/1,000 sq. ft.) increased color lasted 30-40 days. This is normal for a soluble source.

Prilled Potassium Nitrate To Open New Vistas For TURF

W. A. DANIEL
PURDUE UNIVERSITY

POTASSIUM NITRATE, chemically KNO_3 and having an analysis of 13.75-0-44.5, has a salt index of 74 on a pound for pound of material basis or 20.1 on an equal plant nutrient (N plus K_2O) basis (compared with sodium nitrate as 100).

Thus, potassium nitrate has far less potential of causing burn than do most other soluble fertilizers.

Prilling has given free flowing, non-caking in bags, freedom from moisture attraction and easy fall-off from leaves of turf.

Potassium nitrate has very low hygroscopicity, so it attracts less moisture.

Plots 3′ x 50′ at the Purdue Agronomy Farm were fertilized on the bright hot afternoon of June 23, 1970 with prilled and non-prilled potassium nitrate.

Each plot was then walked over 10 times as a path. One-half (25′) was hand-watered for 10 minutes to dissolve pellets but one-half was not watered for 48 hours.

The response in greenness and clippings is primarily to nitrogen, for potassium was ample in soil due to prior buildup in all turf plots.

In four different outdoor treatments—6/23, 8/6, 9/13 and 10/14 at rates up to 2 lb. N and 6.8 lb. K_2O/1,000 sq. ft.—there was no turf burning with prilled formulations.

Rates of 0.75 lb. N and 2.6 lb. K_2O could be a normal application.

N-P-K RATIOS. Current fertilizer analyses of 12-4-8, 16-4-8, 18-5-9, and 24-4-12 illustrate formulations marketed by many companies.

By repeated use, these can provide the potassium needed. With complete fertilizers, KNO_3 is another tool with replacement potential as a material if needed.

N SOURCES. Often other nitrogen sources are used. How can potassium nitrate (13.75-0-44.5) tie into these programs?

- **Where organics,** such as Milorganite

TABLE 1—Response of Bluegrass Turf to KNO_3—Applied 6/23/70

lb/1,000 sq. ft. N	K₂O	4 Days % Leaf Burn Non-Watered	19 Days Greenness rating 1-9*	21 Days Clippings grams	48 Days Greenness 1-9*
		PRILLED			
0.5	1.7	0	5	12	8
.75	2.6	0	4	27	8
1	3.4	1	3	40	4
2	**6.8**	**0**	**1**	**52**	**3**
		STANDARD (Non-Prilled)			
0.5	1.7	0	6	18	8
.75	2.6	0	4	29	8
1	3.4	5**	3	40	8
2	**6.8**	**10****	**2**	**68**	**4**

*1 greenest, 3 is ample, 9 is least
**burn at overlap and turn around when not watered in

(6-5-0), are used KNO_3 can be a source of quick nitrogen for cold weather or booster usage and also maintain ample potassium. Both spring and fall applications are suggested.

• **With Ureaform** (38-0-0), which is gradually decomposed by bacteria and thus regulated by soil temperature. KNO_3 applications in early spring and in mid-fall would boost available nitrogen plus build postassium supply.

• **IBDU (Iso butylidene diurea)** 31-0-0 is degraded by hydrolysis, so it depends on moisture rather than temperature—and the timing of KNO_3 applications would be optional. When is a supplemental nitrogen useful with IBDU? Likely split application or one early fall use would be preferred.

• **Often no phosphorus** is desired—as in control programs for **poa annua** using granular calcium arsenate. Here the arsenic buildup to toxic levels for **poa annua** is most effective if no phosphorus is used and available soluble phosphorus is lessened as soluble arsenic is increased. Then roots pick up arsenic and plant growth is restricted by arsenic dominance. Since complete fertilizers are to be avoided in this program, KNO_3 can fit in.

KNO_3 is a tool in helping achieve the desired goal because it can readily supply some soluble nitrogen plus ample potassium for management needs.

THE END

Potassium Builds HEALTHY Pines

. . . JOURNAL OF KOREAN FORESTRY SOCIETY REPORTS—NO. 10, 1970

NPK TRIALS in Korea's Kangwon Province showed applied potassium producing healthy pine seedlings tolerant to needle cast infection.

To minimize experimental error, this pot trial on 2-year-old Korean red pine seedlings laid out 27 treatments with 8 replications. It was conducted for 4 years—1963 through 1966—by the Forest Research Institute of the Ministry of Agriculture and Forestry.

The pine trees responded most distinctly to nitrogen and phosphorus the first two years, less distinctly to potassium while seedlings were free from needle cast infection.

But when needle cast seriously infected the trees by the third year, response to potassium was very outstanding, followed by phosphorus effect.

Although K influenced tree growth less than N did, K influence on growth was clearly observed after the disease invaded the trees.

The distinct influence of K after the infection may be due to K's role in helping plant life form carbohydrate and fiber which builds plant health and disease resistance.

Disease Infection by Treatment (1966)

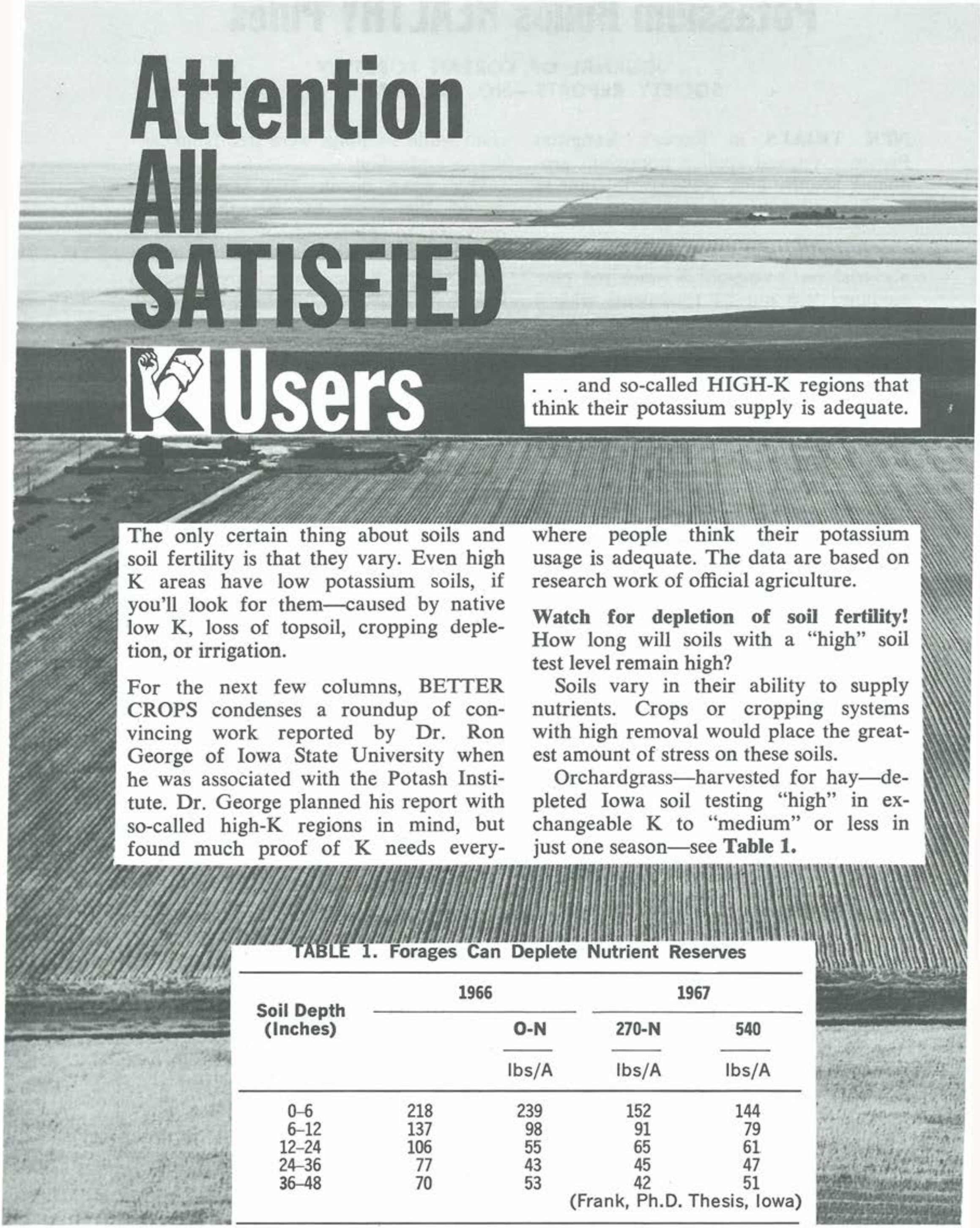
− Complete defoliation from needle cast May 20, 1966

+ Healthy seedlings 1963–66

Treatment			1	2	3	4	5	6	7	8	Sum
0	0	0	−	+	−	−	+	−	−	−	2
0	0	1	−	−	+	−	−	+	−	−	2
0	0	2	+	−	+	+	−	+	+	−	5
0	1	0	−	−	−	−	+	+	−	−	2
0	1	1	−	−	+	−	+	−	−	+	3
0	1	2	+	+	−	+	−	+	+	+	6
0	2	0	−	+	−	−	−	−	+	+	3
0	2	1	+	−	+	−	+	−	+	−	4
0	2	2	+	+	−	+	+	+	+	+	7
1	0	0	−	−	−	−	−	−	−	−	0
1	0	1	−	+	−	−	−	−	−	+	2
1	0	2	−	+	−	+	−	−	+	+	4
1	1	0	−	−	−	+	−	−	−	−	1
1	1	1	+	−	−	−	−	−	−	+	2
1	1	2	+	+	−	+	−	+	−	+	5
1	2	0	−	+	−	−	+	−	−	−	2
1	2	1	−	+	−	+	−	−	+	−	3
1	2	2	+	+	−	+	+	+	−	+	6
2	0	0	−	−	−	−	−	−	−	−	0
2	0	1	−	+	−	−	−	−	+	−	2
2	0	2	+	+	−	−	+	−	−	+	4
2	1	0	−	−	+	−	−	+	−	−	2
2	1	1	−	+	−	−	+	−	+	−	3
2	1	2	−	+	−	−	+	−	+	+	4
2	2	0	−	−	+	+	−	−	+	−	3
2	2	1	+	−	+	−	−	+	−	−	3
2	2	2	+	+	+	−	−	+	+	+	6
Total			10	15	8	9	10	10	12	12	86

Tree Height by Treatment (1963–66)

Treatment			Year			
N	P	K	1963	1964	1965	1966
0	0	0	12.50	19.26	26.2	32.9
0	0	1	11.65	19.21	26.5	33.0
0	0	2	12.25	18.91	27.1	37.1
0	1	0	12.50	20.06	27.3	32.2
0	1	1	12.00	19.81	27.7	30.8
0	1	2	12.50	19.53	28.0	34.4
0	2	0	13.00	21.30	28.1	33.8
0	2	1	12.50	21.56	29.1	47.1
0	2	2	11.65	20.90	29.6	39.1
1	0	0	11.50	21.91	23.5	33.4
1	0	1	12.50	21.66	28.8	37.0
1	0	2	12.25	21.91	30.1	43.2
1	1	0	12.50	23.07	29.2	37.5
1	1	1	13.25	24.70	31.2	40.2
1	1	2	13.75	25.81	34.5	44.9
1	2	0	14.25	24.90	29.0	41.9
1	2	1	12.75	24.25	30.8	44.5
1	2	2	12.50	25.08	33.3	49.4
2	0	0	14.00	22.66	32.7	38.0
2	0	1	13.00	23.52	32.0	40.0
2	0	2	13.25	23.55	34.8	45.6
2	1	0	15.75	26.07	30.3	40.5
2	1	1	13.00	25.13	30.7	41.1
2	1	2	12.75	26.97	32.5	48.2
2	2	0	14.00	27.21	32.2	38.0
2	2	1	12.50	25.52	34.1	46.2
2	2	2	15.00	28.92	37.3	50.4
Total Average			12.93	23.09	30.4	40.03



Attention All SATISFIED K Users

. . . and so-called HIGH-K regions that think their potassium supply is adequate.

The only certain thing about soils and soil fertility is that they vary. Even high K areas have low potassium soils, if you'll look for them—caused by native low K, loss of topsoil, cropping depletion, or irrigation.

For the next few columns, BETTER CROPS condenses a roundup of convincing work reported by Dr. Ron George of Iowa State University when he was associated with the Potash Institute. Dr. George planned his report with so-called high-K regions in mind, but found much proof of K needs everywhere people think their potassium usage is adequate. The data are based on research work of official agriculture.

Watch for depletion of soil fertility! How long will soils with a "high" soil test level remain high?

Soils vary in their ability to supply nutrients. Crops or cropping systems with high removal would place the greatest amount of stress on these soils.

Orchardgrass—harvested for hay—depleted Iowa soil testing "high" in exchangeable K to "medium" or less in just one season—see **Table 1.**

TABLE 1. Forages Can Deplete Nutrient Reserves

Soil Depth (Inches)	1966		1967	
		O-N	270-N	540
		lbs/A	lbs/A	lbs/A
0–6	218	239	152	144
6–12	137	98	91	79
12–24	106	55	65	61
24–36	77	43	45	47
36–48	70	53	42	51

(Frank, Ph.D. Thesis, Iowa)

All forage crops—grasses, alfalfa, corn silage, summer annuals, etc.—remove the vegetative portion of the plant.

We can expect them to exert greatest stress on soils. **Figure 1** shows how increasing the hay or meadow crop in the rotation pulled down K.

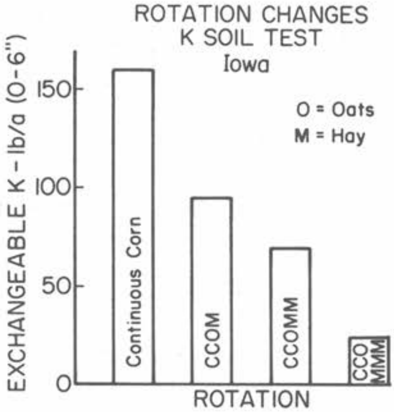


FIGURE 1—Increasing meadows in the rotation pulled down soil K in the spring of the first year of corn in the rotation —13-14 yr. study. (Grimes, Ph.D. Thesis, Iowa).

Complete soil test information (initial, during, and following study—both surface and subsoil), fertilizer applied, crop yield, and chemical analysis are essential data to evaluate this relationship.

"Whole-crop" harvest vs. grain-only comparisons and fertilizer rate studies would add to the value of these data.

Research from the state of Washington (Bulletin 697 by D. W. James, W. H. Weaver, and R. L. Reeder) points to the depletion of high K soils. **Figure 2** tells this story.

Watch for high K sandy, low exchange capacity soils to deplete faster than most. Weathered soils without applied fertilizers support only low yields.

Forage for "whole crop" harvest, high yields, and irrigation speed depletion, assuming high quality water containing few nutrients. But, we can expect most soils to decline when cropped and fertilized.

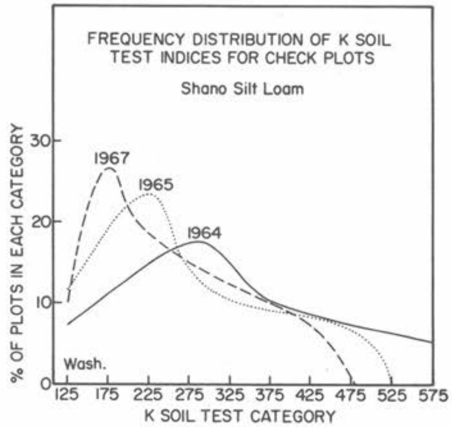


FIGURE 2—Soil tests of 475 and above had disappeared by 1967 even though levels had ranged to 1000+ in 1961! Crops were grown each year without K fertilizer on 63 plots sampled each February or March.

Scientists R. D. Ringler and R. A. Olson found available K declining and being replaced by Ca and Mg under irrigated cropping.

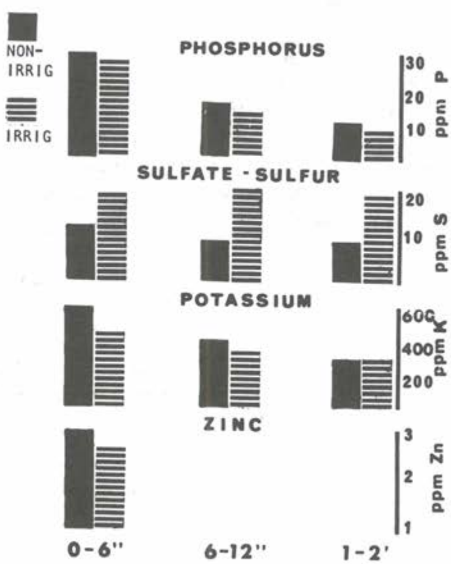


FIGURE 3 shows how irrigation pulled down soil K (particularly in the surface soil) in Nebraska studies.

Do soil samples vary by seasons? The time you take soil samples can affect K soil test results, Illinois researchers have found.

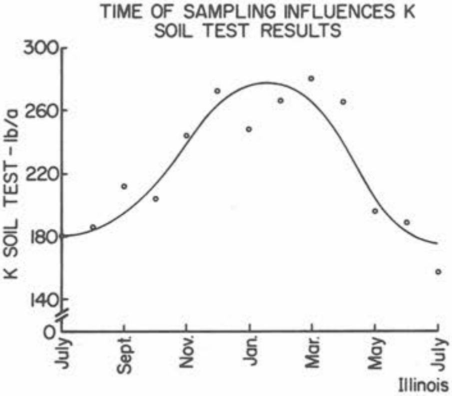


FIGURE 4 shows the sharp difference between July and January. Such findings have caused Illinois to subtract 30 to 60 lbs from the test results on late fall, winter, and early spring samples.

West Virginia reports similar seasonal variation. Other states are looking at this phenomenon. What about your soils?

Which is better—testing soils air dried or field moist? Subsoils often release K upon drying, Iowa scientists found. So, drying soils before analysis tends to **over-estimate** K supplying potential.

Look at K release from three Kansas soils in **Table 2.**

Note how the Nebraska Sharpsburg soil with the dry test increases in K at lower depths. This K release pattern typifies drying of the soil, observed earlier.

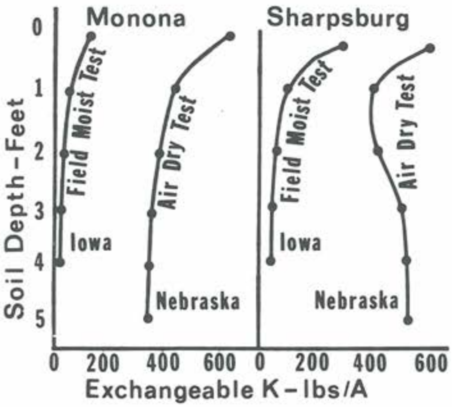


FIGURE 5 shows how sharply results can differ between the two testing methods—air dry and field moist—on the same soil, even though sampled in different states.

How much do air dried and field moist soil samples differ in tests—25% to 300%. We do know higher readings are coming from air dried samples. We know soils vary in their tendency to release K normally. All this makes accurate fertilizer recommendations a constant challenge. Should other states try field-moist soil analysis?

TABLE 2. Exchangeable K (lbs/A)

	Topsoil		Subsoil	
	Moist	**Oven Dry**	Moist	**Oven Dry**
Cherokee	50	**72**	84	**248**
Labette	172	**232**	71	**216**
Summitt	138	**324**	136	**412**

(Bohannon, Kansas)

How important is nitrogen-potassium balance? High N fertilization—without the right proportion of other nutrients —has led to poor stands, increased disease, poorer quality, and other problems.

The role of high K rates needed by high N fertilization has been widely reported.

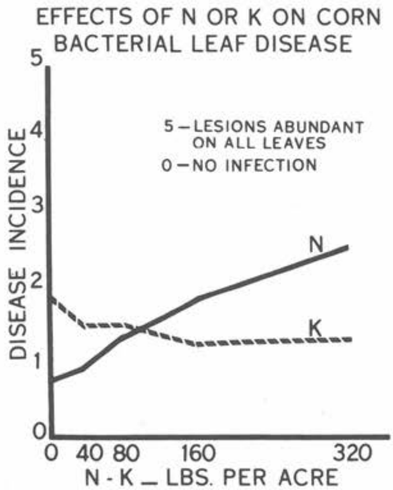


FIGURE 6 shows how high N tended to increase and high K to decrease bacterial leaf disease in Iowa corn.

Higher N rates averaged across all K rates increased the number of lesions, while higher K rates averaged across all N rates decreased them.

Nitrogen fertilization has decreased % leaf K in corn even where 100 lbs K_2O was applied. Both N and P increased with high N rates in an Iowa study—see **Table 3.**

TABLE 3. N (lbs/A)	Corn leaf content %N	%P	%K [1]
0	1.6	.24	**1.9**
100	2.3	.29	**1.6**
200	2.7	.32	**1.5**

[1] 100 lbs. P_2O_5 and K_2O applied to all plots. (Holmes, Iowa)

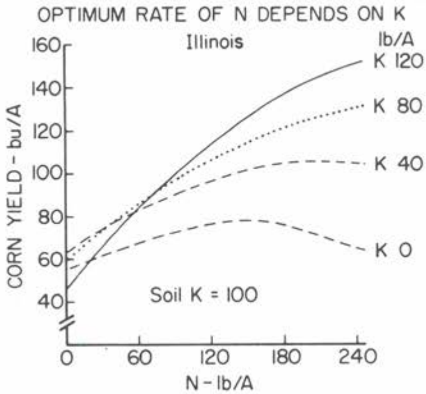


FIGURE 7 shows a classical Illinois study where N gave good returns on low-K soil only when higher K rates were added.

The role of NK teamwork in building good root systems and strong stalks, in delaying aging and reducing stalk rot development has been reported many times. As farmers need and use higher N rates, do we understand "adequate" K soil tests and fertilizer needs?

What about NK balance and quality? Drastic shifts in organic acids and increases in non-protein nitrogen (NPN) have been observed with poor NK balance in grasses—see **Table 4.**

Potassium was found to reverse these effects in orchardgrass—see **Table 5.**

TABLE 5. K_2O Treatment lbs/A	True Protein %	NPN %	Malate me/gm
0	1.61	.90	1.48
166	1.71	.80	.88
332	1.87	.62	.86

(Cummings, Indiana)

NPN and Organic Acid Content of Tall Fescue

TABLE 4. Treatment	NPN Content %	Succinate me/gm	Malate me/gm	Fumarate me/gm
None	0.76	3.44	21.48	56.99
150 lbs. N	1.03	22.22	118.81	19.19

(Teel, Indiana)

Do these quality changes influence livestock use of the forage?

How does soil aeration and temperature affect K? Poor aeration inhibits K uptake more than it does other nutrients —see **Table 6.**

TABLE 6. Relative Yield (nonaerated/aerated)	
Potassium	0.3
Nitrogen	0.7
Magnesium	0.8
Calcium	0.9
Phosphorus	1.3
Dry Matter	0.6

(Lawton)

Location Affects K Content

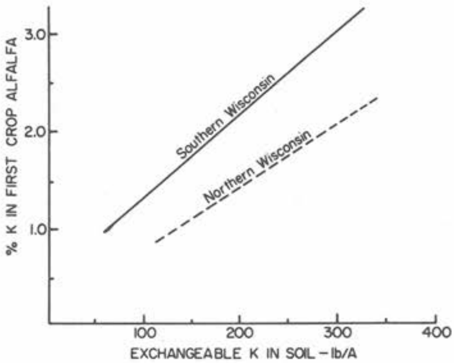


FIGURE 8 shows alfalfa on northern Wisconsin sites had much less % K than that on southern sites.

Are wetter soils and colder soil temperatures involved? What about the trend toward earlier planted corn and soybeans?

Soils are bound to be more saturated, poorly aerated, and colder. Does earlier planting require higher soil test levels to insure top plant performance?

Should we re-assess starter fertilizer responses in view of early planting trends? What about early growth of forages?

Can we create yield potential for top-profit fertilizer rates? Farmers must try to put together a management package that will get the most out of their applied and native fertility.

Progressive growers and researchers do this.

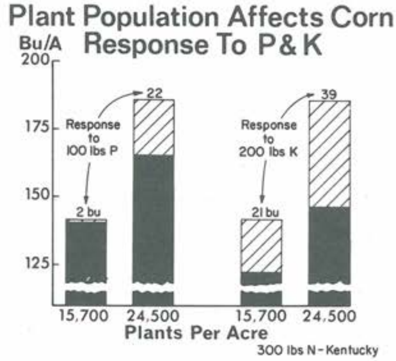


FIGURE 9 shows how Kentucky researchers got the most out of their P and K when their plant population was adequate.

Best populations vary with region and local conditions.

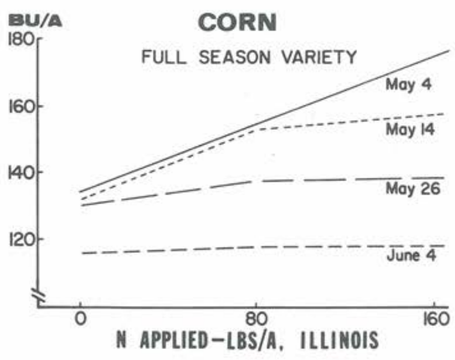


FIGURE 10 shows how Illinois researchers got much higher yields from their N by planting early. This work has emphasized the need to plant on time.

Is subsoil fertility important? It is vital with today's deeper plowing and high-yield demands. A nutrient-rich subsoil insures continued full feeding for plants when dry periods send roots reaching deeper for moisture.

We must not forget deeper plowing

dilutes the plow layer's nutrition by mixing the poorer subsoil with topsoil.

Should we increase fertilizer rates? Most states make this adjustment with lime rates.

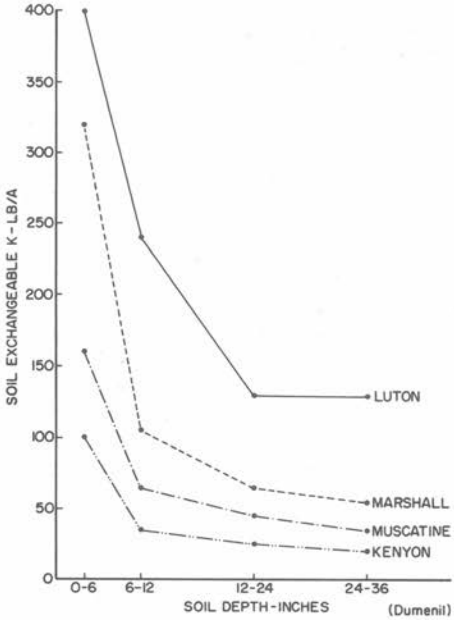


FIGURE 11 shows how sharply potassium declines with soil depth in Iowa soils. This trend shows up with moist samples, much less often with dried samples. In fact, some subsoil K tests actually increase with depth unless the field moist analysis is used.

Does this mean dry soil samples cause sites with topsoil removed to test higher than they should?

Such sites included eroded spots, terraced fields, fields leveled for irrigation purposes, and all other situations where topsoil is removed.

What about low K soils in high K regions? Don't give up if you have not found low K soils or K responsive conditions in your so-called high K region. They are there. Keep looking.

In north central Nebraska, generally thought high in available K, 74 subirrigated meadow soils showed surprising need for K. The sites tested roughly 24% low (75 ppm), 53% just medium (75-150), only 23% high (150 ppm) in potassium.

Don't let declining K content—from loss of topsoil, cropping depletion, irrigated sandy soils, etc.—threaten your yields or profits. **THE END**

HUNDREDS are responding . . .

. . . to the recent inquiry we ran in the past two issues of BETTER CROPS. Many have passed along good ideas on how they put this little magazine to use.

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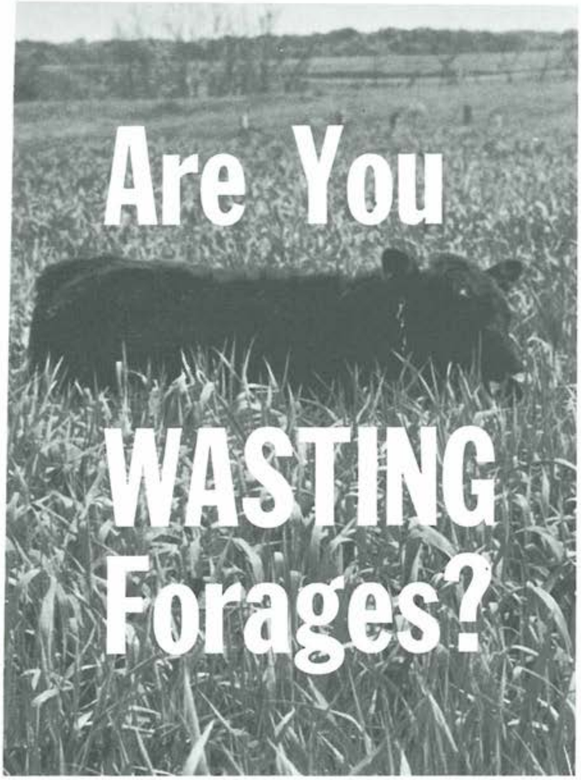
Are You WASTING Forages?



NIVEN MORGAN
SHREVEPORT, LOUISIANA

W. R. THOMPSON, JR.
STATE COLLEGE, MISSISSIPPI

KNEE-DEEP FORAGE in your pasture makes good conversation or bragging material—but rarely a profit-maker because by then it is too old, too fibrous, too tasteless, and too low in nutritive value. Forage is to be USED, not looked at.

When pastures are properly fertilized, managed, and USED, they will return $4,000-$5,000 to land, capital, and management per 100 acres.

Some farmers make still greater profits by a more intensive forage program. In some instances, return to management alone approaches these figures.

A cattleman or forage producer can lose his pants by growing an abundance of forage and not properly using it.

Poor utilization of improved pastures is the number one problem affecting profits.

Well fertilized plants not used properly and sold as milk or meat are not profit makers.

Cattle do not like "belly-wadding"—and much forage falls into this classification.

Have you read or been told never to graze pastures below 4 to 6 inches? Such information can be **true** or **false** depending on the entire forage management program.

If permanent pastures are properly rotated to allow grass to grow up for hay in the rotational program, then they can be grazed very closely. In most cases, pastures are not over-grazed as long as cattle can get their "fill" in a reasonable length of time providing there are sufficient nutrients in the soil plus a little moisture to bring back new growth rapidly.

A properly grazed pasture may have more leaf area below 2 inches than an improperly grazed pasture has below 4 to 6 inches. Leaf area remaining is more important than height.

What should pastures be judged on? In too many cases, they are judged by only the quantity of forage. The quality of the forage is of utmost importance.

Stocking rate and condition of the cattle form the real basis for judging pastures. Healthy, well-fed cattle are profit makers—undernourished cattle are free loaders.

In a rotational program, at least 5 cows and possibly 10 per acre should be rotated on a pasture at one time in order to graze it down quickly, possibly in one week.

Fewer cattle cause "spot grazing." The animals will continue to graze on the closely grazed spots and will not graze the taller, older, more fibrous spots unless starved to them.

When such pastures are clipped, they are usually mowed higher than the closely grazed spots.

When cattle are rotated back onto such a pasture, they will again start grazing on their previously grazed spots due to the higher percentage of leaves to stems.

Cattle prefer to graze on short plants with a lot of leaves instead of tall plants with a few leaves on the top of tall stems.

Farmers cannot afford to fertilize a certain area and have cattle graze on only a portion, leaving possibly half ungrazed—the tall, unpalatable spots.

WHY DO MANY FARMERS "plan on disaster" and stock pastures for the anticipated summer drought?

Stocking pastures with low cattle number during times of high production because of anticipated drought in summer is costing many farmers profits.

When the weather is hot and dry, farmers usually say, "My pastures are burned up." They may be right and can do nothing about it short of irrigation.

But chances are the lack of plant food for the pasture is more serious than the lack of moisture. Adequate plant food greatly increases the efficiency of moisture.

Fertilized forages can withstand the stress of drought much easier than undernourished forages. Fertilizer can make the difference.

Since herbicides do such a good job of weed control, is it really necessary to clip pastures now?

Many farmers have been led to believe that a good chemical weed control program will eliminate the need for a pasture mower.

That opinion is far from correct. A mower is a must in a good pasture management program. A good pasture management program usually has a hay making program in combination.

Hay should be made with the excess forage in the pasture rotational program. If hay is not made, it is usually profitable to clip anyway in order to keep pastures young, tender, and high in quality.

WHY FERTILIZE PASTURES? The reason is clear: to grow more high quality forage that makes possible a higher stocking rate resulting in more meat or milk from each acre.

One hundred cows on 100 acres of high quality forage will usually make more profit per 100 acres than 50 or 25 cows would make on the same acreage.

Until a farmer makes full use of the land he owns, it is usually uneconomical to buy extra land unless he is buying it just as an investment.

Fertilizer can substitute for land and it is less expensive than land.

HOW MUCH FORAGE and fertilizer is needed for cattle? A brood cow and calf needs about 6 tons of high quality forage each year to take care of their nutritional requirements.

Most land can produce this quantity of quality forage when properly fertilized and managed.

To produce this amount of forage with a protein content of 12.5 percent would require approximately 300 lbs. N.

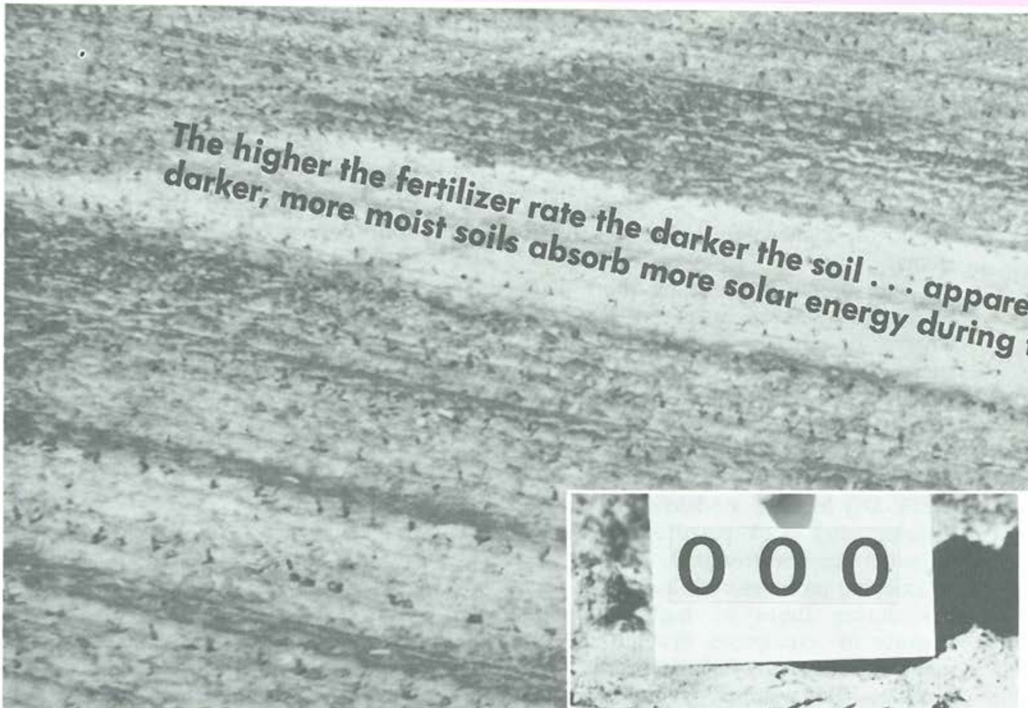
The P_2O_5 needed would be around 100 lbs, depending on soil type.

The K_2O needed would be from 300 to 400 lbs, depending on both soil type and whether the pasture is grass alone or grass plus clover.

Available soil N, P_2O_5, and K_2O can be deducted from above figures to determine amount of each element which should be added, considering the efficiency of each element under the existing conditions.

Remember PROFITABLE PASTURES DON'T JUST HAPPEN. THEY ARE PROPERLY PLANNED, FERTILIZED AND PROPERLY MANAGED. **THE END**

WHY IS SO MUCH FORAGE wasted in many improved pastures? Improper utilization is the answer—too low a stocking rate, manure piles, and a poor combination of rotational grazing with hay-making.



Fight FROST Damage with

WILL FERTILIZATION reduce frost damage on corn? A high fertility experiment at Ohio's Agricultural Research and Development Center produced an interesting phenomenon.

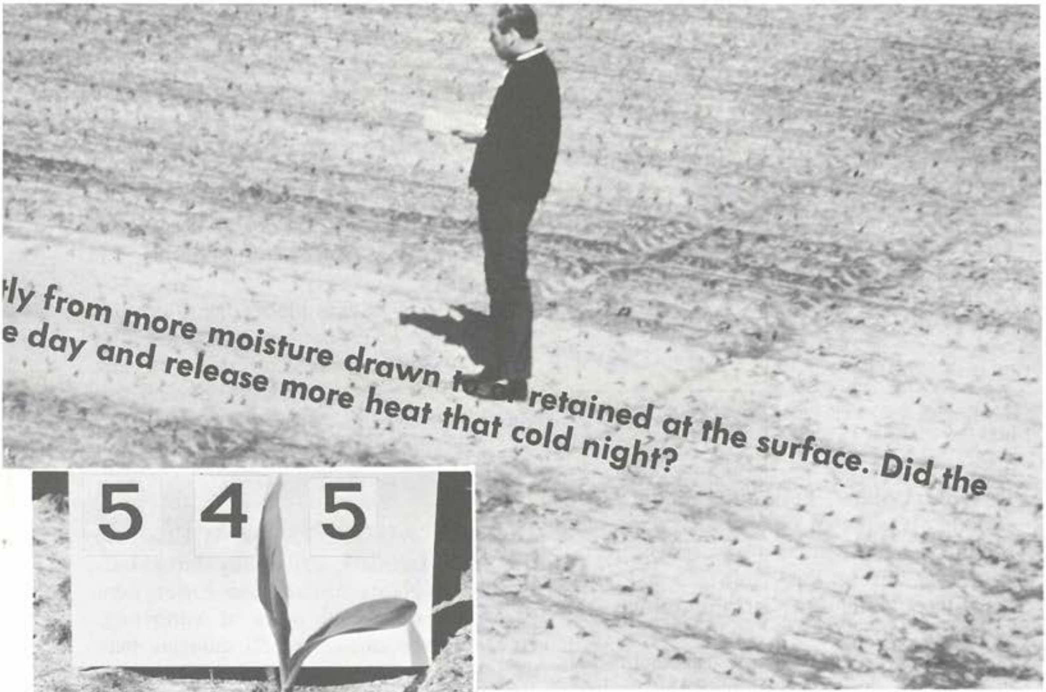
Although the findings are based on after-the-fact measurements to record and help explain some of the observations, they indicate fertilization may help reduce frost damage under certain conditions.

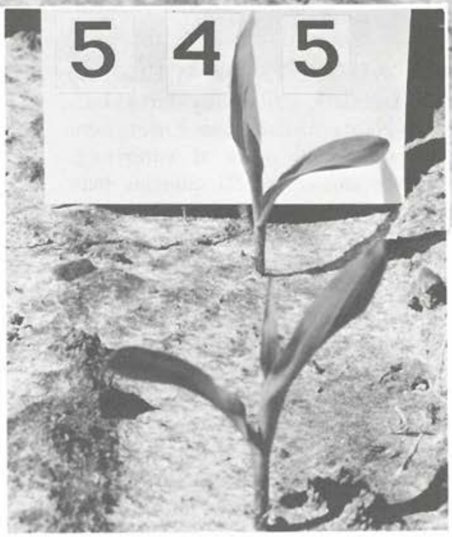
Corn planted April 13 in an NPK factorial experiment emerged on April 28 and grew normally for 9 days. Then the expected frost occurred during the night of May 6, 1970.

The temperature dropped to 25° F, setting a new record low for that date at the Center, and remained below freezing for 7 hours.

THE CORN WAS PLANTED 1½ inches deep, so the growing point was protected from the frost.

Under normal conditions, this frost would have killed the aerial portion of these seedlings, which were about 3½





JOHN F. TRIERWEILER

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER

FERTILIZATION

inches tall.

But while 96% of the plants in the unfertilized plots were damaged by frost only 7% of the plants in some of the high fertility plots were damaged, a plot by plot count showed.

Plants were classified as damaged when all the aerial portion was killed.

On the average, only 20% of the plants in the fertilized plots were damaged. All of the damaged plants survived but were set back about one week in their growth.

Frost effect on the plants was clearly associated with fertilizer treatment and only slightly influenced by micro-topographic variations.

THE FERTILIZER TREATMENTS consisted of all combinations of five levels of N, P, and K plus a check.

Nitrogen was applied as ammonium nitrate, phosphorus as superphosphate, and potassium as muriate of potash.

The fertilizers were broadcast and disked before planting.

Table 1. Effect of Fertilizer on Frost Damage to Corn Seedlings *

N	Damaged Plants	P_2O_5	Damaged Plants	K_2O	Damaged Plants
lbs/A	%	lbs/A	%	lbs/A	%
200	30	75	20	100	22
331	19	131	20	182	20
548	21	229	25	332	21
906	**14**	401	22	**604**	**15**
1500	**10**	700	20	**1100**	**14**

* Check plots (0-0-0) 96% frost damaged.
Soil test 0-6 inches, P_1 61, ex K 261.

Table 1 shows how different fertilizer treatments affected frost damage to corn seedlings. The values for a given fertilizer element in this table are averages for all combinations of the other two fertilizer elements.

Nitrogen and potassium treatments reduced frost damage, but phosphorus had little or no effect on the number of damaged plants.

Statistical analyses of the data showed that decline in damaged plants was highly significant for any combination of nitrogen and potassium.

TOTAL MINERAL ANALYSES made on two representative samples of damaged and undamaged plants showed no notable differences in mineral composition.

The obvious relationship of higher content of mineral salts in the plant depressing the freezing point of water may not account for the increased frost resistance of plants in the fertilized plots.

But even though the mineral content of the damaged and undamaged plants was apparently the same, their organic composition may have changed.

If so, the fertilized plants may have contained more free amino acids, sugars, or other soluble material which could bind more plant water or lower its freezing point.

The higher the fertilizer rate, especially for the highly soluble N and K carrier salts, the darker the soil. The color of the soil may have provided a clue to frost resistance.

Those plots containing the more soluble fertilizers (salts) appeared to have more moisture and/or soluble organic matter, drawn to or retained at the surface of the soil. Higher moisture would cause a darker soil color.

The day before the frost was clear and sunny, so all soil temperatures increased.

Moist soils have higher heat capacities, greater thermal conductivities, and less reflectance than drier soils. So, the darker, more moist soils could have absorbed more solar energy during the day and released more heat during that still night.

HIGHER AMOUNTS OF WATER in the high fertilizer soils may have buffered the plants against the lower temperatures, since each gram of water as it freezes gives off about 80 calories heat of fusion.

The soil, water, air, and plant in contact with this freezing water would be able to absorb this heat and maintain a temperature nearer the freezing point.

Also, heat from the soil conducted through the plant may have maintained the temperature of the aerial portion of the plants slightly above the ambient temperature.

These effects on the micro-climate and the plant may have kept temperature from reaching the recorded low of 25°F and may have been sufficient to protect most of the plants from frost damage.

HIGHER FERTILIZER RATES of this experiment were **not** selected to produce top yield and are not recommended.

These rates were chosen to study nutrient interactions, especially induced deficiencies, under field conditions with very heavy fertilization or very high soil test values.

Since these fertilizer treatments greatly decreased frost damage under the conditions accompanying this frost, these findings were reported.

From a practical point of view, even the standard maintenance rates used in this experiment reduced the amount of frost damage considerably. **THE END**

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Tillage can affect a crop's nutrient uptake many ways.

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Four steps will help you get there in a blighted age.

...FORAGE: GROW IT, THEN USE IT

The true value of your pasture depends on three things.

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Save some of that 50% gross income now fed to feed bills.

...PLAN THE BEST FOR SOYBEANS

A good-price crop deserves a good manager's treatment.

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Why soil and animal nutrition depend on right balance.

...KNOW YOUR PLANT STANDS

Forget profits if you don't have a proper plant stand.

A kit of these eight 3-minute radio scripts can be secured by writing 1971 PINA RADIO SCRIPTS, Potash Institute of North America, 402 Northwestern Avenue, West Lafayette, Ind. 47906. The price is 4¢ per kit.

FARMERS OFTEN ASK, "What happens to fertilizer applied in dry years?"

A farmer notes poor yields from moisture stress, then feels his fertilizer was wasted.

He is assured the unused fertilizer he applied will produce residual benefits in years to come. And this is about as far as the discussion goes.

Agronomists at Agrico's Agronomic Research Laboratory in Washington C.H., Ohio have been growing crops in their "Standard Plots" for six years—under moisture conditions ranging from extreme drought to good rainfall.

Corn yields—taken from 7 to 20 commercial hybrids grown under four soil fertility conditions—show corn responding to fertilizer applications each year.

In fact, the corn responded to fertilizer and lime in dry years about as well as it did in good moisture years.

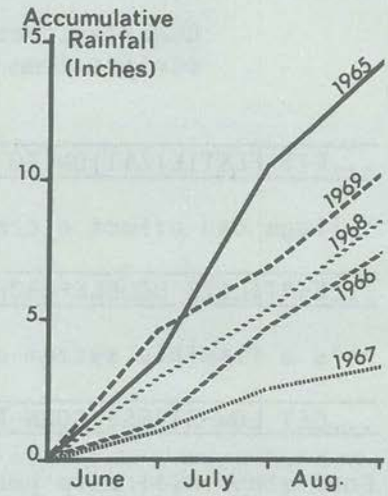


FIGURE 1

R. B. LOCKMAN
AGRICO CHEMICAL COMPANY

Fertilized Corn

Individual yields ranged from **14 bu/A** with wrong hybrid, acid soil, low fertility and drought, to **188 bu/A** with correct hybrid, near-neutral soil, good fertility and good moisture.

GOOD MOISTURE is essential for a good crop. **Figure 1** shows rainfall trends. What are "good" moisture conditions? Total rainfall during a growing season or even during individual months can be misleading.

Rainfall pattern from day to day is a better index. For example, if July is dry until the last week, 3 to 4 inches of rain will not "make up" for earlier moisture stress damage to the crop.

Yet, July moisture figures would show July to have sufficient moisture.

We started recording weather data in 1965. Dr. Woodruff of Missouri says corn needs about **0.16 inches of water per day** for a good corn growth.

We plotted our rainfall data day by day against time to compare both the **degree** and **duration** of moisture stress with this ideal 0.16 inches per day value.

From such figures, we assigned a "Moisture Index" value for the months of June, July, and August and for the season as a whole. See **Table 1.**

The 1968 season gave just a little more moisture (8.61 inches) than the 1966 season (7.40 inches). But the 1968 season was a much better moisture year.

Why? Because rainfall distribution was better by month and within months. This fact is described by our "Moisture Index" (5 versus 11).

The difference was visually noted during the seasons and was reflected by much higher yields in 1968.

RANGES FOR SOIL TEST values are

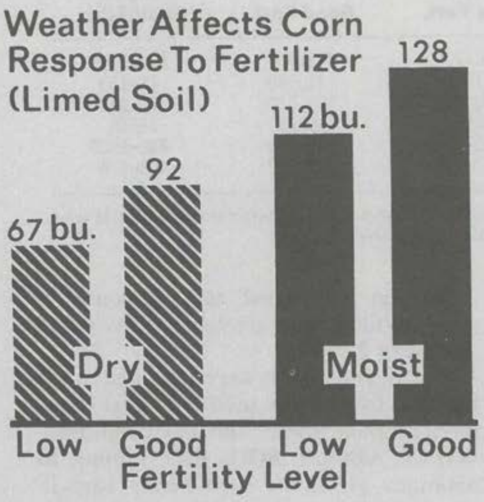


FIGURE 2

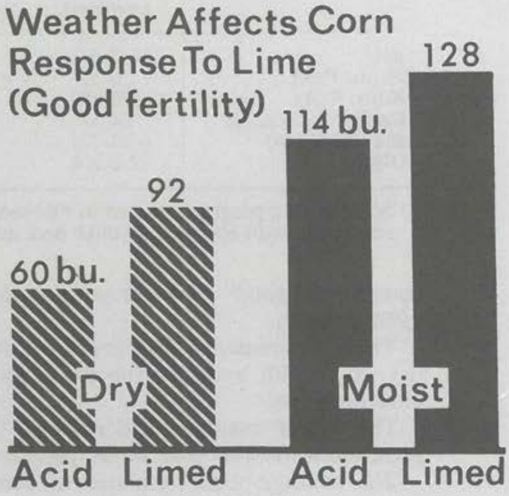


FIGURE 3

Meets DRY Years

listed in **Table 2.** Average corn yields from the plots are listed in **Table 3.** The "Year Average" column clearly shows how moisture affected yield.

Three of the six years were distinctly dry (1964, 1966 & 1967) and three were

Table 1. Moisture Index [1]—AGRICO Plots 1965–69

Dry Years	June	July	Aug.	Season	Avg. Yield Bu/A
1964	—	—	—	(6 est.) [2]	76 [3]
1966	2	2	1	5	72
1967	1	1	1	3	70
Moist Years	June	July	Aug.	Season	**Avg. Yield Bu/A**
1965	4	3	4	11	91
1968	5	3	3	11	116
1969	5	4	3	12	118

[1] Moisture Index — 1 = very dry to 5 = adequate moisture as compared with ideal 0.16 inches per day requirement (Dr. Woodruff).
[2] Moisture data not recorded for 1964 — value estimated.
[3] Yield = 57 bu/A adjusted to 76 bu/A for differences in row width in 1964.

Table 2. Range of Soil Test in AGRICO Standard Plots—1964–1969 [1]

	Acid Low Fert.	Limed Low Fert.	Acid Good Fert.	Limed Good Fert.
pH	5.2–6.1	6.4–7.0	4.8–5.6	**6.5–7.3**
P_1 (lb. P/A)	6–15	7–18	31–148	**25–139**
K (lb. K/A)	130–150	190–260	170–330	**170–338**
Ca (100 lbs. Ca/A)	24–37	40–67	20–36	**34–50**
Mg (lb. Mg/A)	460–770	1000–2100	480–750	**790–1300**
OM%	2.6–3.4	4.2–5.6	2.8–3.2	**3.3–4.4**

[1] Soil building program started in 1964 increased soil P and K levels with time. Soil pH was controlled with elemental sulfur and dolomitic limestone.

considered "good" moisture years (1965, 1968 & 1969).

Table 4 compares averages for three dry years with averages for three good moisture years.

The 3-year average yield response to good moisture was +42 bu/A per year.

The average yield response to near-neutral soils was +24 bu/A per year.

The average yield response to good soil nutrient levels was +22 bu/A per year.

Under the worst conditions, the average yield was 44 bu/A.

Where moisture, pH, and soil nutrients were near optimum, average yield was 128 bu.

At least half of the 84 extra bushels were the result of soil management practices. **In other words, the farmer is not completely at the mercy of the weather! He *can* do something about yields in those dry years.**

Look a bit further. The question of fertilizer response in dry weather is answered here, too.

On both acid and limed soils, fertilizers increased yields an average of +20 bu/A (from 56 to 76) **under dry conditions,** an average of +25 bu/A (from 96 to 121) **under moist conditions.**

But on the limed soil, response to good fertility was greater in dry years, **as Figure 2** shows.

Up to 188 bu/A were obtained when the best hybrid was used with best moisture, nutrient levels, and pH conditions.

WHAT ABOUT SOIL pH? Liming to optimum pH is an even better bargain than fertilizers if your soil is highly acid. With good fertility, response to lime was greater in dry years, as **Figure 3** shows.

This shows moisture, soil fertility, and soil acidity individually affect yield.

But just because one of these three important yield factors is less than optimum does not mean the other factors will not affect yield.

It takes all three combined with other good management practices to reach top yields. **Yet, yields can be increased year after year with good fertilization and liming practices despite severe moisture stress.**

Look at **Table 4.** Proper lime and fertilizer management increased corn yield from 44 to 92 bu **under drought conditions**—a 110% increase!

When moisture conditions improved, average yields increased from 80 to 128 bu with the same improved soil management—a 69% increase!

Table 3. Corn Yields (Avg. Bu/A) Affected by Seasonal Moisture, Soil Acidity, Soil Nutrient Levels—1964 to 1969

Year	Moisture Condition	Acid Low Fert.	Limed Low Fert.	Acid Good Fert.	**Limed Good Fert.**	Year Avg.
1964 [1]	Dry	48	65	44	**71**	57
1965	Moist	64	87	101	**113**	91
1966	Dry	45	79	64	**100**	72
1967	Dry	40	62	73	**105**	70
1968	Moist	99	118	120	**127**	116
1969	Moist	77	132	121	**144**	118
Six-Year Plot Avgs.		62	90	87	**110**	87

[1] 1964 = wide rows used—yield est. to be 75% of potential yield if regular 3′ row width had been used.

Table 4. Average Corn Yields as Affected by Moisture, Soil pH, and Soil Nutrient Levels

		Soil Nutrient Level				
Moisture Condition	**Soil pH**	bu/A	Low (% Max. Yield) *	bu/A	Good (% Max. Yield)	Avg. bu/A
Dry	Acid	44	(34)	60	(47)	52
Dry	Neutral	67	(52)	92	(72)	80
	Dry Yr. Avg.	**56**		**76**		**66**
Moist	Acid	80	(62)	114	(89)	97
Moist	Neutral	112	(88)	128	(100)	120
	Moist Yr. Avg.	**96**		**121**		**108**
Nutrient Level Avgs.		76		98		87

* Maximum yield (100%) = three-year average yield of all hybrids grown on fertilized, limed soil with good moisture.

In other words, even though yield increases (bu/A) were about the same, the **percentage increase** was greatest under drought conditions. Why? Maybe nutrient uptake from the soil depends on moisture.

On dry years, lack of soil moisture greatly inhibits nutrient uptake rate. If certain nutrient levels are low in the soil, uptake rate becomes still lower, reducing yield further.

Increasing the level of nutrients in the soil apparently reduces this yield limiting effect of moisture stress.

Be ready to use good rainfall! **Table 4** shows good moisture was worth only 40 bu/A with low soil fertility (from 56 to 96), but 45 bu/A (from 76 to 121) with good fertility.

The farmer practicing good soil management gets more from his rainfall any way you want to look at it!

PLANT SAMPLES TAKEN from these crops over the six-year period are showing how optimum nutrient levels are affected by fertility and moisture conditions at different stages of growth.

Plant samples taken during dry periods do reflect potential yield affected by nutrition. But criteria for judging nutrient sufficiency are different for dry and moist conditions.

If plant samples are taken during dry weather conditions, be sure to mark it on the crop history form.

Table 5 shows average mineral composition of corn earleaf samples taken at early bloom stage for moist and dry years. Note how both soil fertility and soil moisture affected analyses and yields.

Many factors control crop yield. The farmer can manage most of these factors.

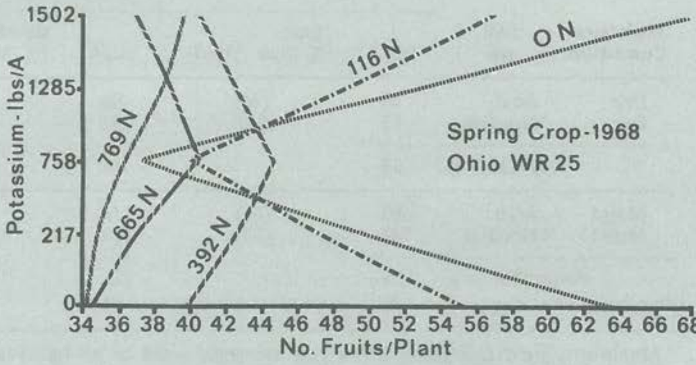
THE END

Table 5. Corn Ear-Leaf Mineral Composition as Affected by Soil Moisture and Soil Fertility. (Plot #1 vs. Plot #4)

	Soil Moisture and Fertility					
	Avg. 3 Dry Years			Avg. 3 Moist Years		
Element	Low Fertility	**Good Fertility**	Avg.	Low Fertility	**Good Fertility**	Avg.
% N	2.5	**3.0**	2.8	3.0	**3.3**	3.2
% P	0.21	**0.32**	0.26	0.17	**0.24**	0.20
% K	1.3	**2.0**	1.6	1.7	**2.4**	2.0
% Ca	0.81	**0.78**	0.80	0.75	**0.88**	0.82
% Mg	0.58	**0.36**	0.47	0.47	**0.33**	0.40
ppm B	13	**18**	16	6	**8**	7
ppm Cu	6	**8**	7	6	**10**	8
ppm Fe	104	**126**	115	85	**85**	85
ppm Mn	84	**65**	74	55	**40**	48
ppm Zn	37	**27**	32	31	**25**	28
ppm Al	48	**58**	53	34	**29**	32

FIGURE 1

N-K INTERACTIONS . . . on number of fruits per plant. Ohio W-R 25 Spring Crop 1968.



N-K Balance IMPORTANT to Greenhouse Tomatoes

Freeman S. Howlett and Dale W. Kretchman

Ohio Agricultural Research and Development Center

MAINTAINING ADEQUATE but not excessive nitrogen supply in the greenhouse tomato is a major problem for the producer.

Excessive supply may reduce fruit set, a well known fact, but its effect upon certain fruit defects has received little attention.

Also, an adequate supply of potassium is essential—but here again its effect upon fruit quality requires further study.

For years, potassium deficiency has been associated with blotchy ripening, reduced fruit firmness, and shorter shelf-life. But its relation to fruit cracking and off-colored fruits (not of the blotchy ripening type) is not as well understood.

Naturally, balance of the two elements is also a major concern since an increasing nitrogen supply induces potassium hunger unless the soil contains enough K. It also becomes evident that the effect of large quantitites of both elements upon yield and fruit defects deserves further consideration.

This research seeks the following:

1. To determine exactly how certain quantities of applied N and K affect yield and accompanying defects.

2. To relate leaf content of N and K

FIGURE 2

N-K INTERACTIONS

. . . on percentage of U. S. No. 1 fruits. Ohio W-R 25 Spring Crop 1969.

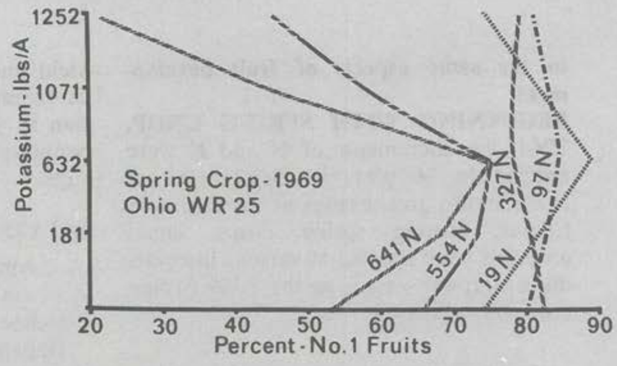


FIGURE 3

N-K INTERACTIONS

. . . on defects per fruit—fruit size 2.8 to 4.4 ounces. Ohio W-R 7 Spring Crop 1965.

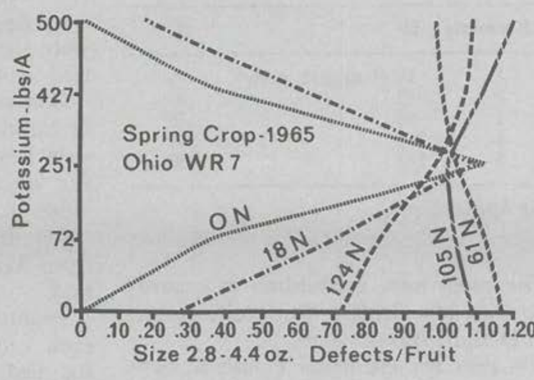


FIGURE 4

N-K INTERACTIONS

. . . on off-colored fruits—fruit size 6.3 to 9.7 ounces. Ohio W-R 7 Spring Crop 1965.

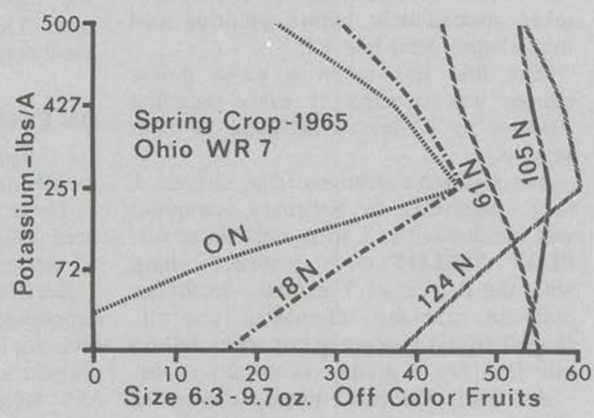
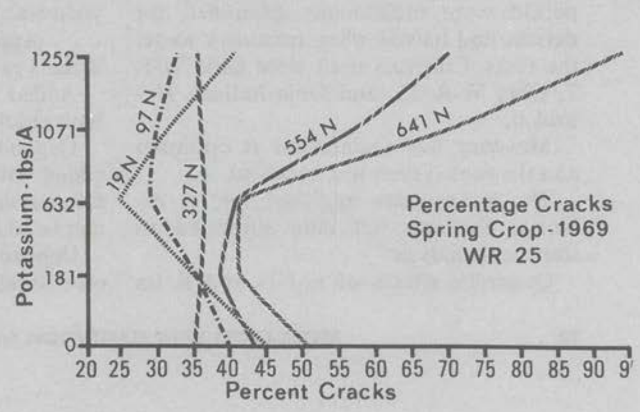


FIGURE 5

N-K INTERACTIONS

. . . on percentage of cracked fruits. Ohio W-R 25 Spring Crop 1969.



to the same aspects of fruit development.

BEGINNING WITH SPRING CROP, 1964, five increments of N and K were applied to 36 plots in Department of Horticulture greenhouses at the Research Center. During spring crops, equal amounts were applied at various intervals during growth—such as the 1969 Spring crop shown here:

Total Quantities of Elemental N-K in Each Application * (Lbs/Acre Basis)

N-K Levels	N	K
1	19 (1 applic. only)	0
2	19	36
3	65	126
4	111	214
5	128	250

* Five Applications.

The plots were established in accordance with the Central Composite Rotatable Design (Box-Wilson).

Soil tests for elemental P and K were taken immediately before planting and immediately after harvest.

The first leaf below a given flower cluster was selected at each sampling date—6 to 12 leaves included in each sample.

Samples were removed from clusters 1 to 8. Beginning in February, sampling was conducted at 2 to 3 week intervals.

PLOT YIELDS were recorded along with the degree of 7 defects—including puffiness, cracking, off-colored, and off-shaped fruits. Percentage of fruits falling into U.S. No. 1 grade was usually noted.

All fruits harvested during the entire period were individually examined for defects and halved when necessary to get the facts. Cultivars used were Ohio W-R 7, Ohio W-R 25, and Ohio-Indiana Hybrid 0.

Moisture was maintained at optimum and the root system was excellent.

The leaves were analyzed for 11 essential elements, all data subjected to statistical analysis.

Quadratic effects of leaf N and K on yield and defects were obtained as well as regression of these elements in relation to yield and defects. This summary contains only a small fragment of the results.

ON YIELD . . .

. . . Applied Nitrogen usually increased yield up to a certain point, followed by a decline at the highest nitrogen level.

Depending on the particular flower cluster, total weight of fruits rose up to 4.0 to 4.5 percent nitrogen in the leaves (dry weight basis) and then declined.

. . . Applied Potassium did not increase yield significantly during the 1966-69 period inclusive.

Soil potassium in the upper six inches of Level 1 plots fell from 171 to 83 lbs —in Level 2 plots from 243 to 166 lbs. But no decline occurred from 1967 to 1969.

On the other hand, Level 5 increased from 313 to 688 lbs over the 4-year period.

Peanut hulls (8 tons/A applied for each crop except the no-N treatment) supplied about 130 lb K in each application. This probably helped hold down yield response to applied K.

ON FRUIT DEFECTS . . .

. . . Applied Nitrogen resulted in more total fruit defects as N rates rose.

These included cracking and off-colored fruits in particular. Puffiness and off-shape were only occasionally affected.

Leaf composition results indicated that depending upon the cluster, cracking and off-color increased as leaf nitrogen increased up to a maximum of 5.5 percent (dry weight basis). At this percentage yield was decreased.

. . . Applied Potassium resulted in less defects per fruit.

Added potassium frequently reduced both cracking and off-color.

Depending on cluster, **cracking declined with increased leaf K up to 4.8 to 6.0 percent.** Above these levels cracking increased as leaf K increased.

Depending on the cluster examined, **off-colored fruits declined as leaf potas-**

sium climbed to values ranging from 4.3 to 8.8.

Puffiness and off-shape were generally not related to leaf K. It is interesting that even though yield was not affected, added K improved quality through less cracking and off-color.

IMPORTANT INTERACTION between applied N and K occurred during spring crops but rarely during fall crops—an interesting observation not yet explainable.

Several typical interactions occurring during the spring crops are shown in **Figures 1 to 5.**

Figure 1 shows that at the three highest N levels (treatment 3 to 5), little change occurred by increasing K increments.

On the other hand, the two lowest N treatments showed an outstanding decline in number of fruits up to and including the median K level. Above median K, a pronounced increase occurred.

These two N treatments represented such low N that they would not be commercially practical.

Figure 2 shows that the lowest percentage of U.S. No. 1 fruits occurred at the two highest N applications.

The percentage of U.S. No. 1 fruits increased up to the median K level and above this point showed an outstanding decrease. This result represents one of several instances in which the combination of the highest N and K levels produced an unfavorable effect.

Figure 3 shows interrelationship of applied N and K to the fruits in a size group ranging from 2.8 to 4.4 ounces. As expected at the three highest nitrogen levels defects per fruit were the greatest in number.

On the other hand, defects at the two lowest N levels increased to the median K level (treatment 3) and then with increasing K showed a marked decrease.

Figure 4 shows the off-colored fruits of this fourth size group—6.3 to 9.7 ounces—were greater in number at the three highest N applications. At the two lower levels, off-color increased to the median K level and then declined.

Figure 5 shows percentage of fruits with cracks was generally highest at the three lowest K levels. However, above the median K treatment at the two highest N applications cracking increased to an outstanding degree.

This illustrates again the unfavorable effect of applying the largest N-K quantities.

IN SUMMARY, these results showed yields declining, while cracking and off-color increased, when N applications raised leaf N above certain levels.

At the same time, potassium reduced these defects appreciably when applications were not excessive.

Furthermore, N-K interaction indicated adverse effect on cracking and percentage of U.S. No. 1 fruits when large quantities were applied.

Concentrations of leaf N and K associated with maximum yield and reduced defects are briefly mentioned in the text.

The line between favorable and unfavorable effects from N-K applications is a fine one. This makes leaf analysis an important indicator for greenhouse tomato plants. **THE END**

TOP PROFIT is the aim of modern northern Corn Belt farmers, and high corn yields must be achieved to get top profit.

Corn management studies started at three branch stations in 1967 are now helping to answer these questions.

Waseca is one of these stations, located in southern Minnesota on fertile silty clay loam Nicollet-Webster prairie soils.

Many factors affect corn production at any location: **(1) Genetic potential of the hybrid, (2) Moisture supply, (3) Air, in the soil and above ground, (4) Light, (5) Temperature, in the soil and above ground, (6) Nutrient elements, 16 of them, (7) Soil pH, (8) Insect control, (9) Weed control, (10) Tillage.**

There is an infinite number of possible combinations of these factors. We are not certain of the optimum rates of all factors.

Some we cannot control well. But the situation is encouraging. Growers frequently approach or even surpass 200-bushel levels in Minnesota.

IN THIS RESEARCH, we have varied four major production factors: (1) Planting date, (2) Rate of nitrogen application, (3) Plant population, (4) Hybrid maturity.

Hybrids were selected for their response to the factors included in the study.

Soil in the research area tests high or very high P and K. Organic matter content is 5 percent.

Phosphate and potash broadcast application has been a uniform 100 lbs P_2O_5 and K_2O per acre annually, plowed down in the fall.

Micronutrients have not been used, since their necessity has not been established in this area.

Herbicides and insecticides have been used as necessary to control weed and rootworm. Data are from 30-inch rows.

Row fertilization was uniform, amounting to 20+50+34 lbs $N+P_2O_5+K_2O$ per acre.

Broadcast nitrogen rates were 50, 150 and 250 lbs/A annually since 1967.

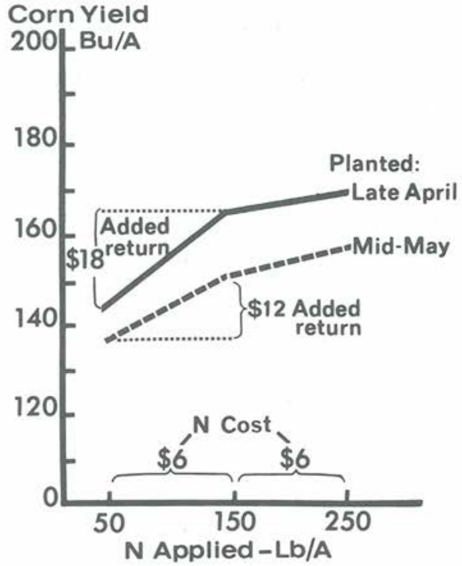


FIGURE 1

Planting dates were April 22, May 1, May 15 and May 31.

Harvest plant populations were 18−, 24− and 30,000 plants/A.

Hybrids were of different relative maturity ratings, selected to represent a group of high-producing hybrids.

You can get

Data shown here are from our full-season hybrids with relative maturity ratings of 105, 110, and 115 days.

WHAT ABOUT N RATE? Top production has been reached at the 250 lb N rate, **Figure 1** shows. But this rate is probably not economically superior to the 150 lb rate as far as return to ferti-

---

The research data presented is part of a co-operative study involving University of Minnesota, Department of Soil Science, Agronomy and Plant Genetics and branch stations at Waseca, Lamberton and Morris.

. . . in a CORN-SOYBEAN DAY at Minnesota's Southern Experiment Station at Waseca, growers want to know the steps to top corn production . . . if Iowa and Illinois practices will pay off in these northern areas.

HIGH corn yields IN NORTHERN AREAS

lizer investment is concerned.

With corn priced at $1 per bushel and nitrogen priced at 6 cents per pound applied, the 150 lb N rate returned $12 more corn than the 50 lb N rate, **when corn was planted by mid-May.**

When planting was earlier—late April—the 150 lb N rate returned $18, a $6 per acre increase.

The increased cost of 250 lbs N, compared with 150 lbs, was barely offset by the yield increase at both planting dates.

Early planting has consistently produced highest yield, with the increase confined mainly to corn planted before May 15, as **Figure 2** shows.

WHAT ABOUT PLANTING RATE & DATE . . . The top yield in Figure 2 may unfairly represent expected results at the 30,000-plant population.

Other data indicate that added yield increases going from 24,000 to 30,000

RUSSELL D. FRAZIER
UNIVERSITY OF MINNESOTA

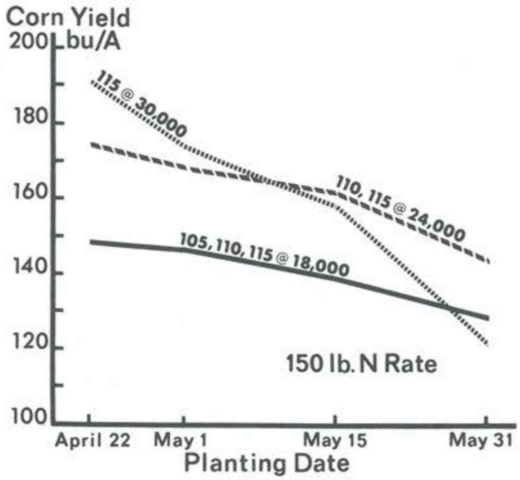


FIGURE 2

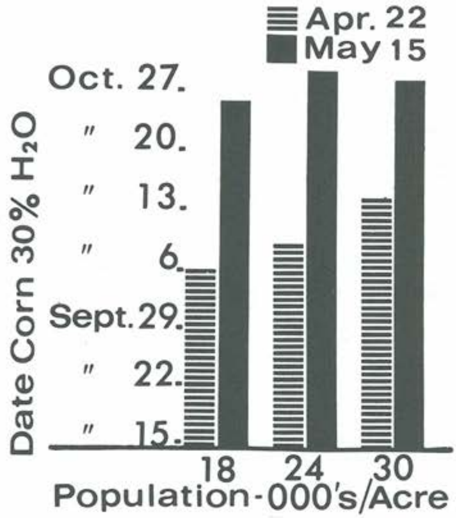


FIGURE 3

populations will not consistently pay for the extra seed involved.

. . . PLANTING DATE & HARVEST MOISTURE? When did the various populations reach 30 percent ear moisture. **Figure 3** shows this with planting dates.

Though frosted off when 2 inches tall, April-planted corn reached harvest stage well before fall frost in a season featured by much wet corn, typified by the corn planted in mid-May.

In 1969, population and planting date apparently influenced the date the corn reached 30 percent ear moisture.

The early-planted corn was delayed in reaching 30 percent ear moisture by about one day for each 1,000 increase from 18,000 to 30,000 population.

This effect was not apparent on the later planting date, where all populations stayed wet until quite late in the season, regardless of population.

IN SUMMARY. Top yields—195 bu/A with low moisture content—were consistently produced with combinations of 110 to 115-day relative maturity hybrids at 24,000 harvest population, moderate N rate, planted early.

Planting date strongly influenced harvest moisture. Top-yielding hybrids consistently yielded 150 to 190 bu/A and were safely below 30 percent ear moisture when planted **before mid-May.**

Conversely, few treatment combinations planted in mid-May or later were below 30 percent ear moisture at harvest or by killing frost.

The 150 lb nitrogen rate quite consistently produced the driest corn at harvest time—may be due to a near-optimum N-K balance at the 150 lb N rate.

Profit-minded farmers in the northern corn belt might profit from our experiences in southern Minnesota:

1—Plant a "hot" 110 or 115-day hybrid.

2—Aim for 26,000 plants per acre.

3—Broadcast and plow down P and K fertilizer to reach relatively high soil tests.

4—Use 150-170 lbs N on continuous corn.

5—Finish planting by May 10.

The right management combination can profitably produce high corn yields in northern areas. **THE END**

Is It Worth Your TIME?

See Page 13

TOP-PRICE CROP DESERVES TOP-NOTCH MANAGEMENT

Soybean prices were UP in 1970. They will continue UP in 1971, many believe. With good prices, higher yields really put more dollars in the farmers' pockets. Are you planning the BEST for your soybeans?

Corn...cotton...tobacco always get fertilized. And they return money for the fertilizer investment. Then, why do so many farmers fail to make this fertilizer investment for their soybeans?

Last year Illinois farmers fertilized about 94% of their corn acreage--but barely 16% of their soybean acreage...Ohio farmers 100% corn--only 46% soybeans... Mississippi farmers 100% cotton--only 25% soybeans.

Soybeans respond to fertilizer--particularly phosphorus, potassium, and lime. Especially on soils low in pH and with low phosphorus and potassium levels. Many farmers growing soybeans in rotation with other crops fertilize just enough for one crop.

During the 1970 crop season, one university test lab reported 37% of the corn leaf samples from continuous corn systems deficient in potassium. When the corn was grown after soybeans, 55% of the corn leaf samples were hungry for potassium.

As you know, corn grown continuously receives fertilizer every year. But soybeans following corn generally receive little or no fertilizer. FARMERS ARE NOT FERTILIZING FOR A TWO-CROP SYSTEM.

Recent Wisconsin trials clearly show soybeans will respond both to direct application of potassium and to increased soil K levels. Yield increases reached 20%.

For top-profit yields, join the FERTILITY TEAM with other production teams--ADAPTED VARIETIES, WEED CONTROL, CORRECT PLANTING DATE, BEST ROW WIDTH, and BETTER HARVESTING.

See Page 19 for 1971 PINA Radio Scripts

". . . a deadly

"Man alive . . . the hours I sat on committees! If I could reclaim those hours, I'd be 5, maybe 10 years younger. Why, Martin, I'd be just 73 years old."

His laugh split the early morning air, shaking huge 78-year-old shoulders. His hands, like weathered-gnarled hams, clawed at the tough sod gripping the stump.

He planned to put in ivy and a bird bath atop the stump of a tree he had felled a few days before.

I half stuttered, "Do you mean 5 years of your life were spent sitting in committee meetings?"

"Going to them, sitting in them, returning from them," he laughed, "maybe 10 years . . . since 1910."

The early spring morning had dawned clean and crisp. Maybe he was right. A man could doze through many committees in a half century.

He was not an ordinary man. I had dropped by his place on the way to work to see how he was doing and to get some fuel for a column.

He had lived a remarkable life. A public servant, a scientist, who had once turned down a $50,000 job (in 1940!) to stay a servant. It had paid him. He was strong at 78.

The morning paper had run a column about some committee that spent 18 months and a million bucks to come up with conclusions a legislative body had voted almost 2 to 1 to reject.

We both laughed. Then he mumbled, half to me, half to himself while clawing at the sod on his knees, "You ever seen committee-itis get started, Martin?"

"Not to know it," I replied. "How does it start?"

"Well, somebody says we gotta get people involved . . . then deadly silence sets in . . . and no one says how . . . until someone can't stand the silence any longer and half shouts, 'FORM A COMMITTEE.'

"Then the talking boys move in. Form COMMITTEES! Not one or two, but dozens, they urge.

"And away you go! A committee for every hour of the day, just about, and for every fool subject you can dream up. Proliferation defying old Tom Cat's disdain of birth control."

"Why?" I asked.

"To plan and talk," he replied, "and usually talk, talk, talk."

"Did it help your program?" I continued.

"Our folks worked more than they talked. But I'm not talking about my work. I'm talking about us humans. Committee-itis plagues every human venture—government, industry, university, etc."

"Why?" I asked again.

"To give folks something to do. Often the less creative. This may be harsh. But it exists.

"Most ideas—the ones that capture people's minds and hearts—rarely come from committees."

"Where do they come from?" I egged him on. You could see the big man's steam building up.

"Usually from a talented specialist or a creative two-man team, a million miles from a committee," he laughed.

He was having fun weaving his satire. There was no malice in the man. But through his chuckling fiction, a deadly thread of truth ran.

"In 50 years, I never saw a committee agree on any idea that was as dynamic or as functional or as successful as the idea some creative specialist would quietly submit in a remarkable folio."

"What inhibits a committee?" I asked.

"People! Have you ever seen THREE men talk to each other with the same ease and trust that TWO men do?"

"I hadn't thought about it," I said. "But offhand I'd say you have something."

"Son," he replied, "I've been around a long time . . . all over the world . . . in and out of manure spreaders, university

thread of truth . . ."

halls, presidential offices, and even king's palaces. I know human nature. It came from the soil I love."

"Why is human nature like that?" I wondered.

"Ask the psychologists," he advised. "But name one real creator who has survived a committee. A free-wheeling, uninhibited innovator will get cold-shouldered, even maligned, faster than you can sneeze.

"A good leader will keep his committee personalities and his creative personalities in separate worlds—to get the best from both. It takes a leader with courage to do it.

"He'll often drop by and pick up the current project folio from his creators and take it to his committee sessions himself.

"In about three hours his talkers will run down, happy with the air they have emitted over the proceedings.

"Everyone will go back to work contented—some almost tranquilized over gaining a seat on the committee."

His laugh was contagious. Then he continued.

"The leader, of course, will detour to return the project folio to his shop of creators for final polishing.

"A few months later the organization can pitch that project for all it's worth—to the benefit of public and cause and committee."

I laughed, then asked, "Why bother with cost and time of a committee?"

"Don't you know human nature, Martin? **Many folks equate their importance and ability by the number of committees they can get on—and the length of sessions.** Haven't you ever served on a committee?"

"Once," I replied. "But very briefly. The seat was too large. It was a committeeman's seat. I vacated it—and I will sell pencils and apples to feed my family before I sit at another conference table."

He blinked, then said, "You may have a point, especially for writing and editing folks. I've seen'em balk at what they called 'committee palaver.' "

"They were right," I broke in. "Conferences murder the time a writer needs to think and search and create—and sometimes swear or pray."

"Yes," he said, "but the talkers insist the more committees the more democratic the process."

"Absolutely," I agreed, "for politics. They protect our freedom. They prevent anything from happening too rapidly, too efficiently, and too completely. They dilute power. They prevent dictators. Democracy must have them."

"Aren't they the most democratic process for science and business?" He was egging me on this time.

"Not a dozen, not when stockholders cry for more economy, more coordination," I suggested. "A dozen committees traveling around chewing 10 dozen topics to shreds scorn any stockholder's plea for economy and efficiency."

He broke in, "But I meant aren't they the most democratic process?"

"Are they?" I asked. "I remember a university study on student leadership one time. It reported two things: (1) Students followed the ones who kept talking, usually loud, even when their talking revealed weak knowledge of what they were talking about. (2) They ignored the knowledgeable ones who talked little and never loudly.

"I have never forgotten that report."

He smiled and stopped digging a minute. I was down on my knees helping by then. We both dug a while in silence.

Then he looked up, "You know, boy, I don't see how you hold a job."

"I don't, either," I agreed. "Maybe it's faith. Some call it hypocrisy. But, in all the stumbling, one thing sustains hypocrites like me."

"What's that?" he asked.

"The fact God did not send a committee to explain His Plan to man," I replied.

He pulled hard at the sod, mumbling something that sounded like, "He sure didn't."

THE END

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