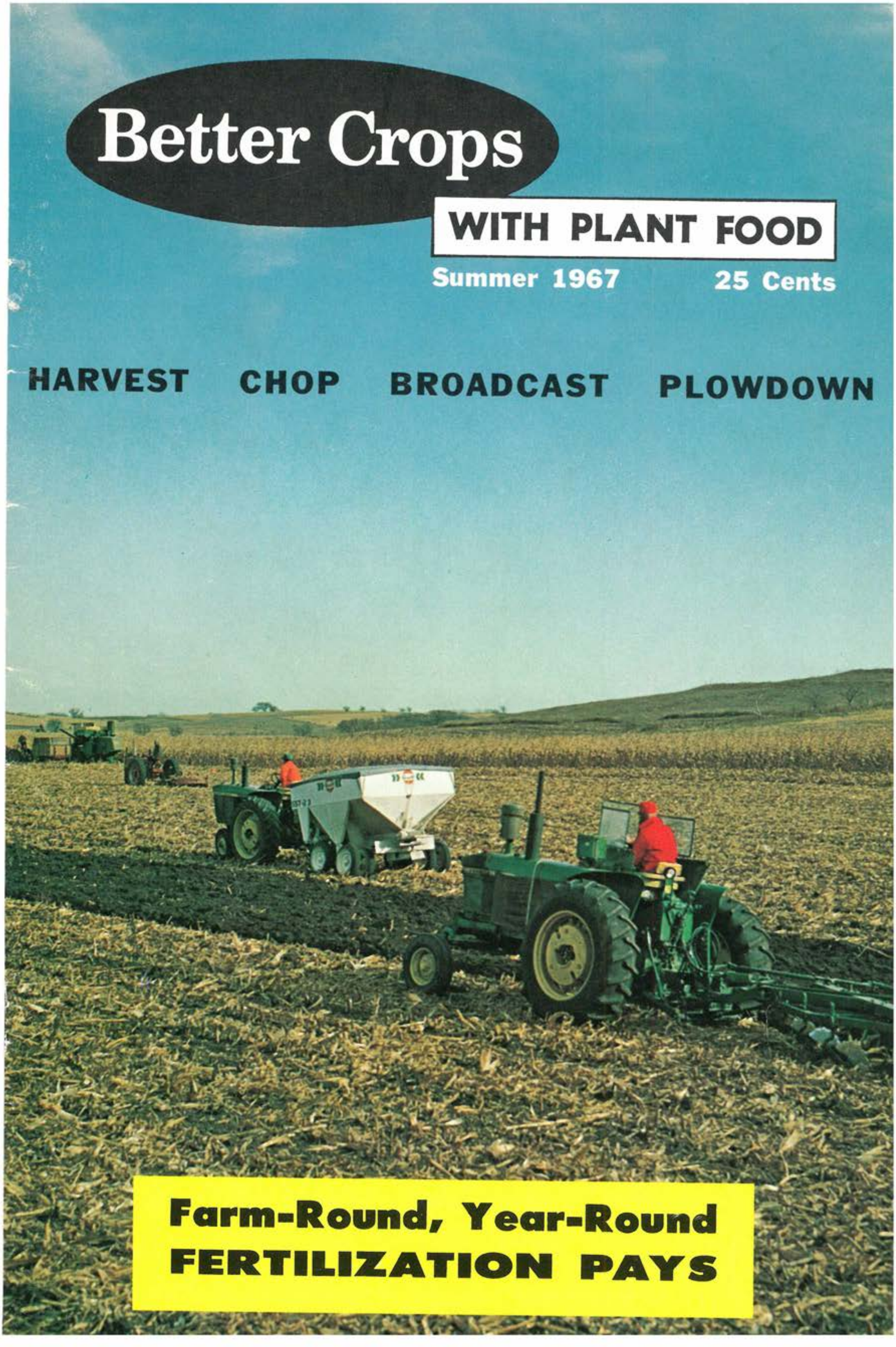
Better Crops

WITH PLANT FOOD

Summer 1967 25 Cents

HARVEST CHOP BROADCAST PLOWDOWN



Farm-Round, Year-Round FERTILIZATION PAYS

What About You?

THE IDEA of fall fertilization, like most ideas, is not new. Men like Firman Bear and Hugh Bennett were preaching it years ago, before many of the current choristers had graduated from their mama's milk—Bennett from the rear of manure spreaders in Ohio, Bear at fertilizer clinics where his clear reasoning planted seeds that have taken years to germinate.

But today it is germinating—FAST. Many trends are pushing it: narrower rows, earlier planting, higher-yielding varieties, increased plant populations, bigger acreages, custom bulk spreading, labor shortages, etc.

Such trends demand more than CROP fertilization, the spoonful (band) along the row. They demand SOIL fertilization, a high-potency buildup of heavy-duty acres into champion producers.

In this issue, scientists and top growers continue to prove that fall-winter fertilizer programs can do the job safely, profitably. Where are YOU in your year-round fertilizer plans?

Better Crops
WITH PLANT FOOD

The Whole Truth—Not Selected Truth

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CONTENTS

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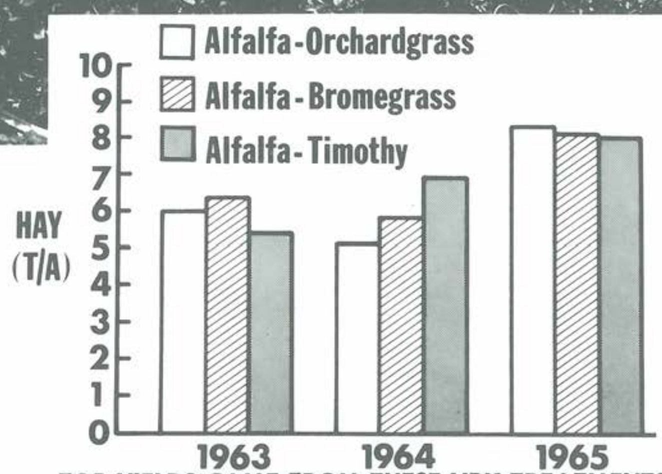
LUXURY K USE



HAY YIELDS (12% moisture)

TOP YIELDS CAME FROM THESE NPK TREATMENTS

1963—Lbs/A: 60 N + 52 P + 100 K
1964—Lbs/A: 120 N + 90 P + 232 K
1965—Lbs/A: 119 N + 84 P + 223 K

J. R. GEORGE
C. L. RHYKERD
C. H. NOLLER

WHAT ABOUT luxury K consumption by crops—is it fact or myth?

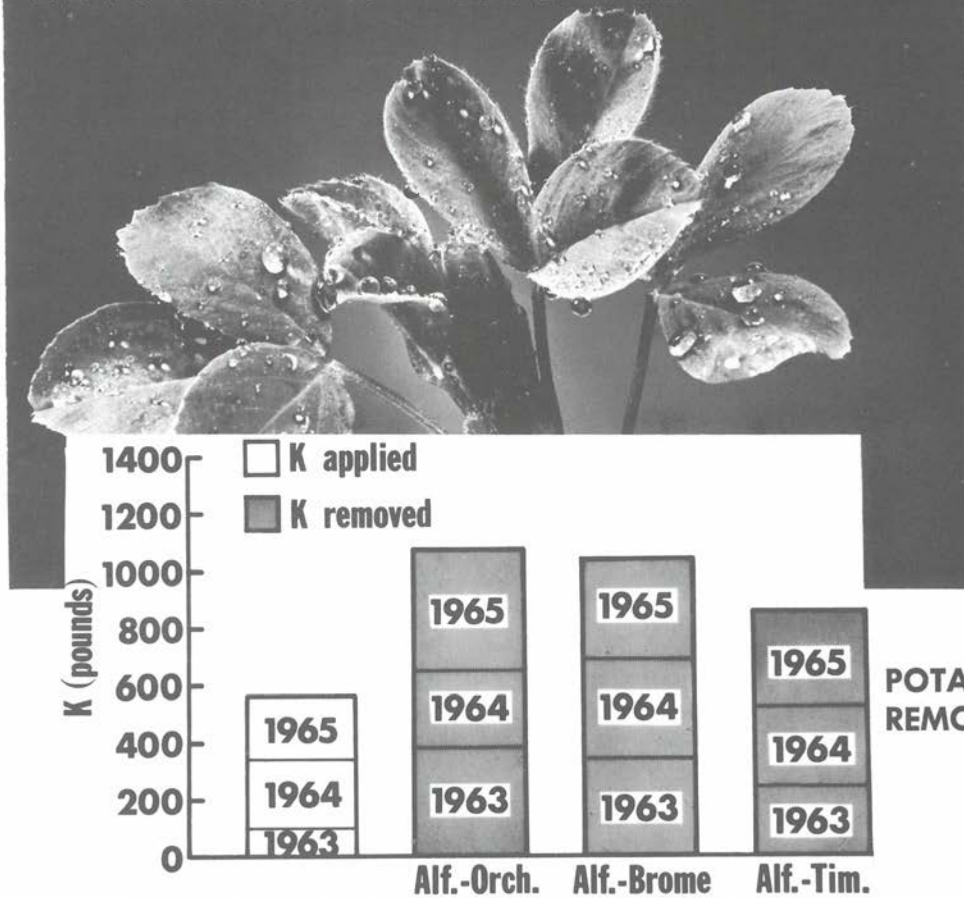
Top forage production under 4 and 5-cut systems demand rapid recovery for high yields. Can soils testing high in available K supply potassium at sufficient rate to meet this demand?

Is the K depleted immediately around the root zone, causing hidden hunger? And at what soil test level does this occur: 150 lbs. K, 300 lbs., or 500 lbs.?

How much does drought affect the K supplying ability of the soil, since potassium is supplied primarily by diffusion through water films around

Formerly graduate student at Purdue University, now Agronomist, American Potash Institute and Agronomist and Animal Scientist, respectively, Purdue University.

...FACT or MYTH



POTASSIUM (K) REMOVAL

FORAGE ACTUALLY MINED POTASSIUM OUT OF SOIL

. . . sometimes twice as much as was applied.
. . . causing Purdue to suggest 500 lbs. 0-0-60 per acre yearly for high yield seekers.

the soil particles? Maybe available K should be higher under dry conditions.

Our idea of adequate amounts, based on plant analysis, has continually climbed—from 0.75% K to 1.5% to 2.0%. But 8 and 10 ton yields from Indiana have recently contained 3 or 4% K and even MORE.

If plant analyses continue to show high yields associated with 3-4% K, maybe we should re-evaluate our idea of "luxury consumption." The percent K in alfalfa decreases with maturity. So, with more frequent cutting, younger plants are being harvested and higher K levels in the plants can be expected.

HIGH YIELDS!

We harvested 8.3 tons of forage in 1965—**not on small research**

TABLE 1. FERTILIZER APPLIED

Year	Application	Total Annual Rate-Lb/A N	P	K
1963	Early spring, after 1st cutting	60	52	100
1964	Early spring, after 1st cutting, after 2nd cutting	120	90	232
1965	Early spring, after 1st cutting, after 2nd cutting	119	84	223

plots, but from a large-scale farm operation!

In 1962 we decided to learn just how high we could go with forage yields on "good corn land." Forages have traditionally taken a back seat in the farm operation, since they are grown on less productive land. To make matters worse, they generally receive little or no fertilizer.

Poor management and high nutrient needs held average state yields to only 2.55 tons per acre in 1965 and 1966—far below potential.

The Normandy Farm near Indianapolis, owned by Mr. and Mrs. Herman C. Krannert and leased and operated by Purdue University, was chosen for this work. Culver alfalfa was seeded as a mixture with orchardgrass, with bromegrass, and with timothy in 1961, but the experiment was not initiated until 1963.

Four cuttings were made each year—the first at early heading stage of the grass, the remaining three at early bloom of the alfalfa. The original mixtures were about 50% grass and 50% alfalfa. But under intensive management, the timothy had disappeared by 1965, leaving 100% alfalfa and 20% bromegrass—80% alfalfa mixture. The orchardgrass survived extremely well and still comprises about 50% of the mixture five years after seeding.

We began with what we thought was a high fertility program, but soon learned that nutrient removal far exceeded our application rates.

In 1963, the top yield of 6.4 tons 12% moisture forage was secured through the NPK treatment of 60+52+100, shown in Table 1. The top yield of 1965, 6.9 tons, came from 120+90+232. And by 1965, the 8.3 tons came from 119+84+223 lbs. of nutrients.

Although analysis of 1966 data is not complete, we averaged about 5 tons on half the normal rainfall—**suggesting high fertility helps in dry seasons.**

WHAT ABOUT % K?

Only four of our cuttings over the three-year period contained less than 2% K, and these occurred with low yields, shown in Table 2. **In addition, 23 of the 36 cuttings contained more than 2.50% K, and 14 of the 36 (nearly half) contained over 3% K—with several approaching 4%!** In general, higher alfalfa

TABLE 2. K CONTENT OF ALFALFA-GRASS MIXTURES (1963-1965)

Percent K	Number of* Cuttings
1.50-1.99	4
2.00-2.49	9
2.50-2.99	9
3.00-3.49	8
3.50-3.99	6
Total	36

* The values indicate the number of cuttings taken during the 3-year period which contained the indicated percent K.

yields come from liberal fertilizer use and more frequent cutting.

The percent K in alfalfa decreases with maturity. So, with more frequent cutting, younger plants with higher K levels are being harvested.

Does this mean a plant analysis value of 2% K is not enough for top production with present day production practices?

REMEMBER!

High yields of good quality forage do not just happen. They come from good management. Much of our success can be traced to:

1—Use of high quality seed of recommended varieties adapted to our area.

2—Thick stands that respond to high fertilizer rates and intensive cutting management.

3—Timely and frequent cuttings contributing to both yield and quality. Protein and TDN decrease rapidly after early bloom. Plan to cut every 30-35 days.

4—Liberal lime and fertilizer applications. **Pour on the potassium: removal of 300 to 400 pounds or more of K can be expected from yields of this magnitude.**

PROFITABLE?

Are these fertilizer rates profitable? You be the judge!

Two tons of this high quality hay will pay the fertilizer bill, leaving 4.5 to 6.5 tons of high quality forage above fertilizer cost. In addition, these fields produced more forage than the Normandy Farm Guernsey herd needed. In 1964, half the 45-acre field was plowed and planted to a corn crop.

WHAT ABOUT K REMOVAL?

We wonder if we are using enough fertilizer. Even with more than 200 lbs. K per acre, our yields have removed more K than we applied as fertilizer—the alfalfa-orchardgrass and alfalfa-bromegrass about twice as much K as we applied.

In fact, Purdue soil tests show the soil K level has declined slightly—from 185 lbs. available K (medium) in 1963 to 165 lbs. K in 1965. How long can we afford to mine the soil? Would higher potassium rates increase yields further? We now advise Indiana farmers to apply 500 lbs. of 0-0-60 per acre yearly if they are seeking high yields.

Is it always necessary to add large amounts of K?

(1) A livestock farmer recycles the K back to the field through manure if he returns the manure to the soil. Once the soil K is built up to a high level, large K applications may not be necessary.

(2) A farmer selling forage is depleting his farm of K unless additions approximate removal.

(3) The farmer buying forage is actually adding K to his farm.

CHEAP INSURANCE

Recent Illinois work has shown that medium textured soils leach less than 2 lbs. potassium per acre annually. This means you can put on enough K to be sure. **You may even get "luxury consumption" of K causing 10 or even 12 ton yields. Would you believe 15 or 20 ton yields???!!!**

Acknowledgment—This research was financed in part from a trust agreement between Purdue University and Normandy Farm, New Augusta, Indiana; Mr. and Mrs. Herman C. Krannert, owners.

THE END

NOTHING SUCCEEDS like success. Nothing teaches like experience. Another WET SPRING has shown farmers, fertilizer dealers, and extension workers the need to examine our year-round programs to get fertilizer applied ON TIME.

The 1967 Illinois Fertilizer Clinics used a fresh technique to stimulate discussion by dealers and county extension, to explore better ways to serve farmers.

The center of attention was the big roll-up chart shown above. Across the bottom, month by month

YEAR ROUND DECISION CALENDAR

A New Format For Discussing

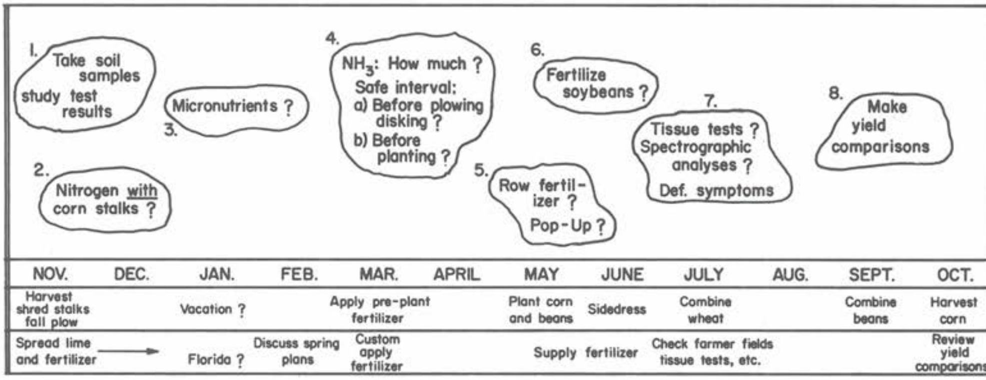
following corn harvest, we listed the things a farmer and a dealer will likely be doing. In the main upper portion, we developed discussion topics around decisions that affect a farmer's fertilizer use. Here are some samples of the agronomic problems we covered:

1. **Study Soil Tests.** When is the best time to take samples? How many samples are needed? Seasonal adjustments in interpreting K tests. Using soil tests to plan fertilizer treatments.
2. **Nitrogen With Corn Stalks?** Advantages and disadvantages of fall, spring, and sidedressing. Is it necessary or desirable to have nitrogen in contact with residues?
3. **Micronutrients?** A review of research results and a suggested position statement for 1967.

SAMUEL R. ALDRICH

4. **NH_3: How much? Safe Interval Before (1) Plowing Or Disking, (2) Planting?** A discussion of the soil factors that influence capacity to hold ammonia. How soon after NH_3 application is it safe to work the soil without nitrogen loss or to plant without seedling injury risk?
5. **Row fertilizer? Pop-up?** Is row fertilizer necessary at high fertility levels? Research results and farmer experiences with small amounts of fertilizer near the seed.
6. **Fertilize Soybeans?** What does research tell us about direct fertilization of soybeans at different soil test levels of P and

HELPING FARMERS WITH THEIR FERTILIZER DECISIONS, Illinois



Fertilizer Timing

UNIVERSITY OF ILLINOIS

K? What is the optimum pH? Does nitrogen pay?

7. **Tissue tests? Spectrographic Analyses?** Can the dealer and farmer make use of these diagnostic tools to confirm deficiency symptoms or find hidden hunger? Plans of the University of Illinois to conduct an over-state micronutrient survey.
8. **Make Yield Comparisons.** Farmers and dealers who set out fertilizer trials will want to harvest them, study and interpret the results, and compare with Experiment Station data.

Humor always adds interest to meetings. Miss Jean Albrecht, our artist, prepared cartoons for overhead projection to introduce each topic—such as pop-up, sidedressing, soybean fertilizer, and slick spots.

The general format of the meetings met these objectives:

1. **A change of pace** from the usual speaker-listener situation. Responsibility for a brief opening statement followed by leadership of the discussion alternated among two soil fertility specialists and the area agronomist.
2. Attention was **focused on making decisions.**
3. Dealers and county extension workers **were actively involved** in choosing best programs based on local situations—kinds of soils, cropping systems, farmer preferences. We assumed dealers and farm advisers would make good use of information they helped create.
4. The **need for forward planning to assure timeliness** in fertilizer applications was readily apparent.

Both dealers and county farm advisers received the new meeting format with enthusiasm.

THE END

FOR CORN . . .

FALL or

REGIS D. VOSS

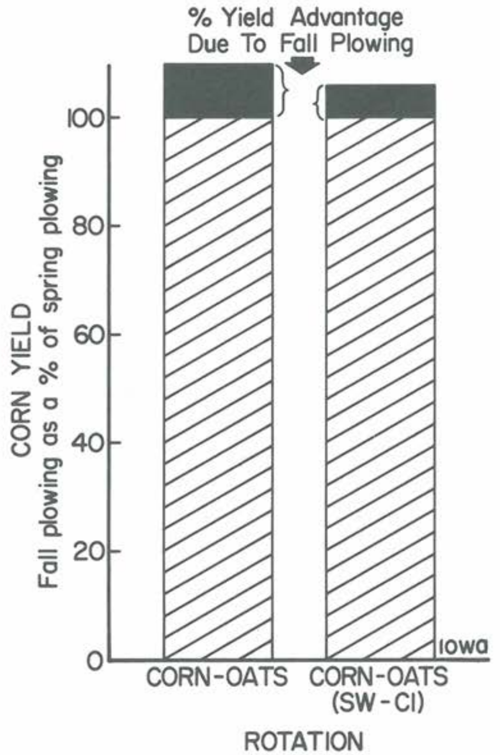


FIGURE 1

EFFECT OF TIME OF PLOWING ON EARLY GROWTH OF CORN

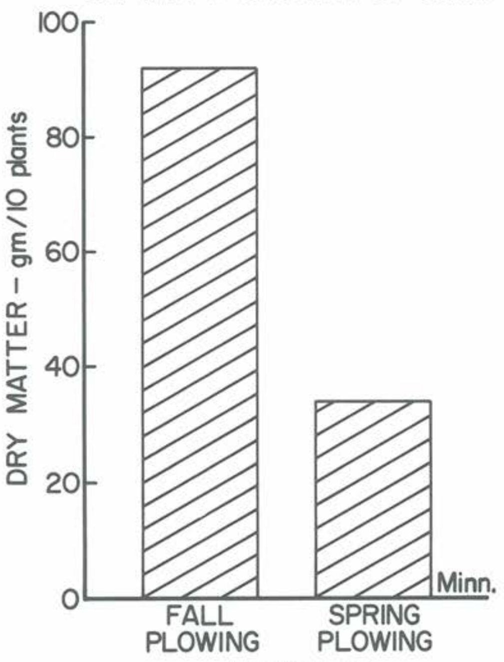


FIGURE 2

MILLIONS of acres of row crop land are fall-plowed in the Corn Belt.

Many reasons are given for fall plowing, ranging from increased corn yield to better labor distribution, especially for growers with large acreages of row crops per man.

The grower must decide for his own situation. To help him decide, let's look at some advantages and disadvantages:

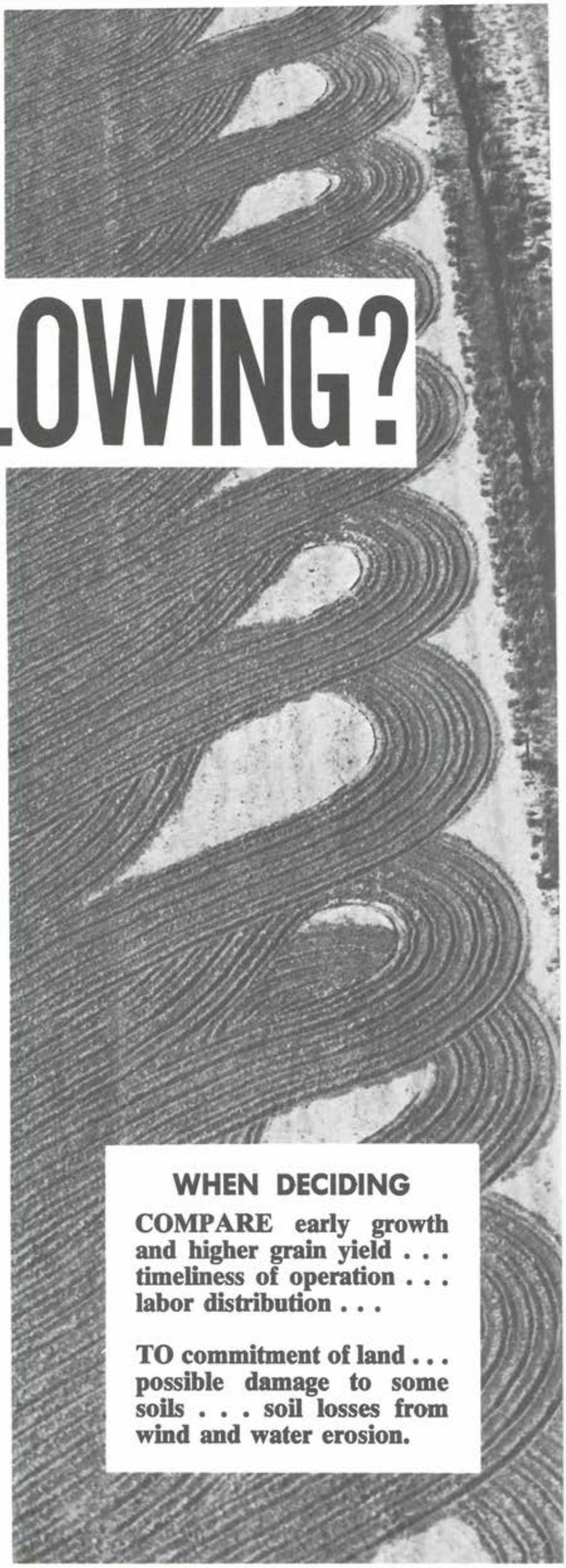
1 GRAIN YIELDS

There is little data comparing the effect of fall and spring plowing on corn yields.

Iowa research workers recently summarized a long-time experiment designed to learn the effect of fall versus spring plowing and the value of growing a sweet-clover catch crop in a corn-oats rotation. **FIGURE 1 shows corn grain yields from an 11-year average over a 22-year period on a Clarion loam soil.**

For the average of all years, fall plowing of both rotations showed important yield advantage over spring plowing. Fall plowing averaged 5.2 more bushels per acre than spring plowing.

SPRING PLOWING?



IOWA STATE UNIVERSITY

2 EARLY CORN PLANT GROWTH

ARS, USDA soil scientists with the North Central Soil Conservation Research Center at Morris, Minnesota, are currently testing corn plant growth and grain yields from fall and spring plowed land previously cropped to corn.

Figures 2 and 3 show results from this important work on Nicollet clay loam at Lamberton, Minnesota, conducted by R. R. Allmaras, SWC, ARS, USDA of Morris, and W. W. Nelson, University of Minnesota, of Lamberton.

FIGURE 2 shows more early corn growth from fall plow than from spring plow treatment. Why? Fall plowed soils generally warm up quicker in spring because their dark surfaces absorb more heat.

On unplowed soils, the crop residue provides a mulch that keeps the soils cooler. Specialists believe the surface residue reduces the net radiation at the soil surface during the main soil warming period—March through May.

FIGURE 3 shows some selected midday soil temperatures from this Minnesota experiment, indicating

WHEN DECIDING

COMPARE early growth and higher grain yield . . . timeliness of operation . . . labor distribution . . .

TO commitment of land . . . possible damage to some soils . . . soil losses from wind and water erosion.

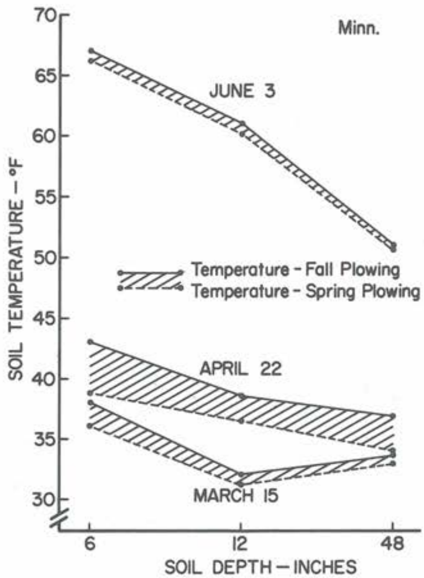


FIGURE 3—Fall plowed soil was warmer than spring plowed soil at all three dates on Nicollet clay loam at Lamberton, Minn.

that a warmer soil temperature can be expected from fall plowing than from spring plowing.

SOIL TEMPERATURE AFFECTS GROWTH RATE

These and other researchers are showing that **soil temperature does affect growth rate of young corn.** They are proving it through carefully controlled greenhouse experiments, field experiments in different soil and climatic regions of the United States, and the use of surface mulches at individual locations.

Table 1 summarizes the general effect of lower soil temperature on growth rate of corn. A small ratio of growth rate mulched to growth rate not mulched (less than 1.0) indicates a more favorable growth rate for the "no-mulch" system.

SOIL PHYSICAL CONDITION

It is easier to prepare a seedbed on many fall plowed soils than on spring plowed soils, due to beneficial freezing and thawing of soils that may have been compacted by fall harvesting and other field operations. But, too often this is compared to soils plowed and prepared through very untimely spring operations. To insure early planting and other necessary field operations, wet soils are often spring-plowed and worked, damaging the soil's physical condition and increasing compaction.

The modern grower cannot wisely separate the effects of timely and untimely operations from his comparison of fall and spring plowing.

But remember fall plowing can adversely affect some soils. If weather action disintegrates primary soil particles, producing crust and sealing the surface, water has a hard time going in. Increased runoff can lead to water ponds on level soils.

TIMELINESS OF OPERATIONS

Timeliness is vital to the modern grower. Early planting is producing higher yields in most of the corn belt. **FIGURE 4 shows what plant-**

TABLE 1. REDUCED SOIL TEMPERATURE FROM MULCH AFFECTS GROWTH RATE OF YOUNG CORN[1]

State	Ratio of growth rate mulched / growth rate—not mulched Range
Iowa	0.42–0.60
Minnesota	0.40–0.80
Ohio	0.80–0.96
South Carolina	0.96

[1] W. C. Moldenhauer and M. Amemiya, SWCRD, ARS, USDA, Ames, Iowa.

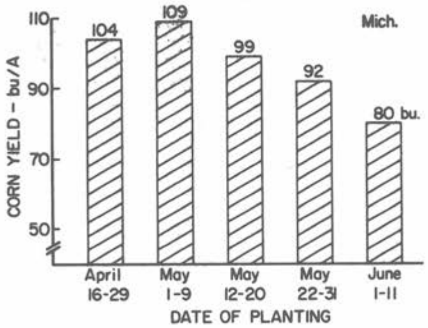


FIGURE 4—Average yields from 10 years of planting date experiments near East Lansing, Michigan. They planted 19,200 seeds per acre, using commercial seed of 6 to 8 hybrids, early to late in maturity.

ing date meant to Michigan corn yields over a 10-year period. Early May plantings consistently paid off.

Early planting enables silking and pollination to occur before the hot dry weather of late July-early August hit the crop. May 1 or before is a reasonable goal to shoot for in having land plowed for corn in the central corn belt.

Size of operation, other farm enterprises, available labor, and probability of favorable weather must be considered.

The probability of three consecutive dry days (less than 0.10 inches of rain) in central Iowa declines through April and is lowest from mid-May to mid-June—6½ times in 10. But this probability is higher in fall, October-November—8 times in 10.

So, fall weather favors field operations, while fall plowing provides a hedge against unfavorable spring weather which may delay field operations.

FERTILIZER APPLICATION

Fall fertilizer application for corn commits the land to corn for most efficient use of the fertilizer dollar. It can help (1) spread out the tremendous load rising fertilizer consumption puts on transportation and storage facilities, (2) insure full delivery and other services to the crop producer, (3) keep heavy equipment out of spring-soft fields, (4) plow down phosphorus and potassium fertilizer for longer availability and dry weather insurance.

Fall application of N should be considered according to the individual state recommendations. Fall plowing does allow for increased spring preplant application of N.

EROSION

Soil erosion—from wind and water—is the main hazard for fall plowing. In Iowa, spring winds of 55 miles per hour measured at 30 feet elevation (65-70 percent of this velocity at ground level) can occur once every two years. Due to 70-80 miles per hour winds, expected once every 50 years, wind erosion filled many roadside ditches with top soil in north central Iowa in the springs of 1964 and 1967.

Water erosion of soil can occur on sloping land. TABLE 2 shows predicted losses for two Iowa soils that are associated with level soils commonly fall plowed and, therefore, these two soils are also fall plowed. The predicted annual soil loss from fall or spring plowing these soils with 2 percent slope is larger than the allowable soil loss. Allowable soil loss means the loss that can be tolerated and still maintain a yield level.

Even if these soils are in row crop two-thirds of the time, annual erosion losses are greater than allowable soil loss. **With current crop production systems on these soils, erosion losses can be decreased by other alternatives: (1) less intensive cropping to row crops, (2) a no-plow tillage system.** The consequence of any alternative does not appear suitable to row crop producers at this time.

Plow methods depend on surface

TABLE 2. PREDICTED ANNUAL SOIL LOSSES FROM WATER EROSION FOR TWO IOWA SOILS WITH DIFFERENT TIMES OF PLOWING AND CROPPING SEQUENCES.[1]

	Annual Soil Loss, Tons/Acre			
	Nicollet		Muscatine	
Cropping System	Fall	Spring	Fall	Spring
Continuous Corn	8.4	8.2	9.9	8.8
Row-Row-Oats (sw-cl)	6.1	5.1	7.6	6.5
Annual Allowable Soil Loss	4		5	

[1] Universal soil loss equation used. All crop residue left on surface until plowed. Assumed 2% slope and 300 ft. slope length.

roughness and porosity for erosion control rather than on residue effect as in no-plow tillage. TABLE 3 shows how a plowed field has a maximum roughness and water storage capacity. Additional experimentation indicates plowed land allows more water infiltration initially though runoff rate for plowed and unplowed soil eventually becomes similar.

THE END

TABLE 3. RANDOM ROUGHNESS INDEX AND POROSITY MEASUREMENTS ON THREE CONDITIONS OF TILLAGE.[1]

		Total Porosity, inches		
			July 17	
Treatment	Random roughness June 8	June 8	Cult.	Uncult.
Untilled	0.34	3.20	3.23	3.30
Plowed	0.86	5.06	4.26	5.03
Plow-disk-harrow	0.44	4.39	3.66	4.04

[1] Conservation Res. Report No. 7, ARS, USDA.

WHAT ABOUT THE SOUTH?

—on heavy soils

Texas A&M University tests indicate applying fertilizer in the fall may be as good as waiting until spring.

In a recent test at A&M's Blackland Experiment Station, Temple, fertilizer was applied in October, November, December and January. Grain sorghum was planted in the spring. There was no yield difference attributed to month in which fertilizer was applied.

The moral, says Dr. C. D. Welch, extension soil chemist, is in many cases on heavy soils, fertilizer can be put down in the fall, slack season —with no loss of yield.

"But fall application of fertilizer to sandy soils is not a good idea," says Welch. "In sandy soil, one inch of water penetrates about one foot, so 8-10 inches of water may move nitrates below the root zone."

Many Texas farmers fall-plow their land. This makes fall fertilization a natural. As a rule, the ground is not as wet in the fall and reduces chance of compaction. Also, fall is a slow time and applying fertilizer then means the farmer can get right to planting in the spring.

There are some disadvantages of fall fertilization, says Welch. If a farmer, for some reason, cannot plant the crop in the spring, nitrogen put down in the fall cannot be recovered.

If low spots in the field hold water for several days when the temperature is high, most of the nitrogen that has had time to convert to nitrate form will be lost to the air as a result of denitrification.

Texas News

PLANNING BETTER FERTILITY

T. R. PECK
UNIVERSITY OF ILLINOIS

AGRONOMISTS work in many ways to manage the environment so crops will grow their best.

Soil fertility is the branch of Agronomy concerned with reactions of the essential plant nutrients in the soil and their relation to plant growth. Sixteen known elements influence plant growth. The farmer wants to know **(1) what nutrients to worry about, (2) whether the levels are adequate, (3) what amounts should be added? Diagnostic techniques have been developed to help him decide.**

The essential elements for plant growth are listed and classified here according to their proportion in the plant:

Plant Structural Elements: Carbon, Hydrogen, Oxygen

Major Nutrients: Nitrogen, Phosphorus, Potassium

Secondary Nutrients: Calcium, Magnesium, Sulfur

Micronutrients: Manganese, Iron, Boron, Zinc, Copper, Molybdenum and Chlorine

Crop growth and ultimate yield indicate a soil's fertility status. But so many factors can influence plant growth that fertility conclusions might be carefully reached unless growth conditions are well controlled.

For example, several "growth" problems may occur at the same time: weeds, insects, soil tilth, unfavorable weather, etc. Experimental field fertility plots are designed to minimize non-fertility factors on growth. Such experiments are expensive, unwieldy, and perhaps unnecessary to have in each "farmer's field."

So, agronomists are concerned with the development of **DIAGNOSTIC TECHNIQUES** and their calibration from experiment fields located on major soil areas. Calibration of adapted techniques allow the experiment field results to be carried to the farmer's fields.

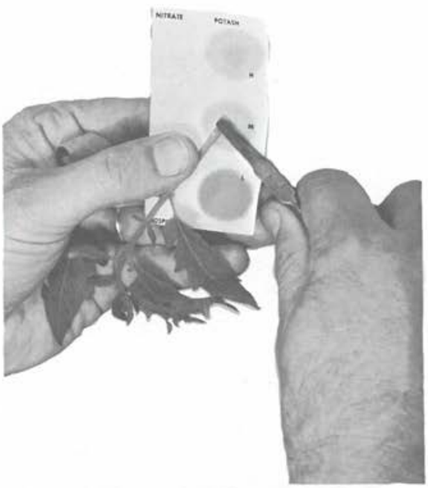
Each diagnostic technique has a specific role. A grower using these tools will find each technique compliments the other:

Soil tests—Characterization of the available level of plant nutrients in the soil.

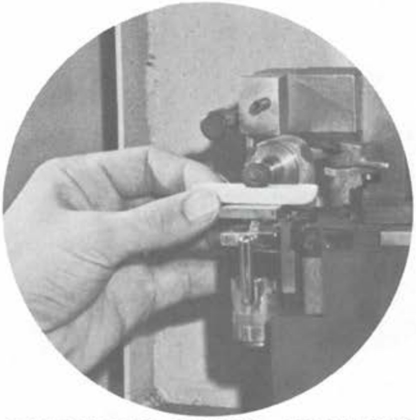
Visual symptoms—Field examination for abnormal growth.

Tissue tests—Plant sap analysis usually performed in the field on fresh plant material.

THROUGH SOIL TESTING



THROUGH TISSUE TESTING



THROUGH PLANT ANALYSIS

Plant analyses—Total mineral composition of plant material (commonly a specific plant part) usually performed in a laboratory.

Field experiments have indicated that the supply of three essential elements—carbon, hydrogen, oxygen—cause no economic concern at this time since they appear to be supplied adequately from the air and water. But the plant takes up the greater proportion of the other elements from the soil.

Field experiments have shown almost universal deficency of N, P, and K and the need for lime to correct acidity in soils.

Because of the nature and reactions of nitrogen in the soil, no successful soil test is generally used at this time. The symbiotic association of rhizobia bacteria with leguminous plant roots remove nitrogen as a limiting factor for these plants when they are properly inoculated. Amounts of nitrogen to apply to non-leguminous crops are best guided by recommendations from field experiments.

For the other elements—phosphorus, potassium and the measure of soil acidity—soil testing has been very successful. Except for isolated cases, calcium and magnesium are adequately supplied as plant nutrients through the liming program.

Inadequate soil levels of sulfur and micronutrients do occur, but field experiments have indicated these are not widespread general problems. And while soil tests for particular micronutrients have been developed, these have not been highly successful over a wide range of soil conditions.

With the coming of accurate, rapid and routine plant analysis, we can expect better information about the secondary and micronutrient status.

THE END

FALL

START THE BALL IN THE FALL

- Fertilize wheat at planting.
- Plow down NPK following corn and bean combining.
- Winterize alfalfa and other forages (topdress).
- Plow deeper.
- Store N in soils below 50°F.
- Treat problem spots.
- Make year-round plans.
- Check crop nutrient removals.

WINTER

DON'T BE TENDER, GO IN WINTER

- Broadcast NPK on snow or frozen level fields or up to 5% slope if there is good cover.
- Plow down NPK if conditions permit.
- Lime any time.
- Apply NPK to pastures.
- Topdress winter wheat with N.
- Attend meetings. Gather new ideas.

FALL-WINTER SPREADING ST

HERBERT L.
GARRARD A

INSURE NEEDED NUTRIENTS STORED IN FIRM FALL-WINTER SOILS

INSURE EARLY PL
THOSE EXT

SPRING

MAKE 'EM RING IN THE SPRING

* Soil sample fields missed last summer or fall.
* Plow down NPK.
* Plant corn and beans EARLY applying sideband and/or pop-up.
* Band seed alfalfa.
* Topdress alfalfa with high K fertilizer after cutting.
* Sidedress corn early, if pre-plant missed.

SUMMER

BE A COMER, USE THE SUMMER

* Study the crop and diagnose problems. Use tissue tests.
* Sample soils and plants for analysis.
* Prescribe and take corrective action.
* Topdress forages.
* Broadcast fertilizer as soon as small grain is off.
* Plow down corrective PK aheac of winter grain and legume seedings.

ARTS TIME $SAVING ACTION

GARRARD
G PHOTOS

ANTING TOWARD
RA YIELDS

INSURE DIAGNOSIS WHEN SOILS BEST TELL YOU THEIR NEEDS

IN MIDWEST

GROWERS SAVE A TRIP . . . USE FALL PLOW AS NITROGEN APPLICATOR

HOW TO DECIDE

✔ Insure preplant supply of N for narrow corn rows—ahead of bad spring weather.

✔ Reduce soil damage by running large applicators and tractors over firm fall soils instead of soggy spring soils.

✔ Gain "dry weather insurance" from some of fall applied N moving into subsoil to be more ready in hot summer than sidedressed N.

✔ Speed up residue decay with fall applied N.

✔ Prevent possible seedling injury from spring ammonia application following corn planting too closely.

NITROGEN

LEO M. WALSH
UNIVERSITY
OF
WISCONSIN

NARROW ROWS, earlier planting, and rising nitrogen rates force today's farmers to consider fall application. Top corn growers are asking many questions: **Can high yields be maintained if most of the N is fall applied? What is the efficiency of fall applied vs. spring applied N? Are leaching losses a problem on our silty and clayey soils? Are the different forms of N equally effective?**

The growers are asking—and they need answers TODAY.

MOVEMENT PRINCIPLES

What about N movement in the soil? Available N exists in two forms: (1) ammonium (NH_4^+) N which is not leachable, (2) nitrate (NO_3^-)N which moves in the soil.

LEACHING of nitrates is a problem on sandy soils. From November 1 to May 1 we can expect 8-10 inches of water to be stored in the soil or percolated downward. Since loamy sands and sandy loams will store only 1 to 1½ inches of water per foot of soil, fall, winter, and early spring precipitation could move some nitrates to 6 to 10 feet deep, beyond the reach of corn roots.

But silty and clayey soils will

TO PAGE 20

TIMETABLE IN NORTHEAST

JAMES H. EAKIN, JR.
PENNSYLVANIA STATE UNIVERSITY

WHY IS everyone so interested in fall-applied nitrogen? The answer revolves around labor problems.

The fertilizer manufacturer and dealer have many inventory problems during wet or late spring—so, it is in their best interests to satisfy customer needs as much as possible in fall.

How about the farmer? He is a desperate man today. Show him how to utilize his scarce labor more efficiently and you'll have a customer.

Now, let's add this thing up. The supplier wants to spread fertilizer in fall because of labor and storage problems, and the farmer wants him to do it in fall because it evens his labor load and allows him to farm on time in spring.

PUSH FALL P & K

If we're talking about P and K or liming materials, let's talk about fall applications being perfectly satisfactory under most normal soil situations.

If we're talking about nitrogen, let's center our advice around "early winter" applications. One must call his shots carefully to insure that his nitrogen investment returns dividends when the crop is ready for it.

TO PAGE 22

GROWERS SEE SPRING RESPONSE OF TALL GRASSES TO FALL N . . .

HOW TO DECIDE

- **Know traits of crop to be fertilized—changing crop plans (from corn to soybeans) may waste fall N.**
- **Check soil depth to parent material—at least 3 feet of potential rooting.**
- **Watch soil temperature at application time—50° F or lower.**
- **Be aware of long-time rainfall patterns—dry, frozen winter better than wet, "open" winter. Excessive rain may cause excessive leaching or denitrification.**
- **Know chemistry of fertilizer to be used—certain nitrogen forms preferred.**
- **Consider saving of time-labor to offset partial nitrogen loss.**

MIDWEST NITROGEN TIMETABLE—FROM PAGE 18

FROM PAGE 18

WALSH

store 2 to 2½ inches of water per foot of soil. The 8 to 10 inches of water which would move into the soil would not carry much of the nitrates below 4 feet. So, unless precipitation is far above normal and/or excessive amounts of N are applied, important amounts of nitrates will not likely move below the root zone on medium and heavy textured soils.

NITRIFICATION—the process by which soil bacteria change the nonleachable ammonium N (NH_4-N) into leachable nitrate N (NO_3-N)—occurs rapidly in warm soils, but slows down greatly as soil temperatures drop. The change occurs very slowly when the soil temperature is below 50° F.

So, delay fall application of NH_4-N until soil temperature is below 50° F at application level. Keeping N in the NH_4 form (ammonium) will markedly lower the chance of N leaching, even when precipitation is above normal.

If fall-applied N remains in ammonium form until spring, fall and spring preplant applications of N should be equally effective.

DENITRIFICATION—a microbial process by which available NO_3-N (nitrate) is converted to atmospheric N that corn plants cannot use—occurs when the soil is water-logged in warm temperature.

Poorly drained soils and soils subject to spring flooding therefore, *should not* be fertilized with N in the fall.

LOOK AT RESEARCH RESULTS

To help answer some questions, a Midwest study set up 28 replicated field trials on well-drained, medium and heavy textured soils in several Corn Belt states.

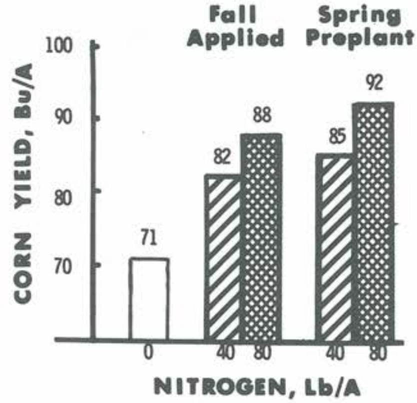


FIGURE 1 shows the response of corn to 40 and 80 lbs/A of N. The N rates were intentionally lower than those required for top corn yields. With low rates, any differences between application time would more likely show up in yield data.

Data in Figure 1 are averages of the NH_4 and NO_3 forms of N. N response was obtained and spring preplant treatment yielded 3 to 4 bu/A higher than the fall treatment. Of course, most of this difference was due to the poorer performance of fall applied NO_3-N. Also, remember that top-yield rates were not used!

FORM OF N. Nearly all commercially available N fertilizer is composed of only NH_4-N, or a mixture of NH_4-N and NO_3-N. Table 1 shows the composition of commonly used N fertilizers.

In the regional research study, an NH_4 form (ammonium sulfate) of N was compared with an NO_3 form (calcium nitrate). **FIGURE 2 shows how fall applied NO_3 yielded 7 bu/A less than spring applied NO_3, while fall applied NH_4 yielded only 2 bu/A less than spring applied NH_4.** Obviously, the NH_4 form of N averaged more efficient return than the NO_3 form when fall applied. No difference was noted between NH_4 and NO_3 when the N was spring applied.

Since the study was conducted throughout the Midwest, location might have affected results. Soil temperatures and winter precipitation are higher in the southern and eastern Corn Belt than around the Lake States.

Ohio and Missouri data were compared with Minnesota, Wisconsin, and Michigan results. **FIGURE 3 shows that NO_3-N was** *as effective* **as NH_4-N when fall applied in the Lake States. But in Ohio and Missouri, NO_3-N was much less effective than NH_4-N when fall applied, and only slightly better than the check treatment. In these states fall and spring applications of NH_4-N were very nearly** *equally effective.*

With normal or below normal precipitation, either form of N can be fall applied in northern Corn Belt states without substantial loss. But in central and southern Corn Belt states only NH_4 form of N should be fall applied—and after the soil temperature is below 50° F.

PREPLANT VS SIDEDRESS. What about sidedress applications? How do they compare to preplant applications? Wisconsin trials, conducted from 1958-1962, showed sidedress slightly more effective (3-7 bu/A) than fall or spring preplant application, as shown in Figure 4.

But, remember N rates used in this study were quite low—40 and 80 lbs/A of N. If higher N rates had been applied (as usually done in the Midwest), there probably would have been no significant yield difference between preplant and sidedress applications.

As corn rows narrow, and as we go to earlier planting dates, application of much of the supplemental N in the fall becomes a virtual "must" for today's top corn growers.

THE END

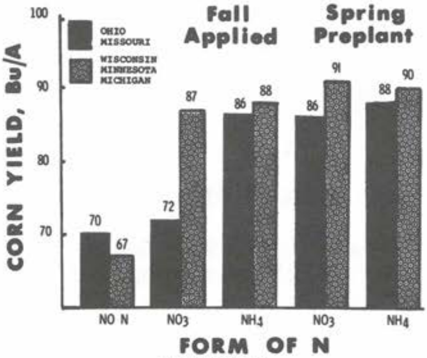


FIGURE 3

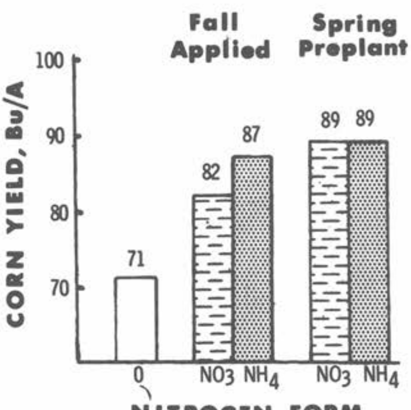


FIGURE 2

TABLE 1. Content of ammonium nitrogen (NH_4-N) and nitrate nitrogen (NO_3-N) in nitrogen fertilizers.

Fertilizer	Analysis	% of N as NH_4	% of N as NO_3
Dry materials:			
ammonium sulfate	21-0-0	100	0
ammonium nitrate	33-0-0	50	50
urea [1]	45-0-0	100	0
High pressure solution:			
anhydrous ammonia	82-0-0	100	0
Low pressure solution:			
aqua ammonium [2]	20-0-0	100	0
N 41	41-0-0	75	25
N 37	37-0-0	70	30
Pressureless solution:			
N 32	32-0-0	75	25
N 28	28-0-0	75	25

[1] Urea is an organic N molecule which quickly changes to the NH_4 form of N.

[2] The analysis listed for this material will vary somewhat.

NORTHEAST NITROGEN TIMETABLE—FROM PAGE 19

EAKIN

WHAT ABOUT RESEARCH DATA?

Garner and Sanders launched excellent work comparing fall and spring nitrogen on wheat in Illinois during the 1930's, while Merkle did equally fine work at Penn State in the 1940's. This work has continued at both these universities, and many others, until today.

What about results? For wheat, spring dressings are generally better than fall dressings, with some exceptions, of course. Iowa's Nelson and Meldrum concluded the same thing Penn State's Merkle did: that "20 lbs. N applied to wheat in spring produced as large yields as 40 lbs. applied in fall."

But we must remember one thing: today's high capitalization demand yields unheard of just a few years ago. The Northeast should be always open to new research of fall vs. spring nitrogen on high-yield crops at modern fertility rates.

WHAT ABOUT RAINFALL?

In humid areas, at least, the rainfall factor might dictate whether fall dressings are as good or almost as good as spring dressings. Wet and "open" winters often limit results of fall dressings. When winter is dry or the ground tightly frozen most of the time, fall dressing will usually look good.

Winter wheat absorbs most of its nitrogen between first spring growth and the heading stage. Some day long range weather forecasts may tell a farmer more accurately what to expect—an "open" winter of leaching water moving much of the N below root zone, or a "tight" winter holding the N in the root neighborhood for early boosting in spring.

FALL VS. EARLY WINTER

If the soil stays refrigerated (below 50°F), nitrification proceeds very slowly. Nitrification is the process by which bacterial action converts positively charged ammonium ions to negatively charged nitrate ions. As long as the nitrogen remains in ammonium form, the negatively charged soil particles hold it tenaciously. Chances of retaining the nitrogen until the crop can use it increase greatly from fall to winter under normal humid weather conditions.

LOOK AT TALL GRASS

Although the following results were gathered during severe drouth years, they are very interesting because ammonium nitrate (50% nitrate nitrogen) was applied from September to April and compared with all ammoniacal nitrogen.

The tall grass was timothy receiving 0-75-150 plus 100 pounds of nitrogen from fall to spring. The yields are for 2 cuttings. The average yield for 0-75-150 was 1.40 tons absolute dry matter per acre. The yields for a split application of nitrogen 100/50 ranged from 3.0 tons dry matter per acre to 3.50 tons per acre.

Data by Dr. L. F. Marriott, Penn State University, show these results:

THREE-YEAR AVERAGE

	Date Applied	* Yield DM/Acre	% Nitrogen Recovery (apparent)
AMMONIUM NITRATE	9/15	2.45	44
	10/15	2.49	46
	11/15	2.36	36
	1/15	2.50	39
	2/15	2.65	48
	3/15	2.55	54
AMMONIUM SULFATE	10/15	2.50	43
	2/15	2.78	60
UREA	10/15	2.34	40
	2/15	2.46	39

* No significance.

In the drouth years of 1963, '64 and '65, it made no difference whether the nitrogen was applied in September or in mid-March—nor whether the nitrogen source was ammonium nitrate, ammonium sulfate, or urea. The apparent nitrogen recovery proceeded as expected, with a trend upward as time elapsed.

Cool season perennial grasses take up nitrogen remarkably well during late fall just before growth stops, showing deep green leaf color and increased growth. Even if some nitrogen does leach, a large portion has already been absorbed by a thick sod with root system almost filling the plow layer.

This is not as true for winter wheat with a root system that is weak by comparison.

THE CORN RIDDLE

The Midwest has recently been more favorable to applying nitrogen on corn land after soil temperatures have dropped—a system not yet favored in the Northeast and the South.

In the deep South, with large areas of coarse textured soils and relatively high winter temperatures, agronomists discourage the practice.

In the Northeast, with cold winters, the practice looks more promising, except for shallow soils. Much northeastern corn is grown on soils less than three feet deep to parent material. Iowa corn roots can sometimes feed five feet deep. This is impossible on most northeastern soils.

If nitrogen applied on shallow soils moves much more than two feet, most of it is gone. **But by selecting deep soils, winter nitrogen applications may well compete with spring fertilization.**

THE END

COME ON—BE HONEST WITH YOURSELF

✔ Check Where You Stand

—Some People Make Things Happen

—Some People Watch 'Em Happen

—Some Don't Know What's Happening

See Pages 25-29

PUT THE FACTS TO WORK

A BETTER CROPS BARBECUE OF HOT TRENDS

Fertilizer is Money

GET IT ON WHILE THE GETTIN'S GOOD

TODAY'S COMMERCIAL TYPE farming demands more fertilizer than a grower can apply at planting or by sidedress. Many scientists and top growers call fall-winter fertilization the answer:

PHOSPHORUS (P) and POTASSIUM (K) can be plowed down in fall on all but the most sandy soils . . . spread on frozen or snow-covered level land to await spring plowdown . . . applied to frozen or snow-covered slopes up to 5% with corn stalks, stubble, or sod cover.

• Both nutrients (P & K) cling to soil particles like magnets . . . stay about where they are put unless moved physically by plowing or disking.

• **On a silt loam soil, potassium loss averaged only 2 lbs. per acre yearly under 40 inches annual rain during a long testing period.**

• Even on a loamy sand, 460 lbs. of potash applied annually for 9 years moved very little below plow depth, with 30 inches annual rainfall plus 10 inches irrigation.

• **Heavy phosphorus applications increased P soil tests from 8 to 170 lbs. per acre in some Midwest tests.**

NITROGEN can be plowed down with corn stalks or stubble on dark colored fairly level soils . . . applied to frozen or snow-covered level fields and slopes up to 5% with heavy stalk, stubble, or sod cover . . . but never to sandy soils in fall.

• **Fall N decays crop residues which hold part of it in bacteria bodies ready to give corn an early spring start.**

• Fall N should be applied after soil temperature tests 50°F or cooler, when nitrifying bacteria virtually stops working. Check by burying a soil thermometer 4 inches for an hour.

• Most of the small amounts that may leach will remain in the sub-soil to give moisture-seeking roots a bonus in dry summer.

Time is Money

SAVE ENOUGH FOR FAST SPRING ACTION

NEXT SPRING a good grower's time will be worth $50 or more per hour, far removed from the 2-row-6-weeks-to-plant-and-fertilize days. Will he NET it or WASTE it on more chores than he can handle?

• **Spring delays can eat time: not enough vehicles to deliver sudden fertilizer demands, not enough of the analyses he needs, not enough labor for peak days, not enough days to take all steps. Let the weather make the field too soggy for him to get the spreader on and another year-round fertilizer planner is born.**

• Fall-winter fertilization not only spreads out the manufacturer's transportation load, but also gives more time for quality curing.

• **Early planting pays extra bushels—sometimes 10 to 20 bushels MORE PER ACRE over his whole acreage. Each day a Corn Belt farmer delays planting after the first week in May often costs him one to two bushels a day. No wonder the good grower will fertilize next year's crop this fall to be ready for a fast start.**

• A good farmer doesn't wait until this year's crops are harvested, stored, or sold before preparing for next year's crop. He schedules a good dealer to follow his corn, soybean, or small grain harvest with immediate fertilizer applications—sometimes timing himself to have harvester, spreader, and plowdown action going at same time. It can be done.

• **The alert grower realizes the nitrogen member of his NPK fertilizer team may be used a little more efficiently from spring and sidedress applications—but wet spring soils, heavy rains after planting, or narrow rows may prevent application before planting or sidedress after planting. He stores NPK in fall soil as an insurance policy.**

• Fall weather is more predictable than spring, the soils usually dry and firm. Even if it's a little wet, the farmer has time to wait for decent weather. For example, Illinois harvests 84% of its soybeans by October 20, 79% of its corn by November 10, leaving many days to fertilize and plowdown before snow gets deep. The spring rush does not give such time.

Plowing is Money

DO IT RIGHT FOR GOOD SOIL CONDITION

GOOD PLOWING is to soil what good exercise is to human health. By fall plowing, a good grower may boost corn yields 5 to 10 percent, help control insects, and reduce deadly compaction.

• Spring pressures can make even the best grower do desperate things: rush a heavy spreader into a wet field, plow too wet toward early planting for best yields. After he frees the spreader and disks out the tracks, he can forget top yields. "Pressed ham" soils don't have the physique for "best yields." Compaction cut corn yields 8 percent in one Midwest study!

• The good grower plows deep in fall, depending on winter freezing and thawing to improve soil breathing and drinking capacity.

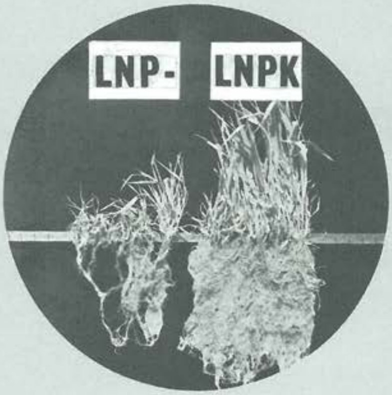
• He usually favors plowdown over disked-in fertilizer. Radioactive nitrogen tests showed 11 weeks old corn feeding only where moisture was. Plants need moisture to take in nutrients. Plowdown phosphorus boosted corn yields 10 bushels over disked P, while plowdown potassium raised them 9 bushels per acre.

• A good grower may gradually plow to 11 inches rather than 7 inches over four or five years, giving his crop an extra week's feeding in dry summer and a cushion between rains.

• Fall plowing sets up early planting with field cultivator on planter or a till planter. It insures warmer soil quicker. Frost can leave a dark, sun-absorbing plowed soil 10 days ahead of an unplowed field insulated by light-colored crop residues.

• The fall plower can expect less insect problems next spring. Plowed fields expose larvae to wind, snow, and ice, reducing survivors. Fall plowed fields showed 45% less western and northern corn rootworm larvae than spring plowed soils in Midwest tests.

• He will not fall plow soils subject to bad winter winds and water. In some situations, he may plow at right angles to the winds and leave stubble strips to protect the soil.



Antifreeze is Money

FERTILIZE TO WINTERIZE PERENNIAL CROPS

THE TOP GROWER now asks his alfalfa to produce 6 to 10 tons and his wheat to give him 60 to 100 bushels per acre.

To do this, all perennial forages and winter annuals must be fit for winter. The unfit rarely survives winterkill. What is winterkill?

1—It is heaving. Freezing-and-thawing soils literally heave plants from the earth, breaking and exposing roots.
2—It is smothering. Plants can't breathe, actually smother from ice sheets formed over the soil with little snow cover. A fast-breathing plant will choke on the toxic products of its own respiration or breath when those products can't get out.
3—It is drought. Plants can't get enough to drink from a frozen soil that is like a dry soil.
4—It is rupture. Plant cells rupture as the plant freezes, its cells lose water, and ice crystals form to rupture cell walls.

• The good grower winterizes his crop with fall fertilizer, because fertility lowers freezing point of cell sap, insures stronger roots, and reduces respiration and water loss.

• In a severe Midwest winter, 90% of poorly fertilized alfalfa died compared to only 20% of the well fertilized crop. And well fertilized and limed wheat produced a deeper, stronger, denser root system that increased spring yields 30 BUSHELS PER ACRE.

• On Canadian peach trees struggling through −8° F periods, 60% more fruit buds survived at high potassium levels than at low potassium.

• Top alfalfa growers, cutting early and often for 6 to 10-ton yields, demanding more potassium to replace the higher amounts removed by younger cuttings.

• A 3-year study of alfalfa-orchardgrass showed more frequent cuttings of younger plants removed some 1,100 lbs. of potassium, about twice that applied in fertilizer. To survive winter and maintain high yields, frequently cut alfalfa might well contain 3 to 4% potassium rather than the traditional 2%, some specialists suggest.

Know-how is Money

USE IT TO SHOOT FOR TOP-PROFIT YIELDS

IF HE'S NOT already getting them, today's top grower is shooting like mad for yields that would have sounded like madman talk to Granddad: 200 bushels of corn, 75 bushels of soybeans, 10 tons of alfalfa—PER ACRE, by cracky!

• He does not always know what fertility is needed for his fantastic yields. He has no high-yield calibration facts to tell him yes or no. He adds what he thinks will remove low fertility—and gets over 200 bushels of corn per acre!

• What "expert" will tell him he's using too much of any one nutrient —nitrogen, phoshorus, potassium?

• In shooting for 200 bushels of corn, sometimes he could have used more nitrogen and potassium than he did. Uptake by the crop and inefficiency of uptake from the soil suggests why:

A total 200 bushel corn crop may contain about 300 lbs. N, 100 lbs. P_2O_5, 300 lbs. K_2O.
A total 10-ton alfalfa crop may contain 150 lbs. P_2O_5 and 500 lbs. or more K_2O.
A total 75-bushel soybean crop may contain 75 lbs. P_2O_5 and 150 lbs. K_2O.

• To insure such crop contents, the top grower realizes soil tests should run medium to high in phosphorus and potassium—YET, he often adds far more than tests indicate to get amazing results!

• He is an agricultural Paul Revere about to spark a revolution in fertilizer use by less spoon feeding at planting and heavier bulk feeding in fall-winter to enrich the thicker plow layer caused by deeper plowing.

• Iowa State advises growers shooting for 200 bushel corn to ADD the following to what they already do for 100-125 bushels:

An EXTRA 9,000 plants.
An EXTRA 210 lbs. N.
An EXTRA 125 lbs. P_2O_5
An EXTRA 150 lbs. K_2O

THE END

STILL TIME

UP
UP
UP

Start Fall-Winter Fertilizer Action

HERE'S SOME FUEL

PROMOTION
SHOWN 1/3 SIZE

PIX 1

PIX 3

PIX 5

PIX 7

PICTURES
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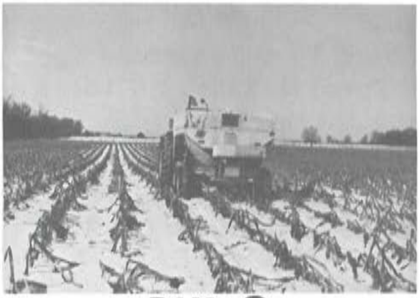
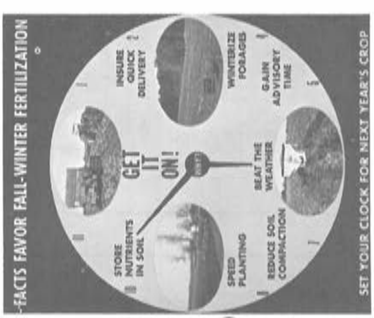


PIX 2

PIX 4

PIX 6



PIX 8

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