

# Better Crops WITH PLANT FOOD

NUMBER 4—1970

25 CENTS

The Practice	Kernel Wt. gm.	Kernels No/Ear	Bushel Wt. lb.	Yield Bu/A
-K ➡	0.203	490	54.7	75.1
+K ➡	0.269	626	57.3	127.3
Increase From K	33% Fatter Kernels	28% More Kernels	5% Heavier Bushels	70% More Yield

**Potash Means More Quality Corn**

FOR CORN QUALITY	-K	+K	% Increase
Potash Treatment, Lb. K <sub>2</sub> O/A	0	100	
Average Yield, Bu/A	75.1	127.3*	69.5
Average Stand, Stalks/A	18,508	19,443	5.0
Shelling percent	83.1	85.1	2.4
Kernel Weight, Grams/Kernel	0.203	0.269	32.5
No. of Kernels/Ear	490	626	27.8
Ear Weight, Grain/Grams	100	168	68.0
Cob/Grams	21	30	42.8
Bushel Weight, Lb./Bu.	54.7	57.3	4.8

\* Average Several Planting Dates. Later Planting Dates Lowered Average Yield.

Stanley A. Barber, Department of Agronomy, Purdue University.

## On the cover...

... Stanley Barber's work at Purdue shows potassium building corn quality.

And quality corn is healthier corn. This stands to reason. People give in to viruses, to all kinds of bugs, when they don't keep themselves built up. Healthy people have stronger resistance—so do healthy plants.

This point seems important in a day beset by corn blights and pollution fears, etc. Anything that helps improve crop quality and efficiency also helps protect the crop and the environment.

How? By producing a crop that does not reject or discard, BUT USES, most elements at its command to give us top food yields.

One of America's long-time great farm magazines, SUCCESSFUL FARMING, expressed the importance of N-K balance this way with corn recently:

**"The nitrogen-potassium balance is especially important in controlling lodging, the susceptibility to leaf diseases such as blight, and for maintaining high yields on soils medium or low in potassium."**

Research has shown potassium increases not only ear weight and number of kernels, but also the energy of corn grain.

It has also shown potash increases digestible nutrients in corn silage, which improves its digestibility.

Corn low in potassium will plague the grower with unfilled, chaffy ears, short internodes and clogged nodes, weak stalks and dead roots.

In right balance with nitrogen and phosphate, potash has been found to influence silage quality in many ways:

- 1—Potash has raised grain to stalk ratio 10% on some hybrids.
- 2—It has boosted ear weight 50% or more, even on medium K soils.
- 3—It has increased carbohydrate (sugar-energy) production.
- 4—It has doubled carotene content for ripe ears on green stalks.
- 5—It has reduced dry matter loss during ensiling process.
- 6—It has increased true and soluble protein and reduced non-protein N.

The influence of potassium on crop quality does not stop with corn, by any means. Step by careful step, research has shown how potassium helps many enzyme actions of plants . . . helps the plant convert energy into food forming action (photosynthesis) . . . helps increase protein content of plants . . . helps translocate vital sugars and starch in the plant system . . . etc.

This work has shown how these K-backed actions affect extra alfalfa cuttings . . . the looks and tastes of canned peaches . . . the market appeal of potato chips . . . the plumpness of rice . . . the health of soybeans . . . the ripening of grapes . . . the acid content of citrus . . . the sugar content of sugar cane . . . the strength of cotton . . . and the hardness of turf.

These roles are featured in separate folders and as a single 32-page booklet. Check your crop interest and order supplies on page 14.



## Better Crops WITH PLANT FOOD

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**POOR CROPPING** and tree conditions in part of a large pear orchard in southern Oregon was brought to my attention by the manager in 1964.

Field observation and several trials pointed to poor uptake of potassium as one source of the problem.

We observed severe leaf rolling and low levels of leaf K from leaf analysis on Anjou, Bartlett, and Bosc pear trees.

To find the best way to increase K uptake, we established several treatments on each variety. Treatments of a check (none) and of two N rates with and without K soil application were adjusted to relate leaf N and K content with tree performance.

# Do FAT K Rates Pay On Pears?

PORTER B. LOMBARD  
OREGON STATE UNIVERSITY

We applied the N (ammonia nitrate) in a band around the tree skirt and trenched the K ( $K_2SO_4$ ) at 12-inch depth on opposite tree sides under the tree skirts.

Three years after the soil treatments were begun, results indicated several new aspects to the problem, some unexpected. **MOST IMPORTANT** was the indication that N applications were depressing leaf K of pears to very low levels, much below the .70% considered adequate (**Table 1**).

The K depression by N application contributes partly to the low K found in pear trees in other orchards on this soil type (Medford silt loam and Cove clay) with a leaf K content ranging from 0.3 to 0.7%.

The total crop area of these soils comprises about 10,000 acres in Bear Creek Valley, although only part of the pear orchards in southern Oregon are on this soil type.

Medford soil series has been described as well drained while the Cove series is poorly drained.

Increased K uptake by trees in the  $K_2SO_4$  plots was noted the first year. But a total of 125 lbs of  $K_2SO_4$  per tree applied over a 3-year period was necessary before leaf levels of K were above .70% for two varieties: Bartlett and Bosc. However, one application of 50 lbs of  $K_2SO_4$  on each Anjou tree, increased leaf content of K above 1.00%. Therefore, we concluded that there was a variety response to K uptake; that is soil uptake of K is greater for Anjou than Bartlett or Bosc. **K LEVEL influenced** cropping, fruit size, and acid content of the fruit. The  $K_2SO_4$  applications increased yield of all three varieties.

Increased acid content in Bartlett and Bosc fruit and improved fruit sizes for the Bartlett variety were related to K level in leaves.

Yield increase has reached 1 to 3 boxes per tree over a total of 7 to 15 boxes for the check. We found 10% larger Bartlett fruit on trees with K level over .70% compared with trees below this K level.

Fruit size is an important factor in Bartlett production.

Varietal response to N applications should not be overlooked.

Bartlett and Anjou yields continued to decline during the past 3 years, unlike Bosc yields, with annual N applications alone when compared to the check plots (**Table 1**).

All three varieties yielded more from NK applications than either the N or the check plots. Yet, Bartlett yield in the NK plot was only slightly higher than the check.

Previous studies have shown Bartlett trees require much less N fertilization than Anjou or Bosc trees. So, N rates used in this study were lower (1.5 and 2.5 lbs N per tree) for Bartlett than for Anjou and Bosc (4 and 8 lbs N per tree).

But even the low N rate decreased

**Table 1. Effect of N and K applications on Yields and Leaf Content of K of Pear Trees Grown on Medford silt loam and Cove clay loam**

Treatment: Year	Comparative Yields			Leaf K (%)		
	O <sup>1</sup>	N <sup>2</sup>	NK <sup>3</sup>	O <sup>1</sup>	N <sup>2</sup>	NK <sup>3</sup>
— Bartlett —						
1965	100	100	100	.50	.44	.63
1966	100	91	97	.49	.40	.65
1967	100	95	105	.64	.46	.82
1968	100	92	108	.44	.36	.81
1969	100	84	108	—	—	—
— Bosc —						
1965	100	100	100	.59	.43	.51
1966	100	138	156	.53	.38	.63
1967	100	102	108	.64	.46	.76
1968	100	119	139	.53	.34	.70
1969	100	104	119	—	—	—
— Anjou —						
1965	100	100	100	.97	.83	1.20
1966	100	109	123	.86	.67	1.19
1967	100	92	99	.79	.68	1.21
1968	100	88	115	.70	.59	1.15
1969	100	70	117	—	—	—

<sup>1</sup> Check plot — no fertilizer application

<sup>2</sup> Nitrogen fertilizer banded in form of  $\text{NH}_4\text{NO}_3$

Bartlett trees — 1.5 to 2.5 lbs — N per tree annually.

Anjou & Bosc trees — 4.0 to 8.0 lbs — N per tree annually.

<sup>3</sup> Nitrogen — potassium fertilizer, N in form of  $\text{NH}_4\text{NO}_3$  banded. K in form of  $\text{K}_2\text{SO}_4$  trenched 12 inches depth.

Bartlett and Bosc trees — 50 lbs  $\text{K}_2\text{SO}_4$  in 1965 and 1966 each and 25 lbs  $\text{K}_2\text{SO}_4$  in 1967.

Anjou trees — 50 lbs  $\text{K}_2\text{SO}_4$  in 1965 banded only.

**Table 2. Estimated annual cost and additional income from N and K applications on pear trees grown on Medford silt loam and Cove clay in Southern Oregon.**

	Bartlett	Bosc	Anjou
N vs none (check)			
Yield (percent of check)	91%	116%	90%
Additional income/acre from N appl.	—	\$190. <sup>2</sup>	—
Lost income/acre from N appl.	\$89. <sup>1</sup>	—	\$64. <sup>3</sup>
Cost of N application/acre	\$14.	\$24.	\$24.
Net profit from Appl./acre	—	\$166.	—
Net loss from Appl./acre	\$103.	—	\$88.
NK vs none (check)			
Yield (percent of check)	108%	129%	113%
Additional income/acre from NK appl.	\$79. <sup>1</sup>	\$353. <sup>2</sup>	\$94. <sup>3</sup>
Cost of NK application/acre	\$434. (3 yrs)	\$464. (3 yrs)	\$179. (1 yr)
Years of additional income to pay for application	5.5	1.3	1.9

<sup>1</sup> Average tree yield of 11 boxes at \$1.25 est. net income for a field run box.

<sup>2</sup> Average tree yield of 11 boxes at \$1.50 est. net income for a field run box.

<sup>3</sup> Average tree yield of 7 boxes at \$1.40 est. net income for a field run box.



Bartlett yield while depressing K leaf content.

While  $K_2SO_4$  applications overcame the effect of N applications on Bartlett and Anjou, K on Bosc increased yields above the additional cropping from N alone.

Briefly, N application improved Bosc yield on this soil type, but not Bartlett and Anjou yields. Yet, the NK combination boosted yields of all three varieties.

**WILL IT PAY** the manager to apply such a heavy amount of  $K_2SO_4$ ? **Table 2** outlines application cost and estimates additional income that could be expected from the response of three varieties.

Two comparisons are made between the plots N vs none and NK vs none. The important figures are the net profit or loss for N vs none and years to pay for application cost on the second comparison.

Annual N applications alone are profitable on Bosc trees. But this practice would be unwise on Bartlett and Anjou trees growing on these soils, as net loss shows in **Table 1**. The NK team boosted yield income for all three. But it would take 6, 2 and 2 years on Bartlett, Bosc and Anjou trees respectively to pay for the application.

With the small additional income from

Bartletts, it is doubtful a grower would invest in this practice.

But the NK investment for Bosc with a possible additional income of \$353.00 per acre annually would be wise on a short and long term basis.

Although additional yield income with Anjou from NK application is only \$94.00 per acre, the investment is smaller, \$179.00, making the NK application to Anjou worthwhile within 3 years.

**AT THIS POINT** we suggest Bartlett trees receive no N and K on these soils on a short term financial basis of less than 6 years, but receive  $K_2SO_4$  applications only for increasing fruit sizes.

But Bosc and Anjou trees should receive heavy rates of  $K_2SO_4$  with N in the first one to three years to correct the low K uptake. Also take leaf analysis to indicate when the low K has been corrected, and continue it during a K maintenance program.

No specific  $K_2SO_4$  rate for maintaining a proper level of K (above .70%) can be made now.

But annual leaf analysis should indicate when soil application of K is again necessary and the rate can be adjusted accordingly. **THE END**

## Do YOU Read It?

**IS THIS MAGAZINE** useful to you or just another piece of mail?

If you can and DO use it regularly, you will want us to continue to send it to you.

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We would appreciate a note from you, if we have not already heard from you. You might answer two or three simple questions in that note:

- 1—Why do you want to continue to receive **BETTER CROPS**?
- 2—What is there about it you like or do not like?
- 3—How can **BETTER CROPS** be made more interesting to you?

Please address your letter or card in this way:

Active **BETTER CROPS** Reader  
Potash Institute of North America  
1649 Tullie Circle, N.E.  
Atlanta, Ga. 30329

Thank you very much for your help.



## % LOW IN POTASSIUM:

---

Red River Area	—20%
Ouachita River Area	—28%
Mississippi River Area	—37%
Mississippi Terrace	—37%
Flatwoods Area	—39%
Coastal Plain Area	—40%
Loessial Hills	—50%
Coastal Prairie Area	—66%

... while some parishes run up to 70 and 83% low.

# New Report Uncovers K Needs

Condensed from **LSU Bulletin 644**

R. H. Brupbacher, J. E. Sedberry, Jr., W. P. Bonner  
W. J. Peevy and W. H. Willis

**SOIL SAMPLES** from Louisiana's eight major soil areas averaged from 20 to 65% low in potassium.

And some parishes showed much higher percentages of low K soil samples than their soil area averaged.

For example, the whole **Red River Area** averaged 20% of its samples low in K, while its St. Landry Parish averaged 34% low, its Desota Parish 32% low in K.

In the **Ouachita River Area**, which averaged 28% low in K, Caldwell Parish averaged 39% low, Richland Parish 34% low in K.

Six parishes in the **Mississippi River Area** averaged from 45 to 70% low in K: Iberia, 70%; St. Mary, 67%; Lafayette, 53%; St. James, 49%; St. Martin, 45%; and Terrebonne, 45%.

In the **Mississippi Terrace**, six parishes found more than 50% of their soil samples low in K—from 51% in Evangeline

Parish to 73% in Ascension and East Baton Rouge Parishes.

The southwest Louisiana **Flatwoods** showed over 60% of its soil samples low in potassium, the southeast **Flatwoods** only 35% low in K.

Why the difference? Rice, soybeans, and beef cattle pastures in the southwestern **Flatwoods** have not received the intense fertilizer management of the truck crops and dairy cattle pastures in the southeastern **Flatwoods**.

In the **Loessial Hills Area**, made up of many soils moderately to severely eroded and underlain by sandy materials, 50% of the soil samples were low in K.

The **Coastal Prairie Area** showed more low-K soil samples than any of the other seven soil areas—66% low in K. And Calcasieu Parish had 83% of its samples low in K, highest in the state.

**THE END**

**EVERY MORNING** about 180,000 NEW mouths wake up to be fed.

In 30 years, nearly 7 billion persons may inhabit the earth.

Few experts believe it will be possible to feed them without adequate protein.

The golden soybean has been described as "protein power."

One acre of grazing land produces 43 lbs. of food protein when fed to beef animals. This same acre will produce nearly 600 lbs. of edible protein when planted in soybeans.

Yet, **average** soybean yields have risen less than 3 bushels per acre in 20 years, while corn yields were rising a whopping

"In both example fields, low potassium uptake in the soybeans could limit yields by several bushels per acre based on past experience."

**Dr. Earl Spurrier**  
**Monsanto Company**  
**In Soybean Digest**

# Make Soybeans PAY

"The increase in yields from fertilizer was due primarily to potash. The range of increase with potash was from 2 to 5.9 bushels per acre."

**J. L. Keogh and Richard Maples**  
**Agronomy Department**  
**University of Arkansas**

45 bushels/A average. Why? Agronomists cite certain factors:

- As a legume, soybeans do not respond to nitrogen as corn does.

- Corn does all its vegetative growing before it starts producing grain. But the soybean plant produces its vegetative growth and grain at the same time—leaves, stems, flowers, and pods during a 6 to 8-week period.

- The soybean seed's high oil and protein content require about 2.5 times as much energy as corn does to produce a bushel of grain.

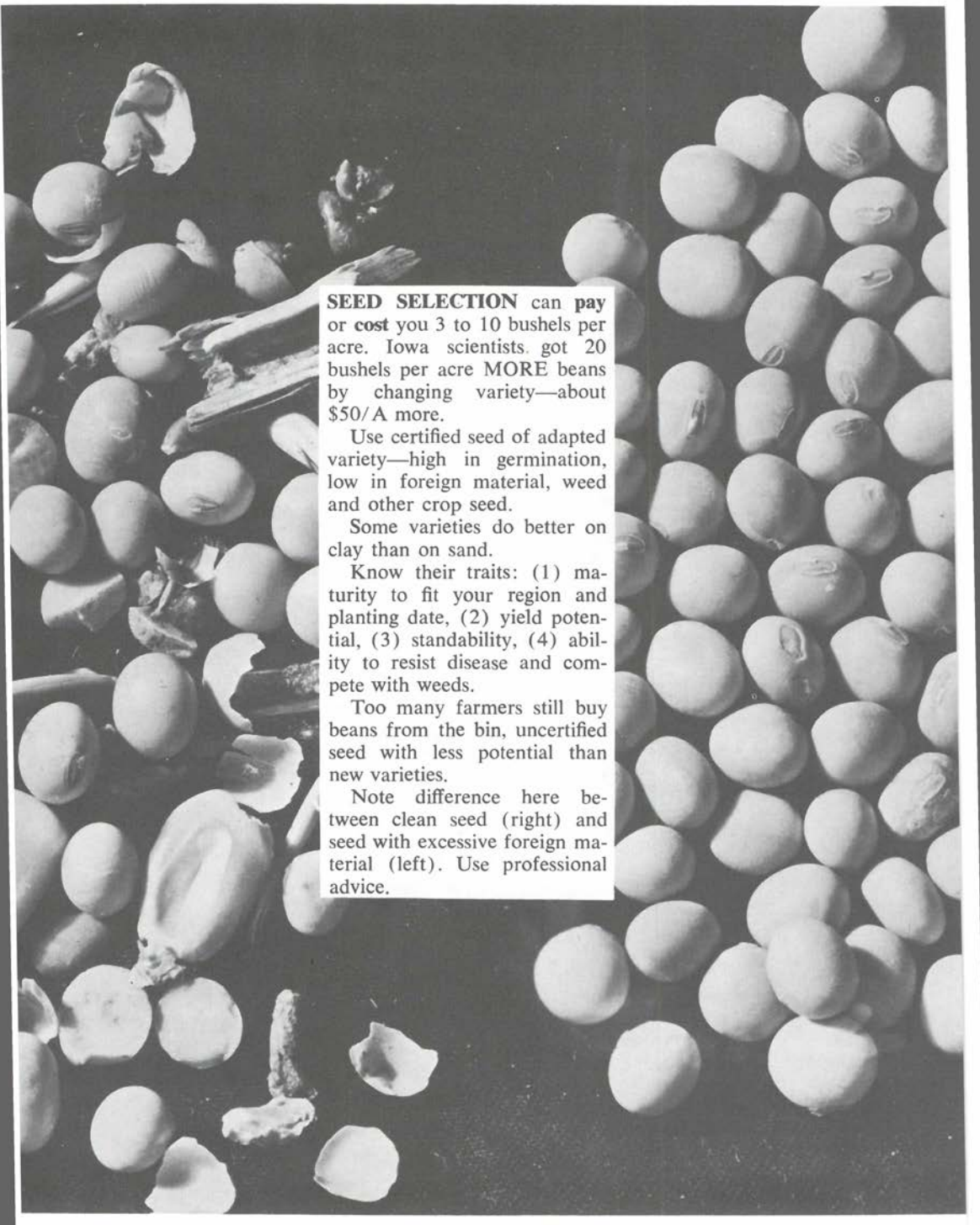
- Soybeans too often "eat at the second table" on slim leftovers from a greedy corn crop.

"Soil test yearly to know just where you stand . . . and keep the potash high. Soybeans are a big user of potash. Add other nutrients, as needed."

**George Tarnow**  
**Champion Indiana Grower**  
**In Farmer's Digest**

Pictures Courtesy:  
Soybean Crop Improvement Council





**SEED SELECTION** can pay or cost you 3 to 10 bushels per acre. Iowa scientists got 20 bushels per acre MORE beans by changing variety—about \$50/A more.

Use certified seed of adapted variety—high in germination, low in foreign material, weed and other crop seed.

Some varieties do better on clay than on sand.

Know their traits: (1) maturity to fit your region and planting date, (2) yield potential, (3) standability, (4) ability to resist disease and compete with weeds.

Too many farmers still buy beans from the bin, uncertified seed with less potential than new varieties.

Note difference here between clean seed (right) and seed with excessive foreign material (left). Use professional advice.



**FULL-FEED FERTILITY** pays off on soybeans when they need it.

Don't expect 50 to 60 bushels on acid soil. Lime for pH 6.5—as far ahead of planting as possible. Some areas report up to \$6 for each \$1 invested in lime. Missouri got 11 bu/A MORE from lime in 6 trials.

Broadcast fertilizer boosted profits \$11/A MORE after 80 lbs. phosphate on Illinois soil, 7 bushels and \$15/A MORE after 60 lbs. potash on Missouri soils testing 150 lbs. K.

Carryover fertility is fine IF the corn leaves anything. Who maintains a TWO-crop soil? After low-K Iowa soil received 200 lbs. potash/A, bean yields jumped 4.3 bu. first year, 5.9 bu. second year—and returns jumped \$8.25/A average.

Low subsoil fertility hampers soybean yields. That's why a recent contest winner strongly urged plowdown, 10 to 12 inches, to feed deep-growing soybean roots in dry periods.





**BEST PLANTING TIME** depends on area, of course.

Some say early May . . . others May 10-20 . . . some May 20 to June 20.

Some say soybean yields start downhill after May 25 plantings.

Check local recommendations. Early corn planting permits earlier soybean planting. Safe bet is to plant when soil is warm enough for rapid germination.

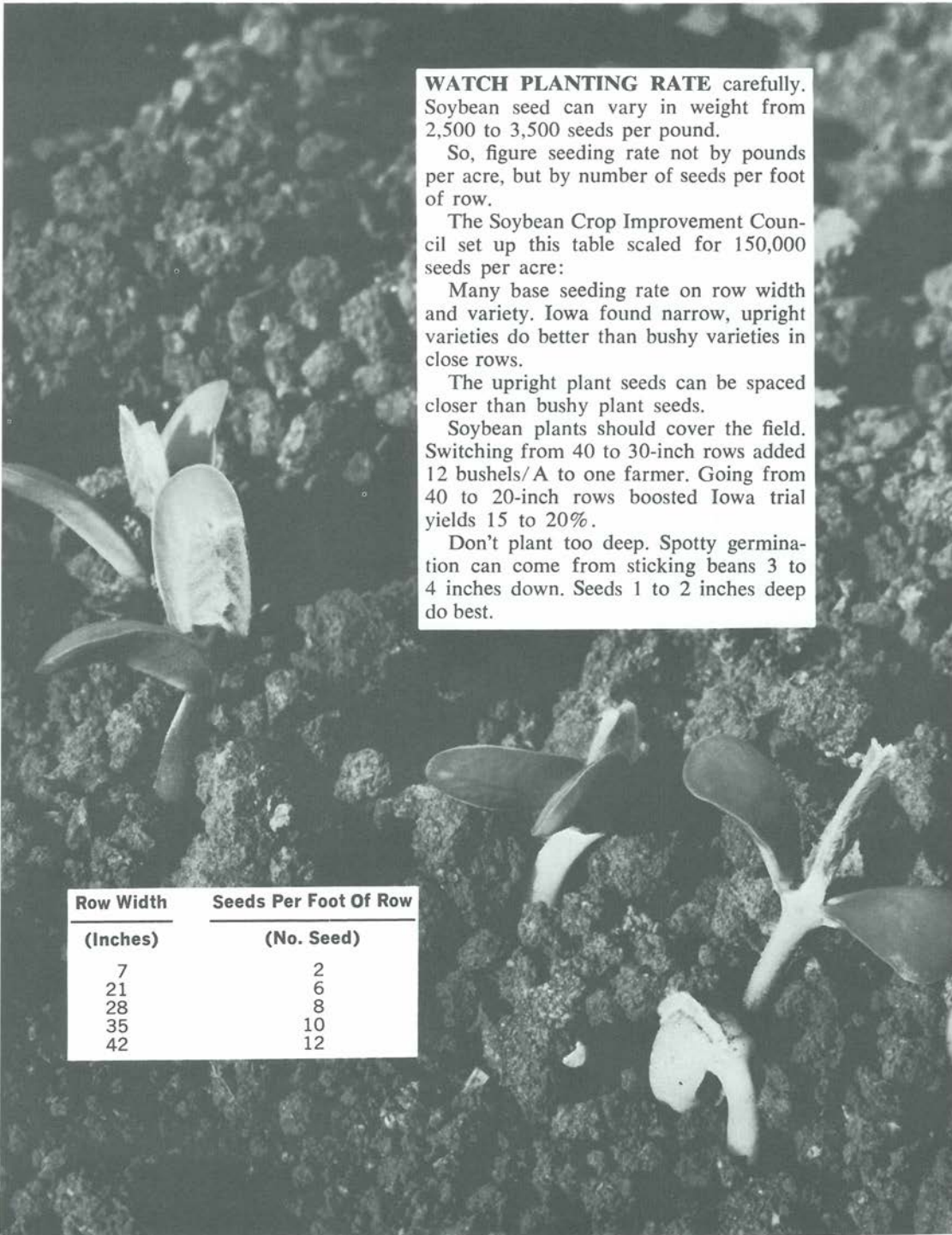
Soybean Crop Improvement Council experts say plant according to soil temperature for best yields.

Let your planter roll after temperature two inches below the soil surface reaches 50 degrees Fahrenheit at 7 a.m.—or when it reaches 55 degrees F at 1 p.m. at the four-inch depth.

If you plant early, use a herbicide for **early** weed control.

When planting without herbicide, delay planting enough to kill crop of weeds in seedbed preparation.

Watch your equipment. Check planter for even seed dropping, right size planter plate. Some varieties need very small-celled plate to prevent doubling, some very large-celled plate to prevent cracking. Run planter 3-4 miles per hour. Excess speed may cause skips.



**WATCH PLANTING RATE** carefully. Soybean seed can vary in weight from 2,500 to 3,500 seeds per pound.

So, figure seeding rate not by pounds per acre, but by number of seeds per foot of row.

The Soybean Crop Improvement Council set up this table scaled for 150,000 seeds per acre:

Many base seeding rate on row width and variety. Iowa found narrow, upright varieties do better than bushy varieties in close rows.

The upright plant seeds can be spaced closer than bushy plant seeds.

Soybean plants should cover the field. Switching from 40 to 30-inch rows added 12 bushels/A to one farmer. Going from 40 to 20-inch rows boosted Iowa trial yields 15 to 20%.

Don't plant too deep. Spotty germination can come from sticking beans 3 to 4 inches down. Seeds 1 to 2 inches deep do best.

Row Width	Seeds Per Foot Of Row
(Inches)	(No. Seed)
7	2
21	6
28	8
35	10
42	12



**LOWER YOUR WEED TAX** with chemical and mechanical tools.

Go after weeds early—in the first four weeks after planting. But don't forget FULL-season control is essential for best yields.

Use rotary hoe after planting when weed seeds are just germinating, but before or just after weeds emerge.

This breaks the crust, gives better stand. Rotary hoe at 8-10 miles per hour. Some say you haven't done much weed killing if you don't knock out 10% of the soybean plants with a harrowing and couple of rotary hoeings.


Then one or two shallow cultivations lick the weeds.

Use herbicides where harrow, weeder, or rotary hoe is ineffective—chemicals carefully chosen for key problem weeds.

You can protect the crop from diseases through resistant varieties and crop rotation. If needed, an approved insecticide will fight insects.

Some folks call weeds the No. 1 yield robber. They steal water, nutrients, and light from the beans.

Just count the pods on soybean plants around big weeds.



**HARVEST ALL** the soybeans you produce.

Did you know just 8 beans per square foot on the ground can cost you 2 bu/A?

Too many 40-bushel soybean yields weigh out 30 to 32 bushels. Why? Harvest loss.

If you combine carefully with a well adjusted machine, you should lose no more than 2 bushels per acre.

Start combining when the moisture level gets at about 13% or below.

You may be losing \$10 worth of beans per acre by wrong combine setting and speed.

Cut 'em slow and low. If you leave a 3½-inch stubble, you leave about 5% of your crop in the field.

A 6½-inch stubble leaves about 12% of the crop.

Add shattering losses at the sickle bar and you'll buy careful harvesting fast.

Make frequent checks on the ground to assure maximum combine efficiency.

What good is the best crop in the county if you leave 10 bu/A of it in the field?



# Soybeans DO Get Hungry

Use facts to tell it like it is!

**Facts** that show soybean fertilization producing **more bushels** per acre, **more nodules** per plant, and **better quality** beans.

**Facts** that show high yields—a **60-bushel crop**—draining hard on the soil's nutrient supply, using a whopping 651 lbs. total nutrients per acre.

The aids below feature these and other **facts for efficiency**. They'll help you convince folks well-fed soybeans **DO** pay off. Order supplies early!

## NEWSLETTERS & FOLDERS

(To Reach Extra Thousands Through Fast-Mail Programs)

	Free Copy	Quantity
Southern Area—Fertilized Soybeans Pay Off: S-156-68	_____	_____ 4¢ Ea.
Northern Area—Fertilize Those Soybeans: M-148-68	_____	_____ 4¢ Ea.
Fertilized Soybeans Can Match Corn Profit-Wise —E-4-67	_____	_____ 4¢ Ea.
How Potassium Builds Soybean Quality—B-1-68	_____	_____ 2¢ Ea.

## PLACE MATS

(To Pep Up Dinner Meetings With Top-Yield Techniques)

Shoot for 80+ Bushels Of Soybeans	_____	_____ 2¢ Ea.
Grow 10-Ton Alfalfa (Mentioned in this issue)	_____	_____ 2¢ Ea.

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(To Display Hunger Signs & Plant Food Removal Trends)

Soybeans Get Hungry, Too. Feed Them! (Wall chart)	_____	_____ 10¢ Ea.
Soybeans Get Hungry, Too. Feed Them! (Fact Sheet)	_____	_____ 2¢ Ea.
Plant Food Utilization By 20 Crops	_____	_____ 10¢ Ea.
Fall-Winter Fertilization Pays	_____	_____ 10¢ Ea.

## EDUCATIONAL KIT

(To Provide Facts Tailor-Made For Newspaper-Radio Use)

Soybean Tips Kit—18 Answers to Profit-Seeking Questions	_____	_____ 4¢ Ea.
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## SLIDE SETS

10-Day Loan Purchase

Fertilize Those Soybeans, 36 slides	_____	_____ \$6.00
Ten More Bushels of Soybeans, 51 sl.	_____	_____ \$7.35

Total Payment Enclosed \$ \_\_\_\_\_

Name \_\_\_\_\_ Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_

Organization \_\_\_\_\_

Potash Institute of North America, 1649 Tullie Circle,  
N. E., Atlanta, Ga. 30329

Better Crops

WITH PLANT FOOD

Number 1 — 1968 25 Cents

With K:

# BUILD CROP QUA-N-LITY

*per plant, per acre*

## QUALITY STORY

The quest for quality food is more vital today than ever before. Top quality will not let us waste our elements and our environment. It makes us USE them and REPLACE them to continue feeding the growing millions.

How potash helps add quality to the needed quantity is worth sharing...with the profit-needy farmer, the classroom student, the local leadership. You can do it with this booklet & these folders.

SEND US THE FOLDERS CHECKED HERE:

POTASSIUM BUILDS GRASS-TURF QUALITY,  
G-1-68

POTASSIUM BUILDS BANANA QUALITY, A-1-68

POTASSIUM BUILDS SOYBEAN QUALITY, B-1-68

POTASSIUM BUILDS CORN QUALITY, C-1-68

POTASSIUM BUILDS ALFALFA QUALITY, D-1-68

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Potash Institute of North America, 1649 Tullie Circle,  
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# Potato Yields And Quality IMPROVED By Potash In Central Oregon

T. L. JACKSON, M. JOHNSON  
OREGON STATE UNIVERSITY

**POTASSIUM IMPROVES** the yield and quality of potatoes, as this 1969 trial in Central Oregon shows.

The experiment, conducted on sandy loam low in P and K, studied the effect of P and K and the N x K and N x P interactions on yield and quality of russet potatoes.

A split plot experiment was established with 80, 160, and 240 lbs. N/A as main plots, and 0, 100, 200, 400, 600 lbs. K<sub>2</sub>O/A and 0, 80, 160, 240 lbs. P<sub>2</sub>O<sub>5</sub>/A treatments, as well as P comparisons at 400 lbs. K<sub>2</sub>O/A.

All the P plus 1st increment of N and 1st and 2nd increments of K were banded about 3" from the seed piece at planting time.

The remaining N and K were banded about 8" from the seed piece.

Plant samples (4th petiole from top) were taken when tubers were 1/2 to 3/4" in diameter, 2 weeks later, and in late August.

The 1st sampling date was analyzed for NO<sub>3</sub>-N, P, K, Ca, Mg, Zn, Mn. NO<sub>3</sub>-N will be determined on the later planting dates.

Alfalfa was grown in 1968, so the 1st 80 lbs. of N per acre were enough to get maximum yields. Under conditions of this experiment, there were no yield decreases from the higher N rates.

**TABLE 1** shows how K increased yields and decreased the percentage of culls up to 400 lbs. K<sub>2</sub>O/A. Getting 22.7 T/A is very good yields in an area of relatively short growing seasons.

The way the KCl treatment decreased NO<sub>3</sub>-N level on the first plant sample is probably due to the Cl in the fertilizer material applied.

More precisely controlled greenhouse experiments are underway to evaluate the effect of K alone and Cl alone on total uptake of N and levels of NO<sub>3</sub>-N in potatoes.

**TABLE 2** shows how P increased yields and decreased culls up to 160 lbs. P<sub>2</sub>O<sub>5</sub>/A.

P and K variables were included in other potato experiments. But this experiment put emphasis on evaluating P and K effects on a soil specifically selected for low P and K soil analyses values.

**THE END**

**Table 1. Effect of KCl on yield, and Petiole K and NO<sub>3</sub>-N, Russet Potatoes, Powell Butte, 69-326.**

Treat. lb K/A	Yield T/A	Culls %	K %	NO <sub>3</sub> %	Mg %
0	12.5	58	5.3	3.07	2.24
100	19.2	27	7.3	2.54	1.82
200	21.8	21	9.0	2.51	1.66
400	22.1	19	10.1	2.36	1.58
600	22.7		9.9	2.10	1.50

Potatoes followed alfalfa.  
Plant samples taken when tubers 0.75 diam.  
Average for 80, 160, 240 lbs N/A (No difference between N rates).

**Table 2. The effect of P on Yield, Grade and Petiole P. Russet Potatoes, Powell Butte 69-326.**

Treat. lb. P <sub>2</sub> O <sub>5</sub> /A	Yield T/A	Culls %	P %
0	19.8	24.8	.26
80	21.3	19.5	.32
160	23.2	19.0	.35

Potatoes followed alfalfa.  
Data averaged for 400 lbs K<sub>2</sub>O/A and 80, 160, 240 lbs N/A.  
No difference between N rates.

**THE WOMAN'S GIRDLE** was killing her, obviously.

She loved to eat. But lukewarm peas and potatoes and creamed chicken had conspired with girdle to murder interest in the coming speaker—one of “those cow college drone-ons Tom invited from State.”

She had never heard him . . . and the cold coffee tasted like tar . . . and Tom had no business trapping the women into this mess. . .

As she wiggled her spare tires into a reasonable compromise with the vicious hotel ballroom chair, the square-jawed speaker shouted, “I’m a FIEND on fertilizer!”

His voice nearly cracked the plaster. He reached deep into a bag of green grass and pulled out a fist full of green cash—money!

Mrs. Tom Girdle sat up!

“And this is why I’m a fiend on fertilizer,” the cow college speaker said.

“High fertilizer rates have made more good farmers than college degrees or anything else I know.

“If I can sell a man on using high rates of fertilizer on all crops and pastures, he is at once classified a top producer.

“That’s what fertilizer makes him, folks, a man with a good home and chore savers in the field—AND in the kitchen, too!”

Fertilizer alone won’t do it, of course. It takes well balanced management. No one knows this better than W. R. Thompson, Sr., the cow college “fiend” that evening.

**But years had taught him** people will squirm and twist when you talk only about soybeans or corn or pastures, but just whisper money and they stop, look, and listen!

When he finished, Mrs. Girdle led her table in the standing applause for Thompson, one-time cotton chopper from Malvina, Mississippi.

You won’t find Malvina on the map, even as a ghost town. It has been buried a long time—about 6 miles east of Rose-dale.

# The PASTURE



But the stocky, cotton-chopping youngster who rolled into that Mississippi Delta town with his ma and pa nearly 60 years ago, from way down in Amite County, is far from dead.

“Pa liked to grow cotton,” the 66-year-old former chopper now remembers, “and when boll weevil hit south Mississippi, he moved to the Delta to grow it until he died at 56.

“He believed in county agents and took their advice—in a day when many scoffed at the ‘new-fangled’ experts.”

W. R. Thompson believes in professional advice, too. He has given it for more than three decades—by precept from university findings, by example from his own farm.

But he has not always taken it. Like the morning he woke up some years ago and told his wife he was going to write a book.

“**She just stared at me,**” he laughed. “So, I wrote it. And when I went to town to seek a publisher, the pros told me it wouldn’t sell enough copies to pay for the ink. In Atlanta, Memphis, and Jackson.

“I printed some copies, anyway. And Elton Stephens—a man who could sell ice to the Eskimos—had enough faith to put it on the market and on the air.”

Now in its 12th revision, the book has sold over 300,000 copies.

Not long after it had sold about 200,000 copies, Thompson ran into one of those professional publishers. The man laughed, “We were wrong, weren’t we?”



# PREACHER



... who was told by professional reviewers that his "little book" would not sell enough copies to pay for the ink.

"Sorta," W. R. replied, smiling.

Many books have sold 300,000 copies—Peyton Place, Lady Chatterley's Lover, Valley of the Dolls, Tropic of Cancer, etc., etc.

But not many with such a title as *The Pasture Book*. Thompson did what most scientists are afraid to do.

He used all specialties concerned with pasture growing—findings from research stations, farmers, and his own experiences—to answer most pasture questions under one cover.

Scientists will write (often at the drop of a hat) little pamphlets about their specialty—the plant, the bug, or the plow—but they fear, worse than the plague, the professional (and personal) castigation of their colleagues for venturing any prose beyond their specialty.

So—the farmer or rancher must plow through a half dozen publications to update himself on pastures. W. R. Thompson changed this.

Farmers, teachers, business leaders responded by the thousands—from 50 states and 14 other nations—not through organized advertising, but man-to-man enthusiasm.

When Thompson sent the manuscript to USDA editorial experts for a readability check, they rated it 7th grade level—or about like most newspaper writing that has moved kings and paupers, angels and prostitutes through the years.

W. R. Thompson did not create a "best selling" pasture book through writing skill alone. He drew on knowledge going back to the early 30's as a public school teacher, county ag worker, and Mississippi State University pasture specialist.

**This is no ordinary man.** One of the few truly great agricultural scientists of this century, Wisconsin's late Emil Truog, often asked program planners to let him introduce the Mississippi pasture preacher at national meetings.

This is what Thompson has been—an old-time, captivating preacher of a very modern pasture gospel, convincing farmers they CAN grow quality pastures for more livestock to supply more milk and meat for more and more people.

America can claim many pasture specialists—competent experts in forage and grassland science. But only one preacher like Thompson, perhaps.

In his busiest years, he has averaged over 70 talks a year throughout the United States and parts of Canada.

A hall full of 500 Georgia preachers on the Emory University campus (of all places for a pasture man) gave him a cheering ovation when he finished telling them about grass and its influence on man, earth, and even heaven.

An old man, obviously deaf, once approached Thompson with enthusiasm etched in his lined face, saying, "I couldn't hear what you were saying, but you were so interested in saying it I knew it was good."

**That is the key to W. R. Thompson, Sr. Interest. Enthusiasm. Highly creative energy. Enough to repel some folks, no doubt, human nature being what it is.**

There is nothing inhibited about Thompson. He is a scientist who has never had to hide mediocrity behind a phony screen labeled discipline.

His work has earned many awards: USDA Superior Service, Progressive Farmer Magazine Man of The Year, Farm Bureau Distinguished Service, Southern Seedsmen Award, American Forage and Grassland Council Medallion, Mississippi State University Faculty Achievement—but no Extension award.

When Mississippi State University granted him a \$500 Faculty Achievement Award, a foreign language professor (of all people) presented the brief sketch on his career.

Like most people with enthusiastic natures, he is an incurable optimist who believes human greed, ignorance, and inefficiency at loose in the world can be conquered.

**He has seen fertilizer strength and use soar in Mississippi—and with it badly needed yields and profits.**

He has seen gullies disappear and year-round pastures appear.

He has seen good livestock come and the eyes of many states watching his native land improve its pastures for those livestock.

And he has been a part of the team

that caused it all.

He is not afraid to look into tomorrow—to see Mississippi becoming one of the largest cattle states of the South, with 5 million pasture acres maintained by well trained livestock producers.

He sees equipment and machinery doing all the labor, creating much larger farms in both crops and livestock.

He sees 3 bales of cotton per acre, 50 bushels of soybeans, 75 bushels of corn, 30 tons of silage, 8-10 tons of hay and enough grass for a cow and calf on one acre—as average returns.

He sees all fertilizer broadcast year-round, usually when convenient, at rates never before dreamed of.

Thompson remembers Big Hugh Bennett, father of the U. S. Soil Conservation Service, with much respect.

**"The years have shown me the smartest scientist often cannot tell people what he knows or motivate anyone but himself,"** he recently said.

**"Not Big Hugh. He could move mountains. He made people see their need to conserve soil resources as no living man has. People listened to him—and then acted! So did Congress!"**

Thompson's speaking talents took him many places—from the Greenbrier's black tie set to Arkansas's manure spreader set.

But one talk he will never forget, to USDA division heads in Washington. Squeezing his huge, wrinkled frame into a front row seat was Big Hugh Bennett, twisted tie, dragging trouser cuffs and all.

Thompson didn't say so. But I suspect the legendary Bennett taking the time to come hear him meant more to the Mississippi pasture preacher than any ballroom of former farm lads straining at black-tie-white-coat sophistication.

Instinct surely told him where the history of mankind would place the old conservationist.

**History may take little notice of W. R. Thompson, Sr., But the world—certainly his world—has known he was by this way:**

● **Answering** urgent questions on pastures and forage production through crystal clear newsletters, pamphlets, and field



demonstrations—reaching thousands of people.

- **Writing** regular columns for such journals as *The Progressive Farmer*, *Delta Farm Press*, and the *Memphis Commercial Appeal* newspaper.

- **Proposing** a "Pasture Year" idea for his state—some two decades ago—which evolved into 11 states and ultimately to USDA and some trade associations promoting a national grassland program.

- **Producing** a movie he called "Twelve Months Green," viewed by hundreds of audiences over Mississippi and other areas, including the Commissioner of Agriculture in England.

- **Urging** his university president—22 years ago—to endorse a program of grassland farming courses leading to a degree in grassland farming.

- **Appearing** on countless programs—ranging from Federal Reserve Banks in St. Louis, Atlanta, and New Orleans to the Delaware Governor's tri-state grassland meeting, LSU's Centennial, and the American Society of Ag Engineers.

- **Inventing** a machine that plants seed, distributes fertilizer, and renovates old pastures all in one operation.

W. R. Thompson has made a success of his life. No reporter can conclude otherwise. Thompson credits others for most of it:

- A hard-working ma and pa who believed in county agent advice for their farm and honest dealing for their four youngsters, "especially with a Master to answer to one day."

- A pretty teacher who followed instructions so agreeably when she taught for him that he asked her to become his wife, the mother of his three children, and a companion who has never grown fat or gray in 37 years with a bouncing pasture preacher.

- An elementary school teacher "hard as nails but as fair as sunshine" who taught him "wrong wasn't right and nothing was right but right." He scored so high on his high school entrance test that he told surprised testing officials that they, too, would "know or else" if they had gone to his grammar school.

- A 110-pound high school speech

teacher who told him to sit on his stern and talk if he couldn't talk on his feet. He did—until he got ashamed of sitting and stood up one day to talk. He hasn't stopped since. She convinced him "if you can't SAY it there's no use knowing it."

- Enough personal poverty in college to keep him working and studying rather than playing around and complaining.

- A college professor who convinced him learning how to study was far more important than what he was studying.

- An experiment station director who taught him how to listen to colleagues and farmers and take all the advice he could get.

- A big farm magazine editor who persuaded him to write his first article. He told the editor he couldn't write. The editor told him just to talk and put it on paper. Then came millions of words and *The Pasture Book*.

- A Mississippi banker who early sponsored his work, lent him money to get started, and offered him the highest paying job he was ever offered—and still encourages W. R. Thompson.

- A Mississippi cattle farmer whose Hereford work has attracted probably more people to Mississippi than anyone else's program.

- Scores of news editors at the university and on the newspapers and radio-TV stations that used his materials regularly and helped promote *The Pasture Book*.

**Like most men** with creative energy, W. R. Thompson has his share of ego—maybe more than his share.

But he loved those pastures more than himself when he gratefully declined a department chairmanship years ago to keep plodding and preaching Mississippi grasslands.

He is still preaching their gospel. He will do so down to the end.

A careful look on that day may detect, written in the grass cushioning his rest, a comment he often made:

"I always talked and wrote as I would like to be talked to or written to."

Maybe that's the key the pros did not see when they told him his "little book" would not sell enough copies to pay for the ink.—SWM

# CABBAGE RESPONSE

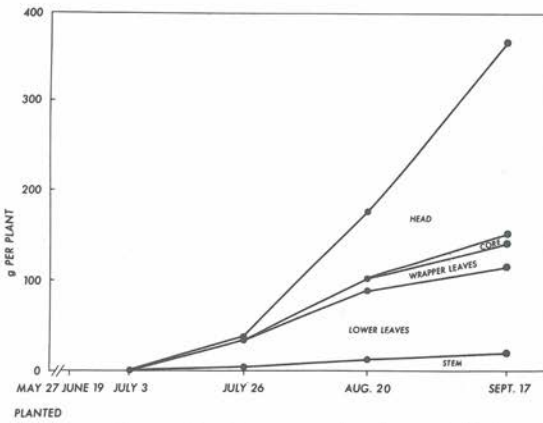
to

**Concentrated  
Superphosphate  
(CSP)**

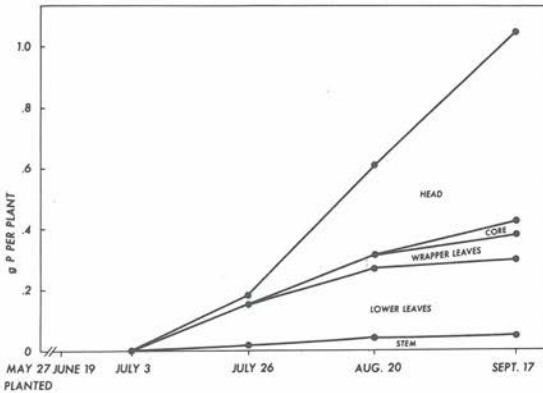
**Potassium  
Chloride  
(KCl)**

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

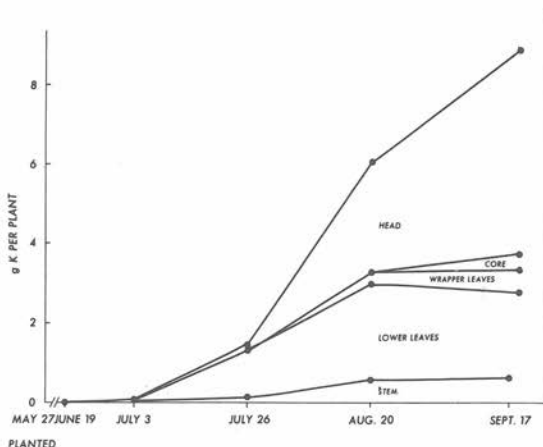
**Figure 1. Increase in dry weight per cabbage plant.**



**Figure 2. Uptake of P per cabbage plant.**



**Figure 3. Uptake of K per cabbage plant.**



**CABBAGE FOR SAUERKRAUT** was grown in soil that had received five previous applications of 4 rates of concentrated superphosphate (CSP) and 4 rates of potassium chloride (KCl).

The King Cole variety was used as a standard variety to study uptake of P and K as well as Ca, Mg, Mn and Zn, and the yield and quality of heads for processed kraut.

Greatest increase in dry weight and uptake of P and K occurred during the last month before harvest. Most increases were in the heads (Figures 1, 2 and 3).

Cabbage plants contained up to 36 lbs. P and 322 lbs. K per acre at harvest time (Figures 4 and 5).

Both CSP and KCl increased yields of whole heads and dry weight of plants (Figures 6 and 7). But at the later harvest, KCl increased percentage of burst heads.

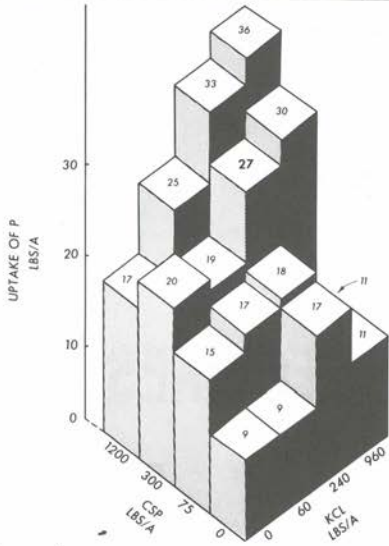
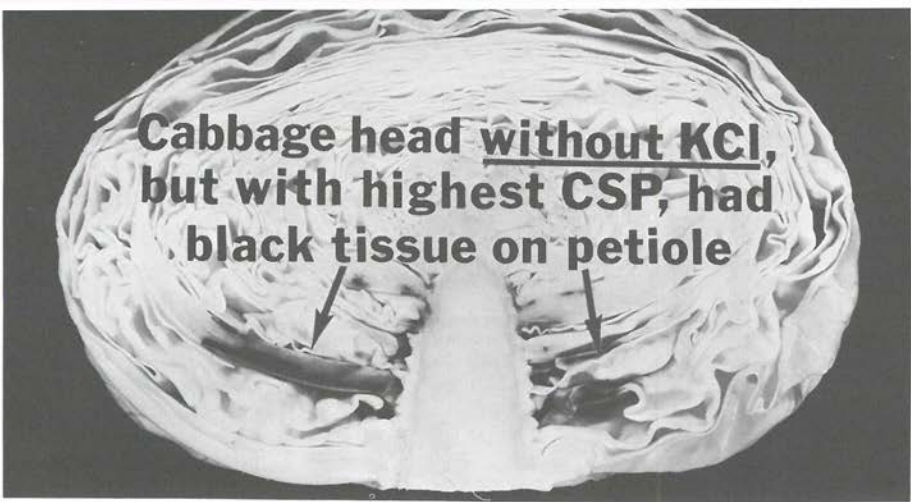
Cabbage plants grown with high rate of CSP and without KCl had scorched margins on the leaves and black tissue on the dorsal side of the petioles within the heads.

Details on the effects of CSP and KCl on uptake of elements by pea, alfalfa and cabbage are available in New York State Agricultural Experiment Station (Geneva) Bulletins 825, 829, and 830, respectively.

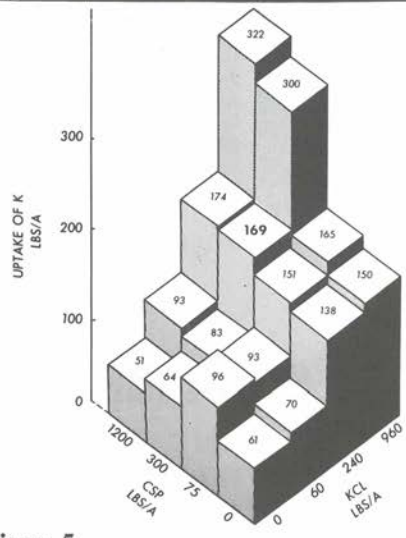
**THE END**



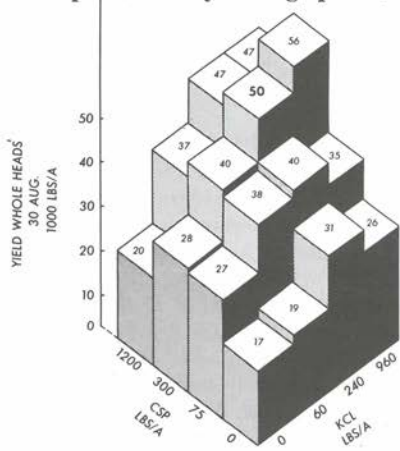
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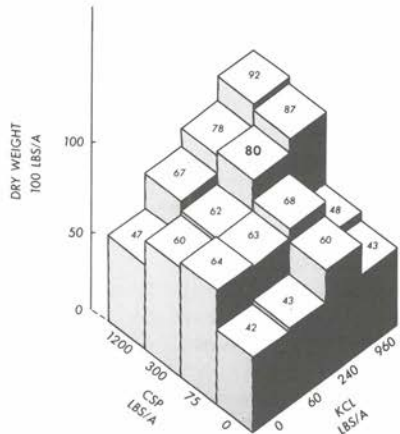
**Figure 4.**  
Total uptake of P by cabbage plants.



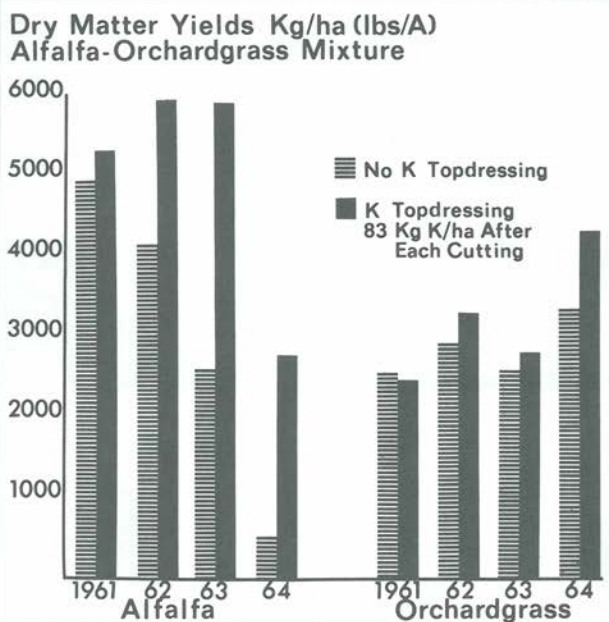
**Figure 5.**  
Total uptake of K by cabbage plants.



**Figure 6.** Effects of CSP and KCl on yield per acre of whole cabbage heads harvested on August 30.



**Figure 7.** Total dry weight of cabbage plants at harvest time.



**FIGURE 1** Without potassium, alfalfa yields declined sharply year by year. K meant 450% more alfalfa by the last year.

## Perennial Forage **REQUIRES** Plenty

**JAPAN IS AWAKENING** to fertilizer needs for producing and maintaining perennial forage stands.

The Obihiro Zootechnical University's Forage Research Center is conducting experiments on the yield, stand life, and mineral composition of alfalfa-orchardgrass and Ladino clover-orchardgrass mixtures.

The climate at Obihiro, Hokkaido, Japan compares to Portland, Maine—cool moist summers with 110-130 frost-free days and long winters.

Erratic snowfall may cover soil up to 100 days. In low-snowfall years, soil may freeze 20-30 inches deep, causing heaving damage in the high water content volcanic ash soils. Rainfall averages 35 inches a year, with good June, July, August distribution.

Soil from volcanic ash contained about 10 percent organic matter, had a pH of

MACK DRAKE, W. G. COLBY,  
HISATOMO OOHARA, NORIHITO  
YOSHIDA, KAZUO FUKUNAGA,  
AND YOICHI OOHARA

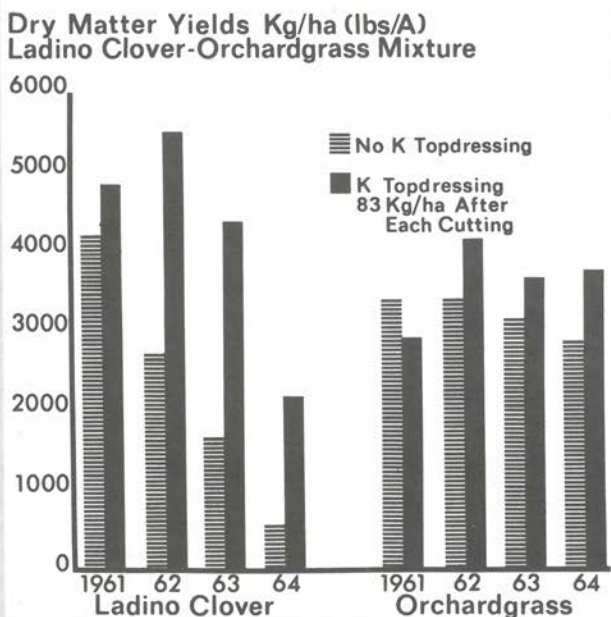
6.0 surface and 6.5 subsoil, and was low in nitrogen, phosphorus, potassium and magnesium.

**A SERIES OF PLOTS** was band seeded to a mixture of DuPuits alfalfa and Mass. Hardy orchardgrass and another series to Ladino clover and Mass. Hardy orchardgrass on May 9, 1960.

Bands of seed were placed 1 inch above precision bands of 11-49-0 fertilizer ranging from 0 to 200 lbs.  $P_2O_5$  per acre. Rows were 8 inches apart.

A uniform soil treatment—supplying 5,000 lbs/A dolomitic limestone, 200 lbs. potassium chloride, 100 lbs. nitrogen as

**FIGURE 2** Without potassium, Ladino clover yields dropped sharply year by year. K meant 275% more clover by the last year.



## of FERTILIZER

### ... in Japan

urea, and 25 lbs. fertilizer borax—was broadcast and disked into the surface 6 inches of soil before banding the 11-48-0 starter fertilizer.

May, June, and July moisture was favorable, establishing an excellent stand even on the No phosphate plots.

Beginning in 1961, two potassium levels (0 and 250 lbs K/A) were applied in increments of 83 lbs. K/A after each of 3 cuttings, each year.

#### WHAT PHOSPHORUS EFFECT?

Greatest response to P (phosphorus) came from two cuttings in seeding year, 1960.

Dry matter yields of alfalfa-orchardgrass were (first cutting) 505, 915, 1435, and 2065, and (second cutting) 1020, 1465, 1830, and 2275 lbs/A, respectively, for 0, 50, 100, and 200 lbs.  $P_2O_5$ /A.

Corresponding Ladino clover-orchardgrass yields were (first cutting) 910, 1500, 1600, and 2000, and (second cutting) 1400, 1450, 1600, and 1870.

In the four harvest years, 1961 through 1964, alfalfa-orchardgrass yields averaged 4 tons/A yearly and Ladino clover-orchardgrass yields averaged 3.5 tons/A.

Compared to No. P, 50 lbs.  $P_2O_5$  fertilizer P increased yields of both mixtures about 11 percent.

But in five years, chemical forage tests showed, over 75 lbs.  $P_2O_5$  had been removed, indicating 75 to 100 lbs. fertilizer  $P_2O_5$  should be applied at seeding.

Once established on this soil, these forage species were able to utilize soil P. There was no yield response to 50 lbs.  $P_2O_5$  applied annually as a topdressing.



**Table 1. Total five year yields and potassium removal in pounds per acre.**

		Applied					
100 lbs K/A at seeding			1000 lbs K/A				
Yield	% K	Total K re-moved	Yield	% K	Total K re-moved	% applied K removal	
<b>Alfalfa-Orchardgrass</b>							
26200	2.53	662	35700	3.28	1166	116	
<b>Ladino Clover-Orchardgrass</b>							
24850	2.45	610	33230	3.48	1125	112	

**WHAT POTASSIUM EFFECT?** Both alfalfa and Ladino clover responded slightly to fertilizer K (potash) the first year, then increased year by year.

Figures 1 and 2 show how K increased alfalfa yields 7, 45, 130 and 450 percent, respectively, in the first, second, third, and fourth years, while it increased Ladino clover yields 17, 100, 160 and 275 percent.

The orchardgrass responded less to K than the associated alfalfa or Ladino clover.

**WHAT POTASSIUM UTILIZATION?** Large increases in forage yields (34-36%) produced by three annual K applications were associated with a much higher percent K in the forage (Table 1).

This combined effect of increased K content multiplied by increased yields doubled the amounts of K removed by both the alfalfa-orchardgrass and Ladino clover-orchardgrass mixtures.

Without topdressed K, both forage mixtures removed over 500 lbs. K/A from soil reserves (Table 1). Both forage mixtures on plots receiving a "considered to be liberal" topdress application of 83 lbs. K/A after each cutting removed 125-160 pounds more K than applied.

Thus both K treatments depleted soil K reserves. This K removal was especially large in the seeding year and in the first and second harvest years for both forage mixtures.

The K in alfalfa ranged from 1.7 to 2.1% and from 2.2 to 2.6% in the first and second cuttings in the seeding year.

In the seedling year, both mixtures removed 95 to 115 percent of this initial fertilizer K.

These relatively low K compositions and K removal data indicated the initial application of 100 lbs. K/A was too low and suggested 100 lbs. K more should have been topdressed after the first cutting was removed.

Potassium removal exceeded topdress application by 60 and 70 lbs/A in 1961, by 70 and 110 lbs/A in 1962, respectively, for alfalfa-orchardgrass and Ladino clover-orchardgrass.

Thus, in the first two harvest years, even where three topdressings of 83 lbs K/A were applied each year, soil K was depleted 130 and 180 lbs/A, respectively, for alfalfa-orchardgrass and Ladino clover-orchardgrass.

In the third harvest year, K removal equaled K applied and the K content of alfalfa and Ladino clover was 3.0 and 3.4% K, respectively. (Table 2).

But winter injury of both legumes in 1963 reduced fourth year yields to half the third year.

**Table 2. Effect of three applications each year on the per cent potassium in forage.**

Year	Alfalfa		Orchardgrass		Ladino clover		Orchardgrass	
	-K	K	-K	K	-K	K	-K	K
1961	2.70	2.90	3.10	3.25	2.45	3.00	3.40	3.40
1962	2.60	3.30	2.10	3.50	1.45	3.30	2.25	3.95
1963	2.55	3.00	3.05	3.40	2.40	3.40	2.60	3.35
1964	2.30	3.30	2.40	4.05	2.45	3.65	1.85	3.95

On the low-K plots, both legume mixtures removed over 200 lbs. K/A in 1961 and 130 to 160 in 1962. This large depletion of soil K was accompanied by loss of legume vigor, reduction from 2.70 and 2.45% K, respectively, for alfalfa and Ladino clover in 1962 to 2.60 and 1.45 in 1962 (Table 2), and in a sharp depletion in 1962 legume stand.

Such K depletion reduced yields 17 and 35 percent, respectively, for alfalfa and

Ladino clover in 1962 and 48 and 59 percent in 1963.

These trials suggest such legume and grass mixtures need minimum values of 3.3% K for alfalfa, 3.5% K for Ladino clover, and 3.5 to 4.0% K for associated orchardgrass to maintain high yields and longlife stands.

Most soils require liberal amounts of fertilizer K skillfully applied to provide a balanced and adequate K supply in the growing plant. **THE END**

## Leaders Use LEADING Practices

WILLIAM REISS AND BEN SOUTHARD  
PURDUE UNIVERSITY

**WHAT DID THE LEADERS** of Indiana's 1969 10-acre corn yield contest do to get there?

Generally they used more of the accepted cultural practices more fully than the other growers.

One cannot evaluate the specific effect of a given cultural practice from the sum-

mary below. Many factors obviously enter into getting a high yield.

In 1969, Indiana averaged 96 bu/A on 4,646,000 acres. This shows much opportunity to improve cultural practices to reach even the low 122 bu/A in the 10-acre contest.

### WHAT CORN CONTEST GROWERS DID TO LEAD

Practice Used By Growers	Below 135 bu (122 bu ave.)	150-160 bu (157 bu ave.)	Above 161 bu (176 bu ave.)
Continuous row crop	53%	73%	69%
Fall plowing	26	29	34
Planted before May 11	45	67	74
Row width—31" or less	33	44	51
Above 22,000 seeded	50	81	89
Cultivation once	60	71	77
Preemergence herbicide	50	61	63
Soil Insecticide	37	52	58
Soil test	28	35	50
Used micronutrient	6	14	14
<b>Total fertilizer applied</b>			
N—lb/A	128	150	183
P <sub>2</sub> O <sub>5</sub> —lb/A	117	116	120
K <sub>2</sub> O—lb/A	126	142	164
<b>Fertilizer brd, sidedrd, plowed down, or disced</b>			
N—lb/A	113	131	162
P <sub>2</sub> O <sub>5</sub> —lb/A	64	64	64
K <sub>2</sub> O—lb/A	95	114	129

# Potassium At WORK In Organic SOILS

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**HIGH VALUE CROPS** grown on newly reclaimed organic soils of low fertility demand intensive fertilizer management.

Potassium supply must be watched constantly, since it is the most naturally limiting nutrient in most peat and muck soils.

Also, too much of an element may lead to nutrient-induced hunger of other essential elements. Due to the low mineral con-

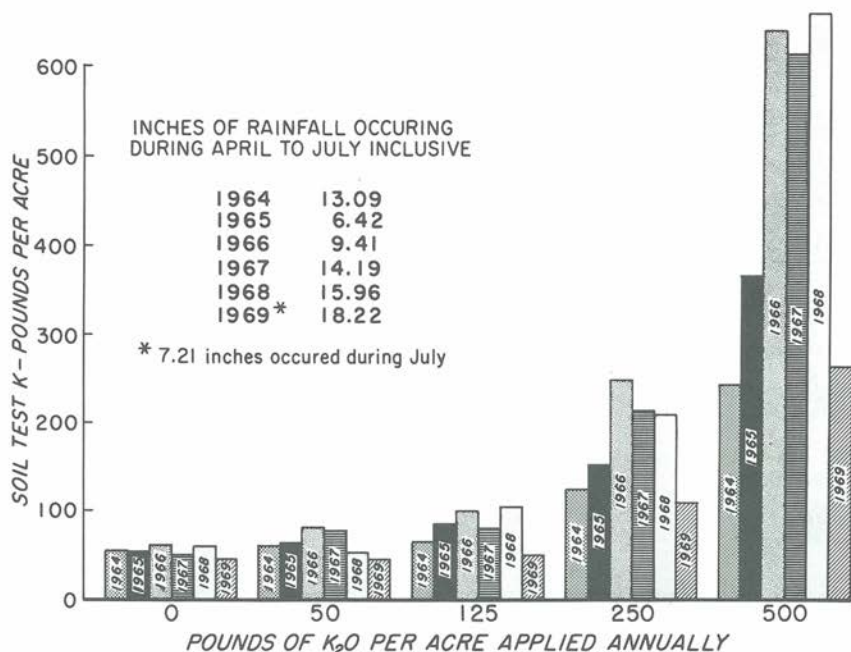
tent of Michigan muck and peat soils most applied potassium is in the exchangeable and soil solution forms.

So, soil extracting solutions that measure these forms of soil potassium (such as neutral normal ammonium acetate) can very reliably predict their potassium status.

**DOES POTASSIUM MOVE** in organic soils? Such soils have high exchange capacity—150 to 200 millequivalents per 100 grams. They have very low leaching losses, it is commonly believed.

**FIGURE 1** shows the long-time application effects of potash on residual soil potassium where known annual rates were applied. Note how:

- Residual soil potassium levels for the 250 and 500 lb. rates increased appreciably up to 1966.
- Values tended to level off during 1967 and 1968, with available K skidding sharply under heavy spring rainfall (11.01 inches) in April, May, and June 1969. An additional 7.21 inches occurred in July.
- Potassium loss between 1968 and 1969 was compounded by the relatively high rainfall (15.96 inches) between April and July in 1968, including 8.29 inches in June.







**Soil K  
40 lbs.**

- Severe Potash Hunger
- Excessive Leaf Drop



**Soil K  
340 lbs.**

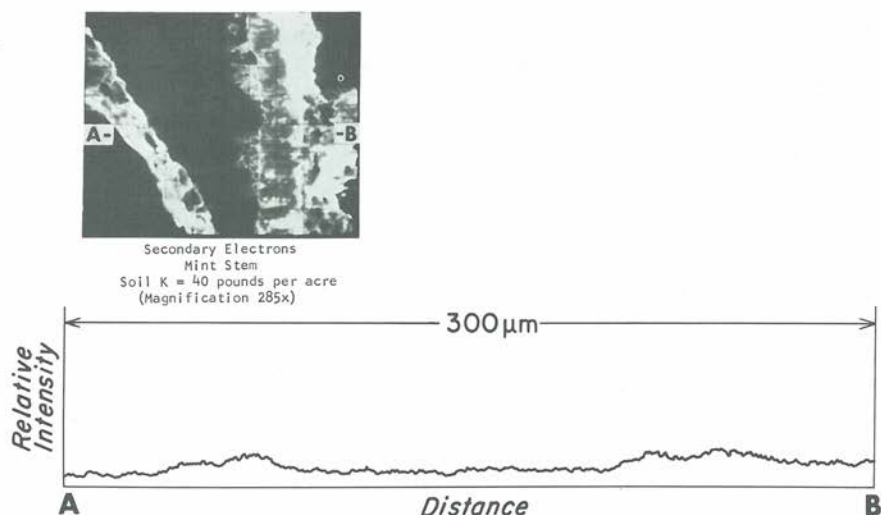
- Good Growth Response
- 3.5 Times More Mint Oil

• At the 500 lb. potash rate, soil K declined as much as 60 percent between 1968 and 1969.

**FIGURE 2** contrasts mint plants growing on soils containing 40 lbs. K and 340 lbs. K per acre.

• Severe potassium hunger, including excessive leaf drop, occurred on the soils containing only 40 lbs. K/A.

• Plants on the high-K soils produced 3.5 times as much mint oil as those on the low-K soils.



**FIGURE 3**  
Cross Section  
and  
K intensity  
of  
Mint Stem

Grown on  
Low-K  
Soil  
(40 lbs K/A)

**TABLE 1** shows potassium, magnesium, and calcium in the mint tissue on July 1 and July 28, 1969.

- Plant potassium generally declined over the 28-day period between samplings.

- A marked inverse relationship occurred between potassium and magnesium in the plant and to a lesser degree between plant potassium and calcium. However, oil yields generally increased in spite of these relationships and depressed yields resulted only when mint grown on soils testing over 260 pounds of K were sidedressed with 500 pounds of  $K_2O$  per acre.

**TABLE 2** shows how potash sidedressed July 5 generally boosted plant potassium and oil.

These data suggest about 2.5% plant K as a critical value for good growth and mint yield.

**FIGURES 3 and 4** show the relative intensity and distribution of potassium in mint systems—determined by the electron microprobe X-ray analyzer (Applied Research Laboratories). These measurements appear as line profiles.

The mint tissue was prepared for microprobe analyses by sectioning fresh-frozen tissue. Sections 15 micrometers thick were placed on polished carbon discs at room temperature and air-dried before microprobe analyses.

**Figures 3 and 4** show cellular detail of

300 micron portions of mint stems obtained from plots containing 40 and 340 lbs. K/A respectively and relative intensity of potassium from points A to B with a line scan.

Potassium distribution is uniformly low across the 300 micron portion of mint stem harvested from 40 lb. K/A plots (Figure 3). But the 340 lb. K/A plots showed high intensity of potassium in the stem (Figure 4). As plant K increased, oil yield increased up to 3.5 fold.

**TABLE 3 SHOWS** internal K movement in organic soil from a celery farm in Ottawa County, Michigan. These growers often use liberal potash rates.

On the farm under study, the water table level was at the 36-inch depth. Note

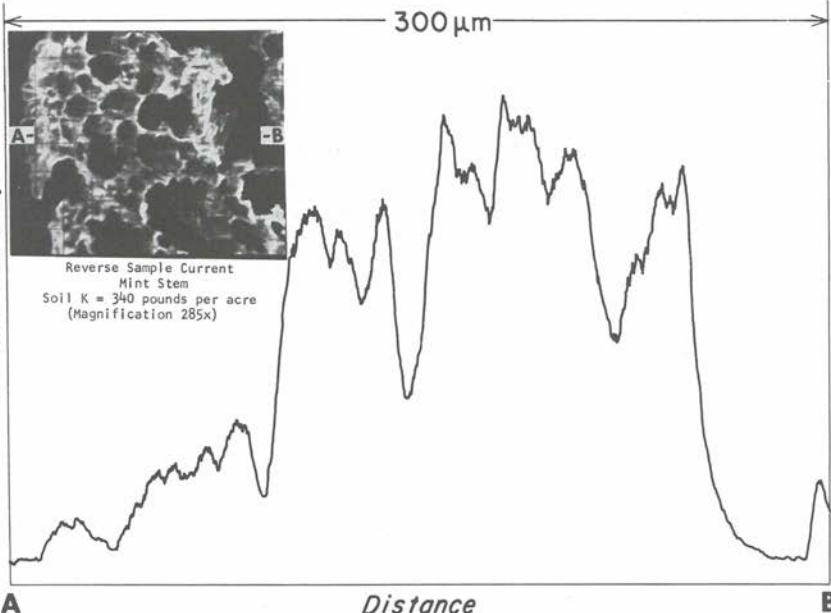
**Table 1. The potassium, magnesium, and calcium content of peppermint tissue as related to soil K, 1969.**

	Pounds soil K per acre	%K	%Mg	%Ca
<b>July 1—</b>				
Top Six Inches	40-60	0.4-0.6	1.3-1.5	1.4-1.6
	90-120	1.5-2.0	1.0-1.2	1.3-1.5
	300-400	3.0-4.0	0.45-0.55	1.2-1.4
<b>July 28—</b>				
Whole Plant	40-60	0.3-0.5	0.8-1.0	1.3-1.5
	90-120	1.7-2.1	0.6-0.8	1.2-1.4
	300-400	2.4-3.0	0.4-0.6	1.1-1.3

**FIGURE 4**  
Cross Section  
and  
K Intensity  
of  
Mint Stem

Grown on  
High-K  
Soil  
(340 lbs K/A)

Relative Intensity



the high potassium level at this soil depth—and the rather uniform values of potassium in the soil profile.

**THESE DATA SUGGEST** that it is not advisable to try to build up residual potassium levels on organic soils in areas of high rainfall or in fields subject to flooding.

Fall potash applications on these soils may be of little value. When heavy rain periods follow potash applications, the soil should be checked so potash may be sidedressed if necessary. **THE END**

The authors acknowledge the assistance of V. E. Shull for operation of the electron microprobe.

**Table 3. Movement of potassium in a muck soil — celery field in Ottawa Co., 1969\***

Depth Sampled in inches	Soil Test K — Lbs/A**			
	July 27	Aug. 24	Sept. 21	Nov. 2
0-4	1082	1082	1353	1285
4-8	1285	1016	1082	949
8-12	949	818	818	949
12-16	818	818	949	949
16-20	818	1016	818	818
20-24	752	818	883	767
24-28	688	883	818	700
28-32	818	818	818	818
32-36	688	1016	1082	1150

\* Soils sampled by B. Schreur

\*\* 380 pounds of K<sub>2</sub>O applied in early July to celery.

**Table 2. The relationships among soil K, sidedress applications of K<sub>2</sub>O, and yield of mint, 1969.**

K Soil Test Pounds Per Acre	K <sub>2</sub> O Sidedressed on July 5 Pounds Per Acre	% K in Plant July 1	% K in Plant July 28	Oil Yield Pounds Per Acre	Value* Per Acre
45	0	0.56	0.44	12.9	\$103.20
45	50	—	—	22.6	180.80
47	0	0.65	0.62	20.7	165.60
47	125	—	—	26.6	212.80
110	0	1.82	1.94	29.4	235.20
110	250	—	—	34.6	276.80
263	0	3.64	2.84	44.2	353.60
263	500	—	3.22	32.7	261.60

\* Based on \$8.00 per pound of mint oil.



**FIGURE 1**

The electron microprobe x-ray analyzer features a 30,000 volt power console (right). A spectrometer tank to test for 3 elements at once (center). A readout console (left).



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## New Tool for studying plants & soils

**THE ELECTRON MICROPROBE** x-ray analyzer can test a sample for any element (except hydrogen, helium, lithium, and beryllium) at concentrations as low as  $4 \times 10^{-18}$  ounce (0.000000000000000004) in a volume of 1 cubic micron.

The first microprobe was commercially available in 1961. The principal designs and early users were in metallurgy and geology.

In 1966, the first plant material was studied with the probe.

**HOW THE PROBE WORKS.** The probe, shown in **FIGURE 1**, is basically a combination of an electron microscope and a spectrophotometer.

**FIGURE 2** shows its working principle: A single atom is struck by an electron from a 30,000 volt power supply. The

electron "A" collides with one of the electrons "B" in the atom.

This collision gives energy to electron "B", causing it to move to a different orbit or level. The space vacated by electron "B" must be filled to maintain the electrical balance of the atom.

Thus electron "C" falls from its orbit into the vacated orbit. This causes energy loss.

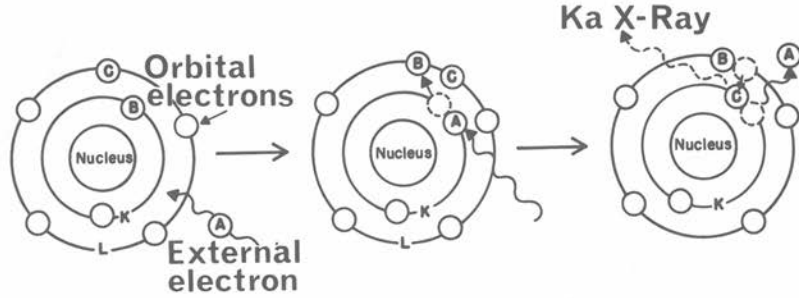
That energy is given off in the form of an x-ray. The x-ray has a characteristic wavelength for each element.

So, by detecting only those x-rays of a given wavelength such as potassium Ka which is 3.740 angstroms, we are able to analyze for that element.

The probe data can be quantitative (how much), qualitative (which element),

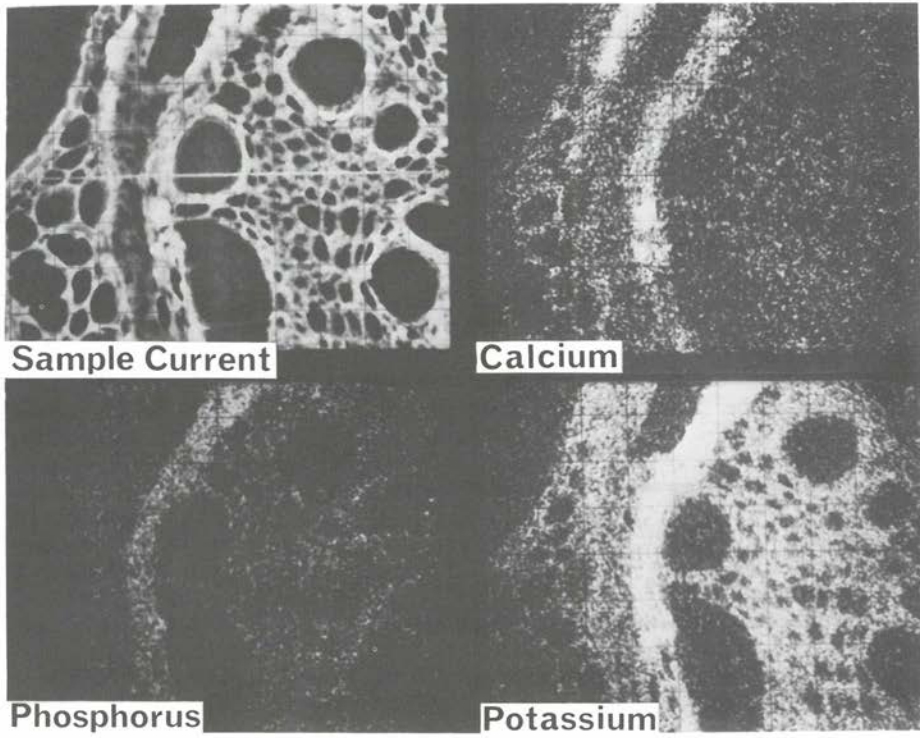
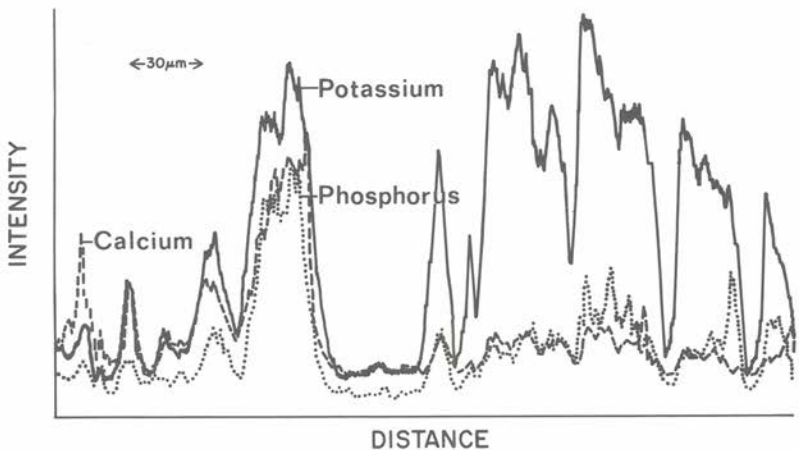
**FIGURE 2**

This action starts in a single atom when the electron "A" from the 30,000 volt microprobe collides with an electron "B" in the atom.



**FIGURE 3**

The line scan (right) compares the elements (Ca, P, K) shown in the cross-section of bean stem below. This scan reading came from the white line area of bean stem "sample current" below.



or semiquantitative (how much with respect to other elements).

The quantitative information comes from point counting of the number of x-rays for a given element over a given time—such as ten seconds. The number of x-rays given off is proportional to the amount of element present.

To find out which elements are present and their distributions, the electron beam is scanned over the surface of the sample as in a television tube.

The resulting x-rays for a given element are then displayed on a cathode ray tube (television tube). By moving the beam in a line across the sample, the relative amount of the elements can be plotted on an x-y recorder—shown by **FIGURE 3**.

**HOW THE PROBE IS USED.** It is widely used to study plants and their environment.

Initial work studied the presence of calcium, magnesium, potassium and several other elements in fruiting stock of the pea.

From there, the probe was used to study crystals in leaves, movements of elements through the soil and into the root system.

After elements enter the root, the distribution throughout the plant can be followed.

**FIGURE 3** shows element distribution in different plant parts—including the cross-section of a bean stem and the distribution of calcium, phosphorus and potassium.

Many other problems have been studied with the microprobe and are reported elsewhere.

As a new research tool, the microprobe is limited only by the imagination of the investigator.

Many new doors have been opened by the probe. Many more will be opened in the future.

**THE END**

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Is It Worth Your  
TIME?  
See Page 4

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**Dear Dr. Borlaug:**

I cannot match the enthusiasm that surely broke out in your hometown of Cresco, Iowa when the headlines read: "Howard County Boy Named Nobel Winner."

But this note should help you know how an average American—a guy on the street with no credentials—received your recent honor.

I told my teen-age son this year's Nobel Peace Prize was historic because it went to a man who calls himself a "dirty-handed scientist," working in a Mexican wheat field when his wife came running with the news.

A man covered with dust and sweat and chaff, suggesting "somebody must have made a mistake" as his wife hugged him.

"What's so great about that?" my boy asked.

"Nothing among such men as Borlaug," I replied. "But, son, you'd be amazed at the people whose scientific goals are the white jacket, the weatherized lab, the walnut-paneled office, and the Washington club pregnant with martini-sipping dandies hungrily reading membership waiting lists outside the lower dining room."

"Why?" he asked.

"Status, boy, that psychological drug human nature craves as frantically as the helpless addict craves heroin. But status rarely associated (in their



# TO:

**Dr. Norman Ernest Borlaug**  
**Rockefeller Foundation Wheat Worker**  
**Winner**  
**1970 Nobel Peace Prize**  
**Somewhere In A Wheat Field On Earth**

minds or chatter) with fertilizer bags and dusty seed and endless rows of stubborn soil."

"Well," he said, "dirt science is sorta hickish these days, isn't it, dad? I mean with all the atomic research and electronic ships to the moon, and all."

**"Not if you want to continue to eat," I replied. "That's what Borlaug's work is all about. Food—for people who have not yet found a way to live without it."**

Yes, Dr. Borlaug, the world owes you and your team much thanks for helping lick world famine today—through disease-resistant wheat of less straw and more grain, yielding two to six times more food than the old varieties.

You brought home the greatest of the Nobel Prizes, in my judgment—not for medicine or chemistry or physics or literature, but the one for PEACE!

The past 14 Americans to receive the Peace Prize since it was first offered in 1901 have come from worlds far removed from wheat fields—ranging from Theodore Roosevelt of international politics to Linus Pauling of nuclear relations.

That is why your greatest thanks should come from the university agronomy departments of America—from your fellow agronomists.

Men whose work with crops and soils, though vital to man's

survival, has never caught the public's fancy—not like the sciences of medicine and the sciences of energy.

Men of probing natures—quiet men as the press called you—not inclined to hog headlines or TV spots with nervous-tongued prophecies.

Too long and too often these agronomists have had to talk to each other, it seems—sometimes like big-eyed farm boys of old whistling by the graveyard at dusk on the way home from the fishing hole.

The louder they whistled the more they heard each other and the less the world across the wall seemed to care.

**What a catch they had on their strings! But who knew or cared, so long as they continued to bring home enough fish (food) for everyone to eat?**

Agronomists should thank you most of all for sticking to the job—26 years as a wheat worker for the same outfit.

Long enough to become the dedicated expert that could bring the world's most coveted prize to the field of crops and soils.

I, too, thank you for that stick-to-it example to my son.

I thank you because "more prestigious" offers surely must have tempted you—with faster income hikes, fancier titles, fatter authority, and other as-

sorted bait that lures less dedicated men from rung to rung.

I thank you because rung jumpers accomplish little. Maybe a few bucks more salary. Maybe a slogan-fat program resurrected from a past so long dead it sounds fresh. Maybe rank an ambitious wife can carry among her clubs. Maybe a little deference from up-and-comers.

But no real accomplishment and rarely any happiness after selling the science they studied so hard to master for 30 pieces of silver and the favor of scientific sycophants.

Thank you, Dr. Borlaug, for never deserting your wheat fields for "more prestigious" roles—if there is anything more important than the search for food to sustain the human species.

Your name now joins such Nobel winners as Woodrow Wilson, Albert Schweitzer, and George Marshall.

The world did not heed these men. It insisted on returning to its ageless pursuits of greed, bigotry, and ignorance.

But they were not "dirty-handed" scientists, working in the soil with grains of wheat.

Maybe the world will understand your quiet thoughts from the field where Clara Borlaug reached you with the news from Oslo.

**You told us, "We have only delayed the world food crisis for another 30 years. If the world population increases at the same rate, we will destroy the species."**

Surely the human race will not destroy itself, Dr. Borlaug, unless it decides self-discipline is one lesson it cannot learn—even after centuries of trying.

**THE END**



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## POTASH INSTITUTE of NORTH AMERICA

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### To Potash Institute Friends

THE BOARD OF DIRECTORS of the Potash Institute has changed the name of the organization from AMERICAN POTASH INSTITUTE to POTASH INSTITUTE of NORTH AMERICA. 11/2/77

The new name more accurately represents the membership of the Institute. There will be no change in policies or in the Institute's market-building education around the world.

Potash Institute scientists will continue to encourage sound soil fertility research and education through grants-in-aid, publications, visual aids, participation in various plant food associations and scientific societies, and grass roots trouble shooting for which the Institute has been known 35 years.

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