Better Crops

WITH PLANT FOOD

September-October, 1959

20 Cents

YEAR	pH	P_2O_5	K_2O	O.M%	YEAR	FERTILIZER USED		
						N	P_2O_5	K_2O
1959	6.2	VH	H	1.6	1958	0	50	150
					1957	0	50	150
1957	6.4	H	M	1.5	1956	0	100	100
					1955	0	100	100
					1954	15	145	240
1954	5.0	M	L	1.2				

WHICH SET OF RECORDS ON THIS FIELD WOULD HELP <u>YOU</u> MOST?

YEAR	pH	P_2O_5	K_2O	O.M%	YEAR	FERTILIZER USED		
						N	P_2O_5	K_2O
1959	6.2	VH	H	1.6	1958	0	50	150
					1957	0	50	150
1957	NO RECORD OF SOIL TEST RESULTS				1956	NO RECORD		
					1955			
					1954			
1954	NO RECORD OF SOIL TEST RESULTS							

HOW SOIL FERTILITY RECORDS HELP THE FARMER KNOW WHY—AS WELL AS HOW!

See Page 4

HOW SOIL TESTING GREW FROM A FEW FARMS INTO A COUNTY-WIDE CAMPAIGN!

See Page 8

Better Crops WITH PLANT FOOD

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CONTENTS

ON THE COVER

. . . It is obvious which record would be more useful to the farmer—the top one which gives him a complete picture of soil test results and the fertilizer he used over a 5-year period.

In their revealing article, starting on page 4, W. C. White and G. D. McCart of N. C. State College report how soil fertility records can help the farmer know *why* as well as *how*—why his soybeans are yellow in certain spots, why the alfalfa stand in field 15 lasted 2 years longer than the stand in field 14.

Such records can help the farmer improve his decision-making abilities as profit margins narrow and competition sharpens.

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Pigs and pies and prizes

GOING TO THE FAIR

IF IT's fair, be fair and take your fair one to the fair! This may baffle the foreign students of our language when they see these identical words of different meanings.

But we who have attended and reported country fairs for about 40 years see in most of them much bucolic benefit. So, it really pays the farm swain to take his girl along when the weather is nice and exhibits are pleasing.

Existing long before the Agricultural Extension Service and cooperating with it today—our gaudy, noisy fairs have helped in the culture of better crops, fruits, and livestock. They have appealed to exhibitors, if for no other reason than to give blue ribbon winners a chance to show off and strut about, hoping for congratulations and a secure name among local leaders.

The native ability of farm folks to take economic punishment and crop losses and still come up serenely at fall festivals, harvest homes, husking bees, conservation days, and county fairs has been one of the chief sources of their great strength of character and staying power. Hearty relaxation has been a mark of rural community life.

This recurring spirit of zestful fun and competition is an antidote against taking life too seriously and developing ulcers. Perhaps that is one reason farmers seem to nurse fewer ulcers than urbanites.

The fair forgets dry digits and indices. It banishes curves of production, price, and income and replaces them with the more vibrant, amusing, and courage-building human experiences.

So—once again the fair gates open wide and we cluster in to see the same old fake stunts and gay deceivers that so often intrigued us in those days of freckles, short pants, straw hats, and small change for spending unwisely. We ask ourselves *why not?* The cold shut-in season is just ahead, and there will be lots of time to study, worry, and plan beside our winter fires.

Just why an old fair fan of my ilk remains favorably inclined toward these small fairs may seen inexplicable. But having long survived Swedish waffles at St. Paul, much brau foam at Milwaukee, and baked beans at Springfield, Massachusetts, and escaped hot-dog barkers everywhere on the tan-bark circuit, I have come through with more tolerance and zest for fairs than might be expected from a hardened veteran.

For us youngsters, the advent of the county fair kept us in a state of anticipation. The way we watched the promising melons and groomed the shotes and bullocks was itself a *summer epic* and a *rural elegy*. We lived 20 miles from the fair grounds, and this meant starting at five o'clock to arrive there before noon. As we drove along the road, cardboard signs on oaks and elms or painted on lichen-covered boulders kept beckoning us onward to this paradise of pleasure.

The last notch in our belt of anticipation was reached when we got to the arched wooden gate. Here we remained in line until Jobe Harris and his assistants checked through the season tickets and finally okayed our passage into that haven, where varied sounds already came to us over the plank fences in a crescendo of magnificent jubilee. The brass band, the hurdy-gurdy, and the naughty hip wiggling hootchie-kootchie enthralled us kids, as we led the stock past the raw performances to the prosaic places where more familiar livestock sounds added to the din.

At an early age, I came to admire the cattle judges who often came from the state college at a modest stipend. Since then, I have followed their antics through manure droppings all over the fall circuit. I have always yearned secretly to be a judge and wear an official badge and be escorted around in conspicuous places.

Evidence of extreme deliberation in making awards is a compliment to the owners of exhibit kine. *One who snaps his fingers and picks winners too swiftly deprives the fans of half their fun.*

Standing off and squinting, smoothing flanks and ribs, hesitating and returning to verify, scratching the head, folding arms and frowning, shifting the leaders, re-shifting the tail-enders, "giving the gate to slope rumpers", and then the final eloquent arm-swinging gesture of decision—I had them all mastered. I found out that judging at fairs is either an act of heroism, an evidence of super-discernment, or just a guessing bluff.

Barring the scarey aerial rides and bumping contrivances, the blatant entertainers have changed but little over the years. The simple mountebanks and charming charlatans with their flamboyant tent shows, oriental dancers and fairies-in-the-well, cane stands, corn games, and swatting racks still pitch their restless tents as usual on the autumn fields of rural glee.

Time out of mind have we all heard those high and mighty resolves to run fairs strictly on *crop demonstrations, skull-blasting items of erudition,* and *unbiased offerings of technical truth.* No era has escaped this criticism of fairs and proposals to take away all public support from them unless they limited their programs to *educational features.*

Yet, no heavy farm repast is ever complete without dessert. Nearly every farm table, as you recall, serves both pie and cake and often pudding too, to give you pleasure with your protein. My idea is to let the customers relax awhile on the midway, with time out from our laboratory lessons and pageants of progress stuff. It sort of salts down the silage and gives tired minds a rest.

The major fall time fairs belong to the tall-grass regions, central meeting places of the rural trading territory, the simon-pure survival of the original European kind. Having been raised in the squash circuit myself, I lean to these annual country shows.

I find advantage in the cheaper gate and more old chums to meet back there behind the horse and cattle barns where the new machinery flashes its brilliant sheen of new steel and bright paint before a sympathetic audience of discriminating users.

It's a great spot to dream in a gossipy way about great changes in the old countryside of my youth, the incompetency of sheriffs, the tendency of taxes to go upward and never disappear downward—and also the mischief in quack grass, brucellosis, oak wilt, high prices, troublesome salesmen, suburban encroachment, and bad side-roads.

Critics in my state argue that we have far too many fairs, duplicating each other and taking mazuma away from folks who should use it for fuel and taxes. Too much gadding about is bad for tires and tempers, they say. Let's have just one or two good fairs and sic the television onto them is their plea. They claim our small country fairs belong to the horse-drawn days and deserve to be regulated into better behavior or relegated to oblivion.

But, unfortunately, efficiency and a rousing good time with old neighbors seldom move in the same orbit—so we still have our numerous fairs on our hands. *The best way to realize how good they really are is to picture our land without any.*

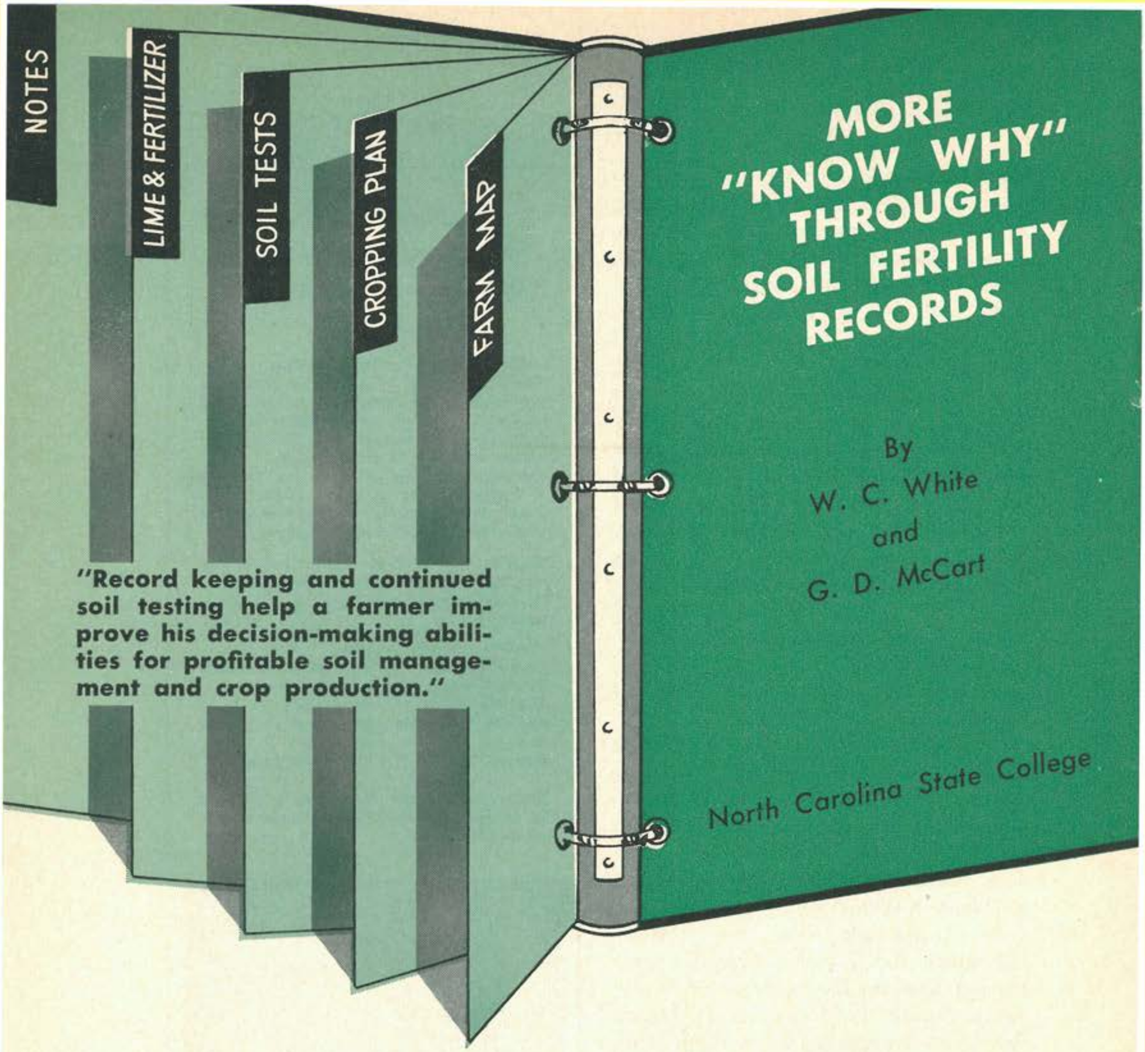
So I am sure that no artificial substitute for a jovial, happy, comforting time on the midway or in the horticultural hall or cattle arena would be acceptable to us chaps from the silo sections. No thanks, we want our fairs to be served up to us in the same old jolly way. Like all humanity, they also have their sins and silly streaks. Yet, we'll take them that-a-way rather than turn them into ponderous programs of important progress.

In most cases, the 4-H clubbers and their leaders have already saved our fairs from disaster. Unless critics can do as well as they have to keep the best fairs running, there's nothing to be gained by wrecking them.

THE END

DO YOU READ THESE JEFF ESSAYS? LET US KNOW BY CARD.

sm-editor



THERE are two principal ways to measure the effects of fertilizer and lime on soil. One is through *crop yield response.* The other is through soil tests to indicate *soil fertility levels.*

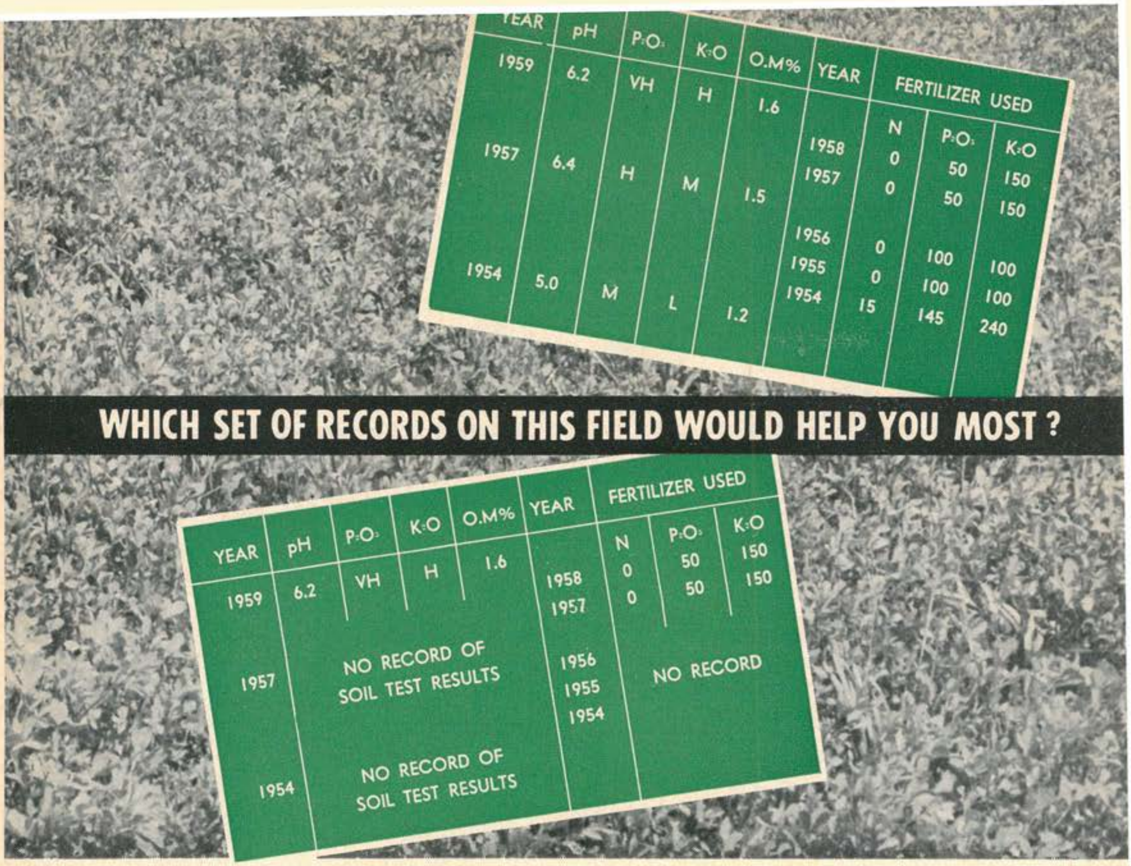
In recent years most farmers have credited fertilization and liming practices with much of their increased crop yields.

But it is difficult for farmers to identify clearly the "cause and effect" relationships of fertilizer and lime use with their crop yield response. The reason is clear. Crop yields are influenced by many other production factors—*rainfall, stand, crop variety, etc.*—which often obscure the actual effects of fertilization and liming practices.

A recent North Carolina study by Baird and Fitts showed how important these factors can be. Variations in soil fertility conditions along with a "climatic" index accounted for about 75 to 85 per cent of the corn yield variations on a number of Norfolk and Portsmouth soils.

A farmer who really wants to evaluate effects of his fertilization and liming practices should look closer than crop yield response. *He should consider effects on soil fertility levels.*

Crops fail to respond to fertilization in many seasons because of drouth, poor stand, and other reasons inde-



pendent of the fertilization practices. Yet, fertilization can have distinct effects on soil. Sometimes they are called "residual" effects—that is, carry-over value from one crop and season to another.

With the exception of nitrogen, soils get more of the applied nutrients than the crop to which they are applied.

For example, the "first" crop seldom recovers more than 15 to 20% of the applied phosphorus and 30 to 40% of the potassium. The recovery is even much smaller for calcium and magnesium added through lime.

The residual effects of nitrogen may be important under two conditions—(1) low utilization of it by the crop to which it was applied, (2) little loss from leaching between crops.

Thus, soil fertility levels, like crop yield increases, are important effects of fertilization and liming. Such soil fertility levels are indicated by the degree of acidity (pH), and quantities of available phosphorus, potassium, calcium, and magnesium.

PURPOSES FOR SOIL TESTING

North Carolina and many other states now have educational programs to teach farmers the benefits of soil testing. Too often farmers test their soils only to get a fertilizer recommendation. Interest in soil testing in many cases is limited simply to determining what rate of a particular grade will fulfill the recommendation.

This interest alone can be worthwhile, since it increases a farmer's "know how" about producing higher yields. *But, interest in recommendations alone sells soil testing short.* In addition to providing fertilizer and

Dr. W. C. White is Soil Fertility Extension Specialist at N. C. State College. A Virginia native, he earned his B.S. at VPI, his M.S. and Ph.D. at Iowa State University. He served as Extension Agronomist in Virginia before doing further graduate work and joining N. C. State.

lime recommendations, soil testing can do these important jobs for the farmer:

1. Show the soil fertility status of a particular field or area.

2. Help in diagnosing special fertility problems, such as very low levels of one or more nutrients.

3. Show long-range effects of fertilization and liming practices where soil test results are available for several years.

Unless a farmer increases his knowledge about his soils through such information he fails to realize the most important benefits of soil testing. If he looks only for the recommendation on a soil test report, he will not increase his "know why" knowledge.

"Know how" has made many American farmers prosperous. But in the future, "know why" is going to be much more important where margins of profit will be smaller and competition closer.

"Why are my soybeans yellow in certain spots?" "Why did the alfalfa stand in field #15 last two years longer than the stand in field #14?" "Why does field #4 have a pH of 6.2 and a high potassium level now while three years ago the pH was 5.0 and the potassium level was medium?"

Only when soil testing is used to answer questions like these—rather than "What fertilizer should I use?"—will it mature into one of the most valuable aids farmers have in understanding their soils and using them efficiently.

RECORDS—A KEY TO SUCCESS

A recent Mississippi survey revealed five practices that distinguished the more successful farmers from others. Two of the practices were *soil testing* and *records.* In view of this and the discussion above, we believe more emphasis should be put on *records of soil tests, and fertilizer and lime used.*

Soil test records over several years for a given field can indicate trends. They show effects of fertilization and liming practices on soils. They show how a soil has changed under certain management. These are the principal advantages of soil test records for several years. A single soil test cannot give you such a picture or show such a trend.

A PROGRAM ON SOIL FERTILITY RECORDS

A number of North Carolina counties have conducted programs in 1958 and 1959 which influenced many farmers to use soil testing. The principal objective was to teach farmers the value of soil testing as a guide in fertilizing and liming their soils. Many farmers who participated took soil samples for the first time.

The real educational value of these programs depends on how much farmers learn about their soils and fertilization and liming practices. Much of this depends on a *follow-up program* to encourage *record keeping* and *continued soil testing* in subsequent years.

This follow-up program in Hoke County—the first North Carolina county to conduct a special soil testing program—is centered around 60 farmers in the Farm and Home Development Program. County Agricultural Agent, W. C. Williford, and his Assistant, Frank Williams, decided this would be a good group to start with in setting up and keeping soil fertility records.

Farm Maps

One of the first steps taken with this group after the county-wide soil testing program was to get each farmer to sample *every* field on his farm. This required drawing farm maps and numbering fields. *Soil classification maps provided by the Soil Conservation Service were helpful.* Most of the farms have 10 to 20 fields.

The program leaders realized that keeping records on this many fields would be a problem for each farmer. Consequently, a *Soil Test and Fertilizer Record Book* (Figure 1) was provided to each farmer, through the financial help of Southern Nitrogen Company, represented by Dr. Irvin M. Wofford. It provides space for records for five years.

This loose leaf record book (Figure 2) has sections for five items: *farm map, cropping plan, soil test reports, lime and fertilizer used,* and *notes.* Each of these sections is organized so records can be maintained on individual fields. The number of pages in each section can be adjusted for the number of fields in a farm.

Cropping Plan

In the "cropping plan" section, the farmer has space to record his average yields per acre, as well as his crops by fields in each year. To keep his records straight, the farmer must clearly identify fields on the farm map by *number or by name* and use that system of identification throughout the book.

G. D. McCart is Agronomist with the Soil Testing Division of the N. C. Department of Agriculture. An Iowa native, he earned his B.S. and M.S. at Iowa State University. He has been associated with the Soil Testing Division in Raleigh since 1954.

Soil Test Reports

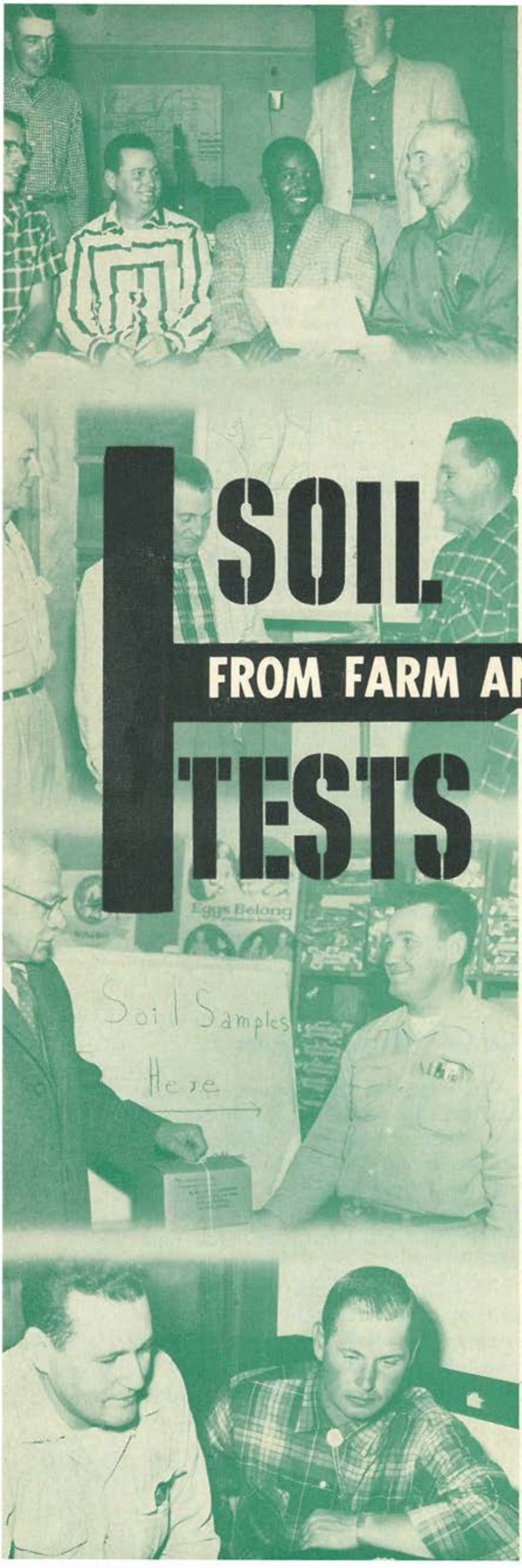
Soil test report sheets can be added to the book since it has a loose leaf binder. Record sheets are provided, however, to record results of soil test reports in an organized and condensed form. From these sheets a farmer can easily determine when a field was sampled and what its soil fertility history is. This record will clearly show the changes in soil fertility conditions over time in a given field.

Lime and Fertilizer Usage

To complete the picture, there is a section for recording the amount of fertilizer and lime used by fields. This section, along with the soil test report section, should be one of the farmer's best means of relating soil fertility conditions with fertilizer and lime used.

This kind of information, and a record of crop yields by fields for a period of years, can help a farmer improve his decision-making abilities regarding the most profitable management of his soils for crop production.

THE END



SOIL TESTS FROM FARM AND HOME DEVELOPMENT

By C. D. Spies and Purdue

FOR Clay Cundiff, assistant county agent in Elkhart County, Indiana, soil tests are a useful tool in doing Better Farming and Better Living work—the Indiana version of Farm and Home Development.

When he started work in 1955, he recognized that additional finances for improving the farm enterprise or home generally had to come from the farm *itself*—in crops or livestock.

EMPHASIS ON SOIL TESTS

Agent Cundiff soon learned that few of the cooperators in Better Farming and Better Living had ever had their soils tested. At every contact with his BF-BL (Better Farming and Better Living) Cooperators, Cundiff would stress the importance of taking soil samples to get an inventory of the soil fertility level. He urged them to *follow* the recommendations made by the soil testing laboratory at Purdue and offered to help interpret the reports.

He made a practice of not taking samples, but demonstrated *how* to take soil samples and left the final effort up to the family. He felt that the more effort they put into taking samples the greater their interest and results would be.

This policy has paid off because after five years very few families ask to have soil samples taken for them. They make it a habit now to ask for soil sample boxes and for the loan of probes to take the samples themselves.

Cundiff finds that response is quicker and greater by always having a supply of boxes and probes in his

L. C. Cundiff
University

TO COUNTY WIDE-PROGRAM

car ready to leave with families when they ask to get their soil tested. He continuously stresses correct sampling procedure.

By 1958 those families who had taken proper soil samples and had followed through with the recommendations were increasing their yields considerably. They were also making greater progress in their farm and home plans.

Of course, soil testing was just one of the good practices that helped these families increase their net worth by approximately $3,000 per family.

SITUATION—MORE SOIL TESTS NEEDED

Cundiff and County Agent Roscoe Stangland still were not satisfied. A look at a summary of the soil test records on file and census information tells why. They found this:

1 That from 1953 to 1957, an average of 500 samples had been sent to the laboratory at Purdue.

2 That each sample represented a little under 10 acres—or a total of 5,000 acres had been tested annually.

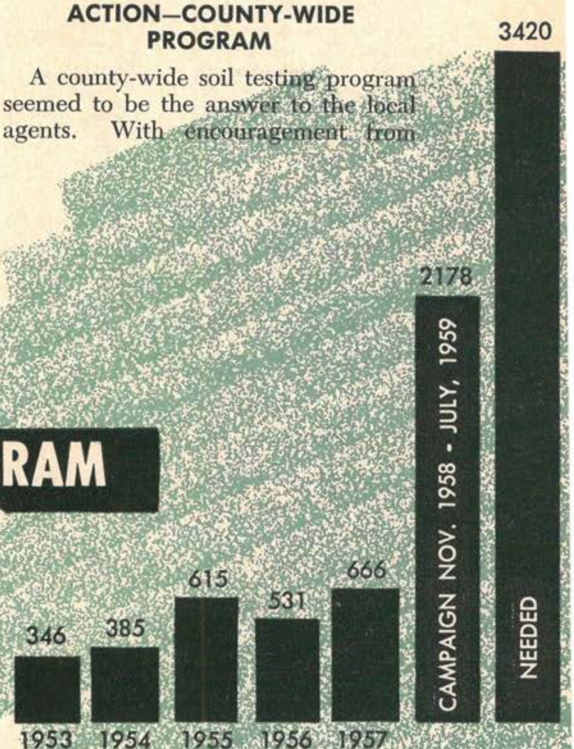
3 That the census showed 171,-000 acres of cropland in Elkhart county. To complete a cycle of testing every 5 years, 34,200 acres should be tested each year.

4 That *only 15* percent of the necessary acreage was being tested on an annual basis from 1953 to 1957.

5 That soil samples in 1958 were coming in somewhat faster—but not enough to make up the difference.

ACTION—COUNTY-WIDE PROGRAM

A county-wide soil testing program seemed to be the answer to the local agents. With encouragement from the Purdue Agronomy Department, a committee was organized to promote a soil testing campaign.



Soil samples increased 227% in Elkhart County, Indiana, when a concerted campaign was launched.

The committee was composed of 16 BF-BL Township Committeemen, 5 Soil Conservation District Supervisors, 2 Soil Conservation Service specialists, 3 Agricultural Stabilization Committee representives, 3 farm organization people, 5 fertilizer dealers, 7 Vo-Ag teachers, 4 credit agency representatives, 2 Purdue University agronomists, and 2 County Extension Workers.

At the organizational meeting of the campaign committee, Cliff Spies, Pur-

C. D. Spies, Extension Agronomist at Purdue University, works in soil fertility and supervises the TVA Test Demonstration Farm program. Previously he served as Area Agronomist in Southwest Iowa. He earned his B.S. and M.S. degrees from Iowa.

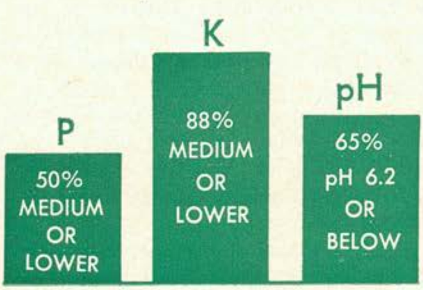
due University agronomist, stressed the importance of soil sampling—why it was important to Elkhart County and what economic returns could be obtained. The committee decided that the county should be flooded with information about the campaign.

PROMOTION PROGRAM

Cundiff took over the promotional program, developing a series of six articles for the three daily newspaper reporters who visit the Extension Office daily. These news items were also extracted for the county's 4 weekly papers and 3 radio stations. The newspapers and radio stations responded favorably, featuring stories and newscasts on increased returns through soil testing.

The advertising manager of a local newspaper helped prepare a full page ad and sell it to the first 10 organizations that were approached. Likewise, one of the weekly paper editors called 8 business organizations to ask them if they would be interested in

A summary of soil tests in Elkhart County showed this:



sponsoring a half-page ad. Each organization cooperated.

Banks, fertilizer dealers, machinery dealers, and credit agencies were invited to sponsor ads. Members of the agricultural agencies and farm organizations talked up the program to individual neighbors and groups.

All farmers operating 40 acres or more received a circular letter from the County Extension office. The letter contained *a summary of lime, phosphate, and potash needs in the county* as shown in Chart 2.

SERIES OF MEETINGS

The campaign committee decided on a series of three meetings to carry through the program. The purpose of each meeting was this:

Meeting No. 1—held on a township basis to explain the program and distribute soil sample boxes.

Meeting No. 2—held on a township or community basis to go over the soil test reports on a general basis, as well as individual.

Meeting No. 3—a general fertilizer meeting at three locations with cooperating sponsorship from fertilizer dealers.

Cundiff's BF-BL Committee organized the first series of meetings since there was one representative on the committee from each township. Meetings were held in October and November, promoted by the BF-BL Committeeman and Vo-Ag teachers at community meetings and by personal contacts.

Dates and locations of the meetings were also announced in news stories and in the circular letter. The meetings were conducted by the local agents, with the Extension Agronomist helping on the plans and attending the first meetings.

Agenda:

The promotional meeting agenda included:

1 Movie—Soil Test.

2 Detailed explanation of how to take samples and fill out information sheets.

3 Distribution of sample boxes, information sheets (a record was made of who took boxes and how many).

4 Sale of sampling probes.

5 Selection of a date and place to collect samples for free transportation to the soil testing laboratory. This was arranged for by the County Extension Office.

Results:

At 14 township meetings, 400 farmers took home over 4,600 sample boxes. By the time the ground froze in December, 1,940 actual soil samples had been taken. The first "push" of the campaign had 6 weeks of open weather and resulted in 400 per cent more samples than the average for the previous 5 years.

The second series of meetings were called "interpretation" meetings. Farmers received their soil test recommendations personally at these meetings rather than by usual mail procedure.

Two agronomists and two local agents, along with Vo-Ag instructors in their areas, handled these meetings. Points covered were: (1) How to read the soil test report, (2) How to use the recommendations, (3) Individual assistance in developing a long-time fertilizer plan for the farm.

Approximately 85% of the farmers who sent in samples during October and November of 1958 were reached in the second series of meetings.

L. C. Cundiff is Assistant County Agricultural Agent heading the Better Farming-Better Living work in Elkhart County, Indiana. He earned his B.S. at Missouri, his M.S. at Purdue. He taught vocational agriculture before going to Iran with the Point 4 Program as Director of Education for Ostan 10.

The campaign was completed with a general soil fertility meeting sponsored by a local fertilizer dealer who furnished refreshments or a lunch. Here two specialists discussed the economic and agronomic phases of soil fertility and soil testing. Three of these meetings attracted over 400 people.

RESULTS AND FUTURE PLANS

Elkhart County agents are well pleased with their efforts in the campaign. And they have these good reasons to be:

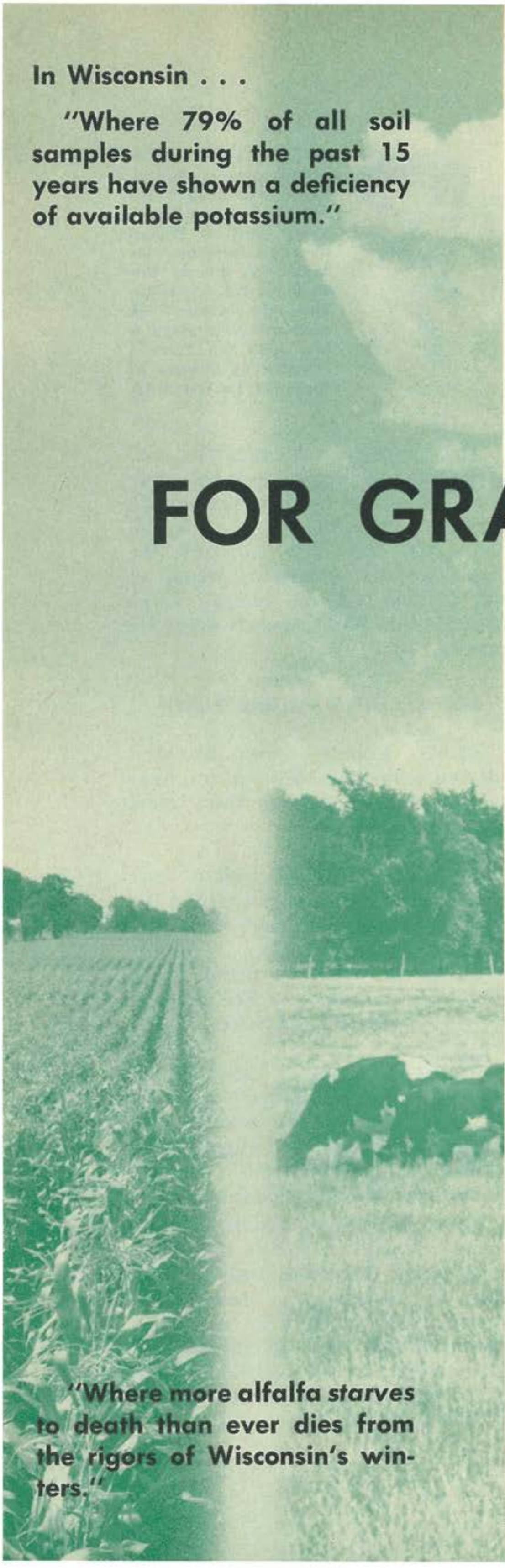
1 More than 1,000 farmers were directly contacted—42 per cent of the farm operators in Elkhart County.

2 In an 8 months period 2,178 samples were tested—a 227 per cent increase over the year before.

3 In the spring of 1959, the Extension Agents spent much time going over the fertilizer recommendations with farmers who either couldn't attend the "interpretation" meetings or had sent samples in later.

Follow-up is being planned. Newspaper ads will be used in the fall of each year. Reminder cards will be sent to farmers who have taken sample boxes but still do not have a report in the files. Changes in fertilizer sales and use will be checked with fertilizer dealers and through the BF-BL program.

THE END



In Wisconsin . . .

"Where 79% of all soil samples during the past 15 years have shown a deficiency of available potassium."

MORE POTASH

FOR GRAIN AND . . .

IN RECENT years, our alfalfa acreage in Wisconsin has increased greatly, *pumping potash out of our cultivated fields at an accelerated rate.* For several years now, Wisconsin farmers have been harvesting more than two million acres of alfalfa—in fact, this year (1959) they harvested 6½ million tons of alfalfa from 2,708,000 acres.

Also, if we include our 1,121,000 acres of clover which yielded about 2 million tons, we harvested a total of about *8½ million tons of alfalfa and clover.* Since clover is *also* a heavy feeder on potash, this means a heavy drain on our available potash.

Two things make alfalfa such a heavy feeder on potash: (1) it uses the potash in the surface eight inches, (2) with its deep roots it feeds on the potash in the subsoil to a depth of 3 to 6 feet.

POTASH LOSSES HEAVY IN LIVESTOCK FARMING

Our old professors used to tell us that in these dairy or livestock farming states, like Wisconsin, plant food loss was greatly slowed down. They thought that growing crops and feeding them to our livestock, with the return of the stable manure produced, kept the plant food in circulation on our farms.

"Where more alfalfa *starves* to death than ever dies from the rigors of Wisconsin's winters."

By
C. J. Chapman

University
of
Wisconsin

LEGUME SEEDINGS

But I maintain that we're losing potash from Wisconsin farms much faster than the cash grain farmers are losing it in such states as Iowa and Illinois. In those states, the large acreages of corn, grain, and soybeans are either combined or crops are harvested in the field. The residues (that is, the straw from grain and the corn stalks from corn crops) are left on the land, disked in, and plowed under. Excepting soybeans, a high percentage of the potash taken up by the crop is left in the straw or stalks, with a very small percentage going into the formation of the grain itself.

But in Wisconsin, alfalfa is harvested and either fed as hay or as silage to our livestock. Since the potash contained in alfalfa and other crops is water soluble, much of it is voided in the liquid manure and subject to great losses in the subsequent handling of the manure. A good part of that potash in liquid form seeps away in the barnyard.

Even where manure is hauled directly to the fields, much of it is lost on the way to the field as the liquid portion dribbles from the manure spreader down the lane.

EVIDENCE THAT POTASH RESERVES ARE RUNNING LOW

But what actual evidence do we have that potash is being depleted in our cultivated fields? First, crops are responding more and more to treatment with fertilizers *high in potash*. Fertilizers used in Wisconsin farms contain a higher percentage of potash than they did 10 years ago.

Also, there is a great movement to broadcast potash on corn fields and plow it under and to broadcast potash or mixtures like 0-10-30 and 0-12-36 as topdressings on old alfalfa fields.

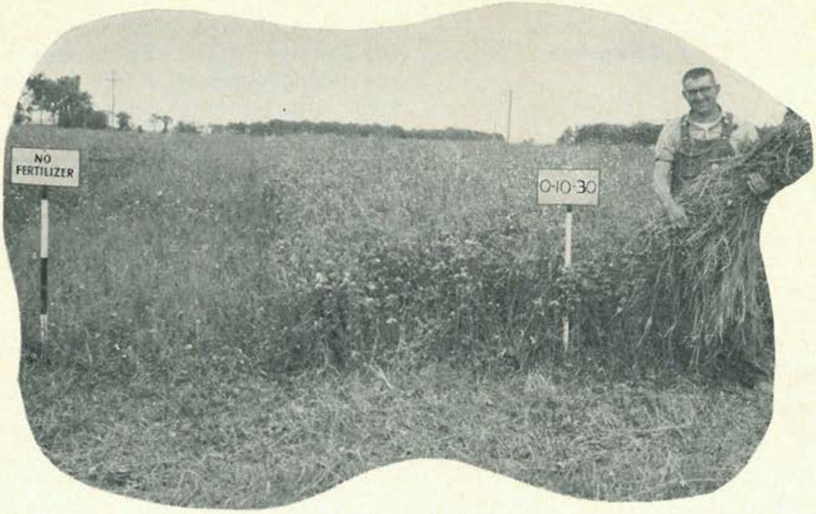
In fact, the average K_2O content of mixed fertilizers in Wisconsin in 1957-58 was 20.28% K_2O, *the highest in the nation*.

What do soil tests show? During the past 15 years, 79 per cent of all the samples tested in our State Soils Laboratory (and that accounts for about 500,000 samples from all parts of the state) *show a deficiency of available potassium*.

Compare that with the phosphate tests where only 63 per cent show a deficiency of phosphate.

What about lime? In spite of the 36 million tons of lime we have ap-

Prof. C. J. Chapman, Wisconsin native and well-known University of Wisconsin soils specialist, has carried the story of better farming methods to his people for nearly 4 decades. Conducting thousands of fertilizer and lime demonstrations on alfalfa, small grain, and corn, he has influenced major crop yields. He has contributed important articles to this magazine for the past 32 years.



Alvin Hoffman of Denmark, Wisconsin, shows the amazing response of his clover-alfalfa-timothy to 500 lbs. of 0-10-30 per acre applied at seeding. The following table shows actual yield and profit:

TREATMENT	YIELD OF GRAIN 1956 BU/A	YIELDS OF HAY 1957 LBS.	YIELDS OF HAY 1958 LBS.	COMBINED YIELDS OF HAY—LBS. 1957 & 1958	COMBINED VALUES OF INCREASES—GRAIN, STRAW & HAY 1956-'57-'58	COST OF FERTILIZER	NET PROFIT PER ACRE
500 LBS. 0-10-30	66.1	10,800	6,637	17,437	$154.25	$16.37	$137.88
NO FERTILIZER	54.3	3,500	3,375	6,875	—	—	—
ACTUAL INCREASE FROM FERTILIZER	11.8	7,300	2,262	10,562	$154.25	$16.37	$137.88

plied during the past 29 years, soil tests *this year* show that over 55% of the soils tested lack enough lime—and during the past 15 years, 58% of the soils tested acid and lime deficient.

To boil down what I have to say about fertilizers for small grain and legume seedings, I would say this:

1 *"Heavier applications of fertilizers rich in potash are suggested at the time of seeding down.*

2 *"Each year thereafter, these old alfalfa fields should be given a top-dressing with high potash fertilizer."*

HOW DEMONSTRATIONS SHOW THE NEED

Our field demonstrations with fertilizer and actual results with fertilizers support the findings of our soil tests. And here are the averages of 81 grain demonstrations conducted over a period of fourteen years:

Where no potash or a low potash fertilizer was applied, there was an increase of 14.1 bushels per acre. Where potash was added and mixtures like 0-20-20 or 0-10-30 were applied, the increase was 17.9 bushels per acre.

Of course, the increase in grain yield is only part of the story, since *the residual benefit of the fertilizer* applied at the time of seeding caused substantial increases in clover and alfalfa yield the following year.

The plots receiving straight 20% superphosphate or the low potash mixture averaged increases of 1893 pounds, while the 0-20-20 or 0-10-30 (high potash mixtures) caused increases of 2313 pounds per acre. The difference in net profit was $34.07 per acre over and above fertilizer cost for the high potash mixtures as compared to $27.44 for the no potash or low potash plots.

The best reason for fertilizing alfalfa with heavy applications of high potash fertilizer at seeding down time and during later topdressing of old established stands is found in the actual plant food that alfalfa removes from the soil.

Let's assume, for example, that a farmer has harvested four tons of alfalfa per acre—say, two cuttings in a favorable year. The chemist tells us that a four-ton crop of alfalfa takes up around 178 pounds of actual potash (K_2O). But expressed in terms of a 0-20-20 fertilizer grade, it would take *890 pounds of 0-20-20 to put back in the soil all the potash removed by this four-ton crop*. Or, with a 0-10-30 mixture, it would take about *600 pounds of this grade to restore the potash removed*.

Few farmers ever apply fertilizer at these heavy rates, although they are depleting their potash reserves at a rapid rate in growing alfalfa.

More alfalfa starves to death than is ever lost to Wisconsin's cold winters. Winterkilling in Wisconsin is due pretty largely to "weakened" stands where plant food supplies have run low.

ONLY 45% OF POTASH IN MANURE GOES BACK ON FIELD

We have been "short changing" our crop land on potash by leaning too much on stable manure. In fact, authorities tell us that on the average dairy farm in Wisconsin, *not more than 45 per cent of the potash contained in crops fed to livestock actually finds its way back on the cultivated fields*.

And here's another factor. In the early days, our fertilizers were relatively rich in phosphate but contained little potash. This caused the available potash to be pumped out of our soil at an accelerated rate. I am constantly telling those farmers who are still using rock phosphate that they should purchase some muriate of potash or mixtures like 0-10-30 to go along with the rock phosphate.

Also, liming our soils has tended to accentuate the need for potash. By neutralizing soil acids, agricultural lime causes changes in the soil that may slow down the rate at which potash becomes available. The same is true for boron, manganese, and iron. Certain of these trace and minor elements become more deficient as we lime our soil.

Another important result of lime is that it produces higher yields which, of course, means greater removal of other nutrients.

Liming acid soils is the starting place and one of the most important soil building practices for maintaining high level fertility and crop production. But we must always remember this lime usage can increase the need not only for potash, but for other plant food elements.

THE END

AERIAL TOPDRESSING *WORKS*

BY J. F. SHOULDERS VIRGINIA POLYTECHNIC INSTITUTE

Where the airplane has already been used to fertilize and make nearly 3,000 acres of steep pasture land productive.

In Southwest Virginia, where more than half a million pasture acres may be saved by aerial topdressing and spraying.

Where the pilots have convenient places to land, load, and take off to topdress 5 acres with 1,500 lbs. of 0-40-20 fertilizer in a matter of minutes.

Where lush growth was produced by 300 lbs. of 0-40-20 per acre—a high analysis treatment because every pound must count when topdressing by plane.

AERIAL topdressing may answer the very difficult problem of applying fertilizer on many Virginia pastures too steep or too rough for other methods of topdressing.

This is the opinion of agricultural advisors who have worked with aerial topdressing and the farmers who have had fertilizer spread by air in Tazewell County. *And they should know, because they were the first in Virginia to organize, direct, and use a county-wide program of aerial topdressing with fertilizer—1,961 acres topdressed from the air in 1958 and 943 acres up to May 15 of this year.*

Tazewell County is located in the Appalachian Mountains in a terrain well suited for grassland agriculture. Many acres of formerly excellent grazing land lie on mountain slopes of 3,500 to more than 4,000 elevation, too steep or rough for tractor (or horse) drawn machinery to operate.

Yet these soils grow excellent pasture when limed and fertilized. This has been proved by research, test demonstrations, and by farmers on their own bluegrass-white clover pastures. Since many of the soils are high in lime, only phosphate and potash are needed.

AERIAL SPRAYING GOES HAND IN HAND WITH AERIAL TOPDRESSING

During the past 25 years, the pasture sods have become weaker and weaker. Brush and weeds have invaded much of the steeper pasture. *But aerial spraying with chemical brush and weed killers is going hand in hand with fertilization.* It takes both practices to bring back these pastures. In fact, aerial spraying to kill brush and weeds really led to topdressing by airplane in southwest Virginia.

For several years, farmers have been concerned about the condition of their steeper pastures. After many acres of the more gentle slopes received fertilizer the response was good. Limited areas of the steep land had been fertilized by hand, as some farmers took a 100-pound sack of fertilizer on horseback when they went to look after their livestock. *Folks knew that phosphate and potash were the nutrients needed.* But how to get them there was the question.

THE IDEA CAME FROM NEW ZEALAND

The first serious thought of aerial topdressing was initiated by Dr. R. E. Blaser, widely-known Professor of Agronomy and Project Leader in pasture research at VPI. From the International Grassland Congress in New Zealand, Dr. Blaser brought back pictures and information showing how aerial topdressing was being done successfully in New Zealand. That was 1956.

When Tazewell County Agent James L. McDonald and ASC Office Manager George R. Hudson heard that aerial spraying for brush control was being done in neighboring Smyth County, they contacted Ashton W. Sinclair, County Agent-at-Large working with TVA demonstration farms.

Sinclair got in touch with Lloyd Lyons, an executive of Yadkin Valley, Inc., the firm doing the aerial spraying, who thought the idea had merit and was interested in trying it out. He agreed to conduct demonstrations if Sinclair would make arrangements.

The sign-up for aerial topdressing got under way on January 1, 1958, before farmers had a chance to see it done. Actually, the first demonstration in Virginia was not conducted until January 18, 1958, in Washington County.

An afternoon demonstration on the same day was scheduled in Tazewell County. But the weather "closed in", preventing a Tazewell demonstration until March. Here 6 acres of pasture were topdressed at the rate of 300 pounds of 0-40-20 per acre. *High analysis fertilizer is of prime importance when topdressing by plane. Every pound must count.*

HOW IT WAS DONE

Twenty-two Tazewell County farmers topdressed *1,961 acres of pasture by air in 1958*. The largest acreage topdressed by airplane on single farms was *214 acres*. Three farmers topdressed this amount. So far this year, 15 farmers have topdressed 943 acres. All sections of the county are represented, the largest number from the Burkes Garden and town of Tazewell areas.

Four landing strips were used in Tazewell County. The strips varied from an alfalfa field in Burkes Garden to an air field at Richlands. Farmers delivered fertilizer to the designated landing strip and helped to load the plane.

When practical, fertilizer was delivered in trailer load lots of 16 tons each with farmers dividing a trailer load when necessary. We used two planes—a Piper cub which carried 700 to 800 pounds of fertilizer per load and a Stearman which carried 1,400 to 1,600 pounds. The spreading time per load was just minutes, depending on the distance from the strip to the pasture.

HOW THE FARMERS RESPONDED

Virtually every farmer who has topdressed by air is enthusiastic. To them, the only disadvantage is the spreading cost—currently $25 per ton or $3.75 per acre at the present rate of 300 pounds of 0-40-20 applied per acre.

"I like it," says James C. St. Clair, a young farmer from near Tazewell. "I had 6 tons and 700 pounds spread on 42 acres and it's really showing up this spring. It's the only way to fertilize my steep pastures and if I keep them I've got to fertilize."

James went on to say that a year or so ago he hauled 800 pounds of fertilizer back on the mountain to fertilize around a spring development.

"It took me all day," he explained, "and it was all my horses could pull. You can't get there with a tractor."

This is why much potentially good pasture has not been topdressed.

Alex Meek of Burkes Garden summed up the thoughts of most farmers when he said, "I feel good about it myself. When you have hillsides standing up in the air so steep that you can't get to it except by hand, the airplane is the only way. I had decided to use this pasture as long as I could, then say 'good-bye' to it. Then this (aerial topdressing) came along. While everybody's fooling, I want to get my hillsides covered with fertilizer."

And he is. Last year he topdressed 107 acres by air and this year another 60. This pasture was also sprayed to rid it of blackberry briers and brush. I climbed to the top of one of his pastures in mid-May. The briers were practically gone. A part of this pasture which was not sprayed because of apple trees was almost covered with waist high briers.

"This was all like that last year," Mr. Meek explained.

Grass is thickening up in the treated area. In parts of the pasture, blue grass and other desirable species were knee high. The cattle in the pasture demonstrated the results of good pasture.

WORKING OUT THE "BUGS"

As problems are encountered, they are being solved. Community action is necessary. *There must be enough acreage to topdress to justify the operation of the airplane.*

One of the largest problems was getting the fertilizer to the plane and loaded when flying conditions are right for topdressing. This has been solved by delivering the fertilizer to the strip and covering it with weather proof plastic covers. This saves rehandling just prior to loading.

The problem of having men to load fertilizer into the plane when they are needed is one that needs further consideration. Another problem is the distance between the landing strips and the pasture. A strip is needed within 5 to 10 miles of the

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pasture. But these and other problems are being worked out.

Aerial topdressing would not have developed this far without the support of the ASC program. The cost of spreading is $1.25 per hundred pounds of fertilizer. This year ASC is paying $1.45 of the $3.75 per acre spreading charge. This helps to bring the cost of spreading nearer to the cost of conventional methods.

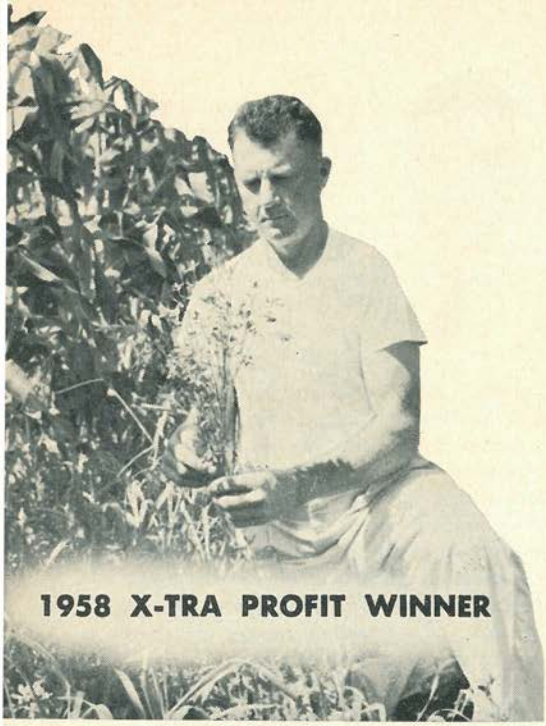
MORE THAN A HALF-MILLION ACRES MAY BE SAVED

Although in its infancy, aerial topdressing is making progress and has a definite place in the area of Virginia, west of the Blue Ridge. Tazewell County has led the way. In Tazewell, there are 86,000 acres of open pasture other than cropland pasture. This is land that can be used only for pasture or woodland. *Agricultural workers estimate that 60% or more of this acreage is best adapted to aerial topdressing.*

The same is true to a greater or lesser degree in the area of the state west of the Blue Ridge Mountains and on the eastern slopes of the Blue Ridge.

But the pressure for improvement of steep pasture is greatest where cropland pasture is more limited as it is in Tazewell. While there is no accurate estimate of how much, *more than half a million acres of pasture may be saved by aerial topdressing and spraying in Southwest Virginia alone.*

THE END



Here J. Troy Schrock of Preston, Minnesota—1958 X-tra Profit winner—shows how he uses corn as a nurse crop for legumes.

X-TRA YIELD X-TRA PROFIT CORN CONTEST

Showing . . .

How corn yields can be profitably increased through right fertilizer usage.

How high plant populations are necessary to capitalize on high fertilizer usage.

How future stress will be on the profit phase of the contest, since yield data has begun to tell the same story every year.

THROUGHOUT the Midwest, various types of corn yield contests have helped promote good production practices. They also indicate the success of fertilizer recommendations that are being made in various states.

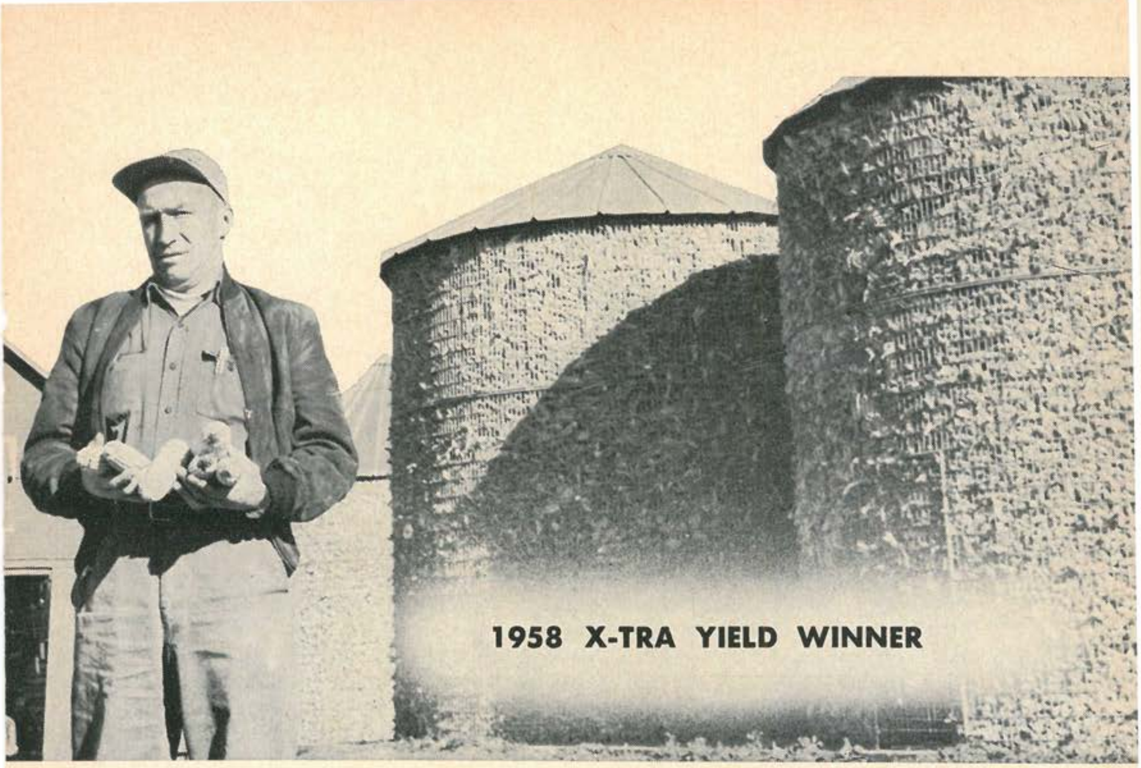
Although these contests should not be considered as research projects, yields of the contest fields illustrate the production capacity of soils when good management is used.

Many farmers and agricultural workers do not realize the yield potential of soils in their areas until these contest trials furnish the evidence. Consistent high yields require that the contestant observe good farming practices with major emphasis on proper fertilizer use.

This project was started in 1953 in cooperation with *THE FARMER MAGAZINE* of St. Paul and Agricultural Extension Soils Specialists of the University of Minnesota—Dr. Harold Jones, now Director of the Kansas State College Extension Service, and Dr. Charles Simkins, University of Minnesota, Extension Specialist, now on leave in Iran.

It was designed to demonstrate that *corn yields can be profitably increased through proper fertilizer use*. To emphasize how production efficiency can also mean top profits per acre, the *X-tra Profit* phase of the contest was added in 1958.

Emphasizing *economic gains* from production should focus more attention on efficiency rather than on *big ears* or *high yields,* although high yields may have been the goal of



Here Donald Hassing of Easton, Minnesota—1958 X-tra Yield winner—shows the results of good corn growing practices.

By
C. J. Overdahl
University of Minnesota

"competitive spirited" farmers.

Recognition is currently given for rank in the following divisions: (1) X-tra Profit (highest net profit per acre), (2) highest yield, (3) and highest increase in yield.

X-TRA PROFIT DIVISION

All contestants were required to have their soil tested and to keep records of field operations and expenditures. Winners in the X-tra Profit division in 1958 were named on the basis of highest profit for labor and management after production costs had been deducted.

Farm Management Specialists cooperated in this evaluation. Costs included *fertilizer, manure, seed, machinery depreciation*, and *interest, repair* and *upkeep, gas* and *oil, har-*

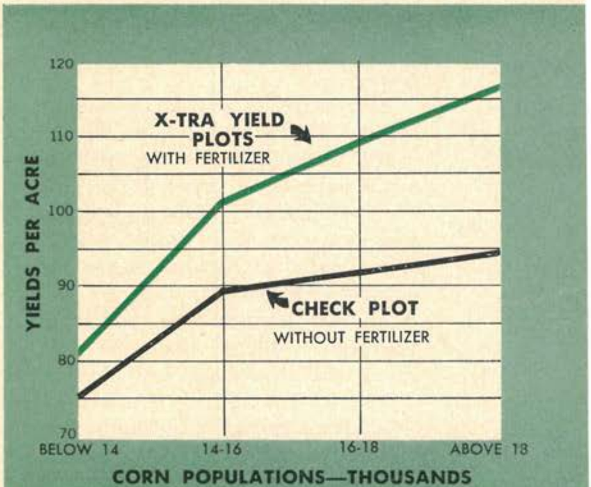


Figure 1. Heavy stands are essential to produce top yields and get full benefit from fertilizers.

Dr. Curtis J. Overdahl is Extension Soils Specialist at the University of Minnesota. He earned both his B.S. and M.S. degrees at Minnesota, his Ph.D. at Purdue. He has also worked for the Agricultural Extension Service in Iowa. He is a native of Elk Point, South Dakota.

vesting and storage and land taxes and interest on land investment.

The highest net return per acre was obtained by J. Troy Schrock of Preston, Minnesota. With a total investment of $60.65, he produced 133 bushels of corn per acre, leaving a net profit of *$72.35 per acre.* Costs were slightly over 45% of his gross income. A highly fertile soil and minimum tillage were factors involved in keeping costs down.

Further details of the X-tra Profit phase remain to be worked out. Evaluating residual or carry-over effects of fertilizer is a problem. Excessive rates of fertilizer applied the year before would not be included in costs for the Contest year. Thus, in the Contest year contestants could invest in a minimum of fertilizer.

This situation was not encountered during the first year of the X-tra Profit phase because the rules were not known until April 1958. However, *contestants having very high soil tests, applying only starter fertilizer with no manure, were at an economic advantage.*

Another problem was that nitrogen build-up through legumes would create an advantage for contestants raising corn following legumes. Because the amount of nitrogen contributed by legumes was difficult to evaluate, two categories were recognized: *one for corn following nonlegumes* and *one for corn following legumes.*

This rule did not appear necessary, however, since contestants having *corn following corn* netted the highest return in all areas except on the sandy soils.

The dry weather in 1958 appeared to handicap the corn following alfalfa. Conversely, sandy soils with low organic matter benefited from the slow nitrogen released by the plowed-under legume.

In 1959, they will attempt to base land charges on the yield of the check plot. Thus, carry-over fertilizer will be partially accounted for in the costs. They will also recognize the greatest return above the fertilizer investment.

HIGHEST YIELD DIVISION

Contestants use very high rates of fertilizer, often uneconomical rates. Competition for a high yield or large increase in yield is keen. The small size of the fertilized area (*2 acres*) also causes little concern for total costs.

Farmers applied equal or higher fertilizer rates on 120 bushel-plots than they did on fields yielding less than 60 bushels per acre. When data are arranged according to check plot yields, we see an important lesson in fertilizer usage.

Low temperatures in May or June are quite frequent in Minnesota. With cool weather and a moisture deficit sometimes occurring in July and August, goals of 150 to 175 bushels per acre are not yet practical—with our present technology, at least.

Contest winners usually obtain 160 bushel yields, but there is no consistent champion. The 1956 champions, L. C. and Earl Schafer of Goodhue, won with a yield of 161 bushels, but obtained only 133 bushels the following year.

Donald Hassing of Easton, the 1957 champion who produced 165 bushels per acre, harvested only 128 bushels in 1958.

These experiences, plus the data in table 1, indicate that the most economical goals for X-tra Yield farmers

CHECK PLOT YIELD BU/A	NUMBER OF FIELDS	AVERAGE CHECK PLOT YIELD	AVERAGE INCREASE	FERTILIZER INVESTMENT	RETURN ABOVE FERTILIZER INVESTMENT	PERCENT SHOWING GAIN ABOVE FERTILIZER INVESTMENT
BELOW 60	48	44.9	33.7	$18.85	$ 14.85	76%
60-80	57	70.5	22.5	18.00	4.50	61%
80-100	61	89.5	14.5	15.68	1.18	43%
100-120	41	110.1	15.8	18.90	—3.10	50%
ABOVE 120	11	126.9	2.9	$22.63	$—19.73	0

Table 1. Farmers applied equal or higher fertilizer rates on 120-bushel plots than they did on fields yielding less than 60 bushels per acre. When data are arranged according to check plot yields, we see an important lesson in fertilizer usage—namely, that the most economical goals for X-tra Yield farmers in Minnesota might be less than 150 bushels per acre, probably 120 to 130 bushels.

in Minnesota should be less than 150 bushels per acre, probably 120 to 130 bushels.

Corn stands must be high to get full benefit from fertilizer. Average yield increases of 5 to 6 bushels a year are typical when stands are only 14,000 plants or less per acre. Figure 1 shows yield trends with and without fertilizer as populations are increased.

YIELD INCREASE DIVISION

Until 1958, Contest rules did not prevent contestants from using the same plot area year after year. Some contestants naturally capitalized on this by building up the X-tra Yield plot each year while allowing the check area to become depleted.

After several years of maintaining the same plot area, in 1957 Donald and Emil Eickhoff of Fountain had the phenomenal *increase of 132 bushels per acre*. This vividedly demonstrated what can happen with two extremes of soil fertility maintenance.

However, new rules in 1958 required that contestants select *different areas* from past Contests.

Soil test and yield increase showed a close relationship. L. D. Hanson, University of Minnesota Extension Soils Specialist, classified the various fields into high, medium, and low fertility.

The lowest relative soil test value of either potassium or phosphorus became the classification for that field. These levels were compared to the percentage of yield increase. The results, presented here, show how reliable soil tests are in predicting fertilizer needs.

P and K soil test	% yield increase
High	22
Medium	45
Low	142

SUMMARY

1 The fields involved in this program are not research plots, but considerable information is gained by corn yield contests.

2 Information on production possibilities *without regard for economics* has reached a plateau since data each year tell the same story.

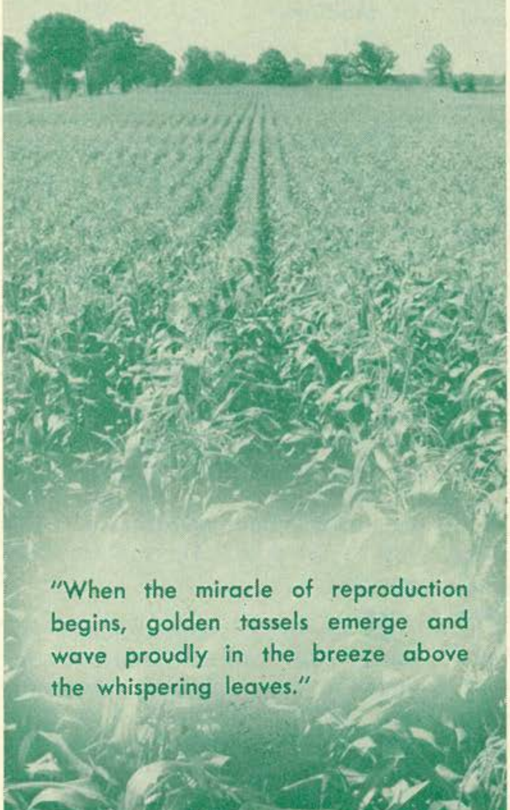
3 Every year it has been evident that high plant populations are necessary in order to capitalize on high fertility. Each year the high yield champion obtains approximately 160 bushels per acre. There is no trend upward.

4 Since contestants have not considered the economics and information is limited on the most economical quantities of fertilizer, the X-tra Profit phase will be stressed more than other parts of the Contest in the future.

THE END

CHEMISTRY IN THE CORNFIELD

By
ERWIN J. BENNE,
MICHIGAN STATE UNIVERSITY



"When the miracle of reproduction begins, golden tassels emerge and wave proudly in the breeze above the whispering leaves."

A LOT of chemistry goes on in a cornfield from the time the seeds are planted until a new crop of grain is produced.

The only living part of a corn grain is the little embryonic plant—often called the *germ, plantlet,* or *embryo*—down near the tip of the kernel.

The rest of the grain consists of stored foods—*starch, proteins,* and *minerals*—which together with the embryo are wrapped up in the hull.

Inside the embryo itself are small quantities of sugar and oil to serve as an immediate source of energy-rich foods for the living cells.

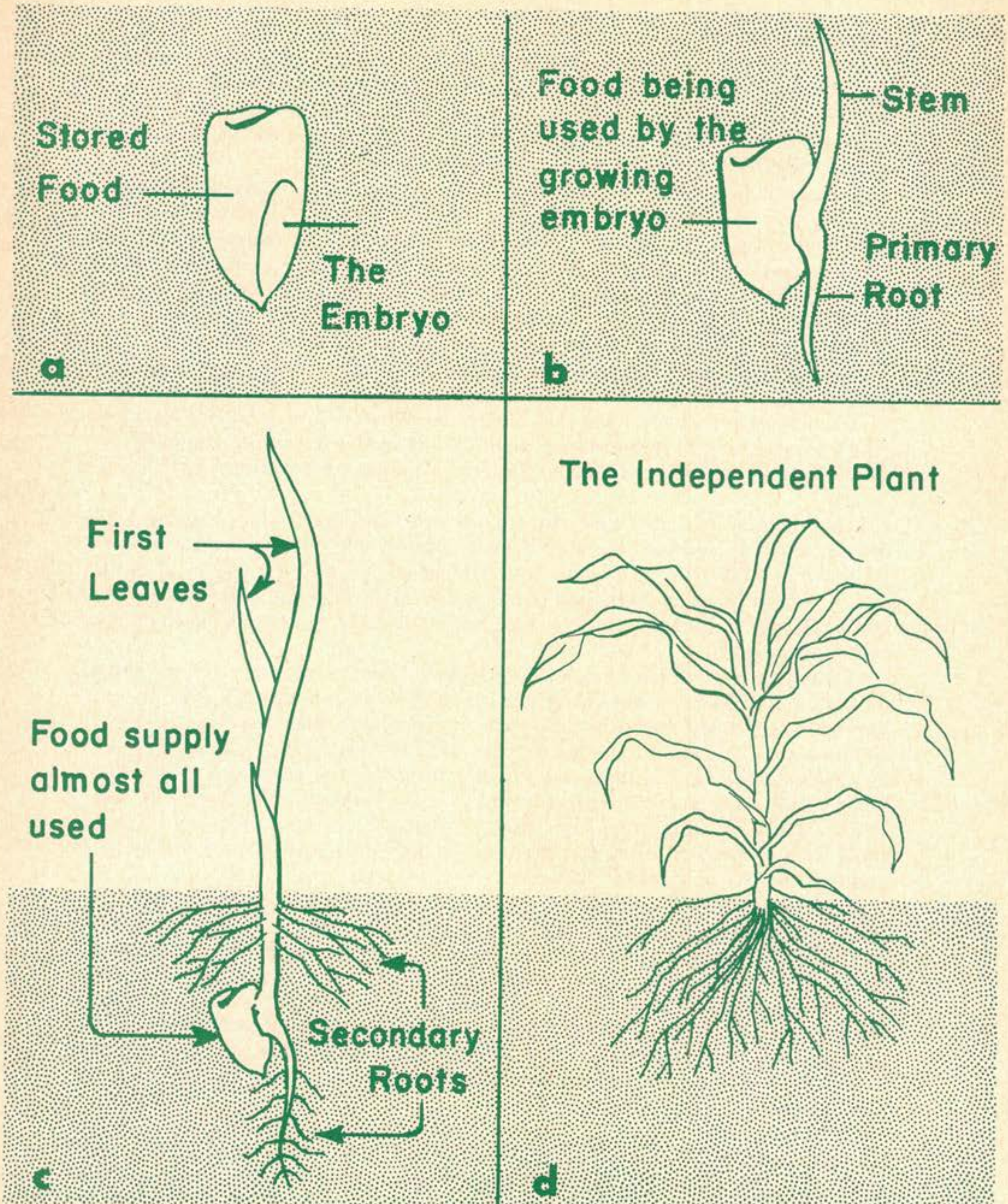
These, together with the stored food materials, must be sufficient to nourish the tiny plant, until it can send its roots into the soil to obtain the minerals it needs and can force its green leaves into the air and use the energy of sunlight for synthesizing the organic foods it must have to live and grow.

When a corn seed is planted, interesting things begin to happen.

Water from the soil enters the seed through the hull, and, if the temperature is favorable, the dormant plantlet wakes up and begins to respire faster.

Chemically this means that the sugars within its cells begin to combine more rapidly with oxygen, forming carbon dioxide and water and releasing energy which can be used by the awakened embryo.

(Continued on page 26)



Primary stages in the life of a corn plant: (a) the planted seed, (b) the sprouting embryo, (c) developing roots and leaves, and (d) the complete young plant which is now able to manufacture its own food.

Respiration requires a continuous supply of sugars, and when those contained in the embryo are used up, the living cells must begin to draw on the starch stored in the seed. Starch, however, is quite insoluble in water, and before it can be carried into the embryo, it must first be digested into sugars that are soluble. This is done by causing the starch to react chemically with water in a process called hydrolysis. To bring this about, the cells of the embryo secrete enzymes which act as catalysts for the hydrolysis reaction.

A chemist describes a catalyst as a substance that can change the rate of a chemical reaction merely by being in contact with the reacting materials. Enzymes are organic catalysts produced by living plant or animal cells. Some enzymes perform their functions inside the cells that produce them, while others are secreted by the cells to exert their effects on substances outside. A great many different kinds of enzymes exist in nature, and life itself depends on their ability to act as catalysts for chemical reactions essential to living matter.

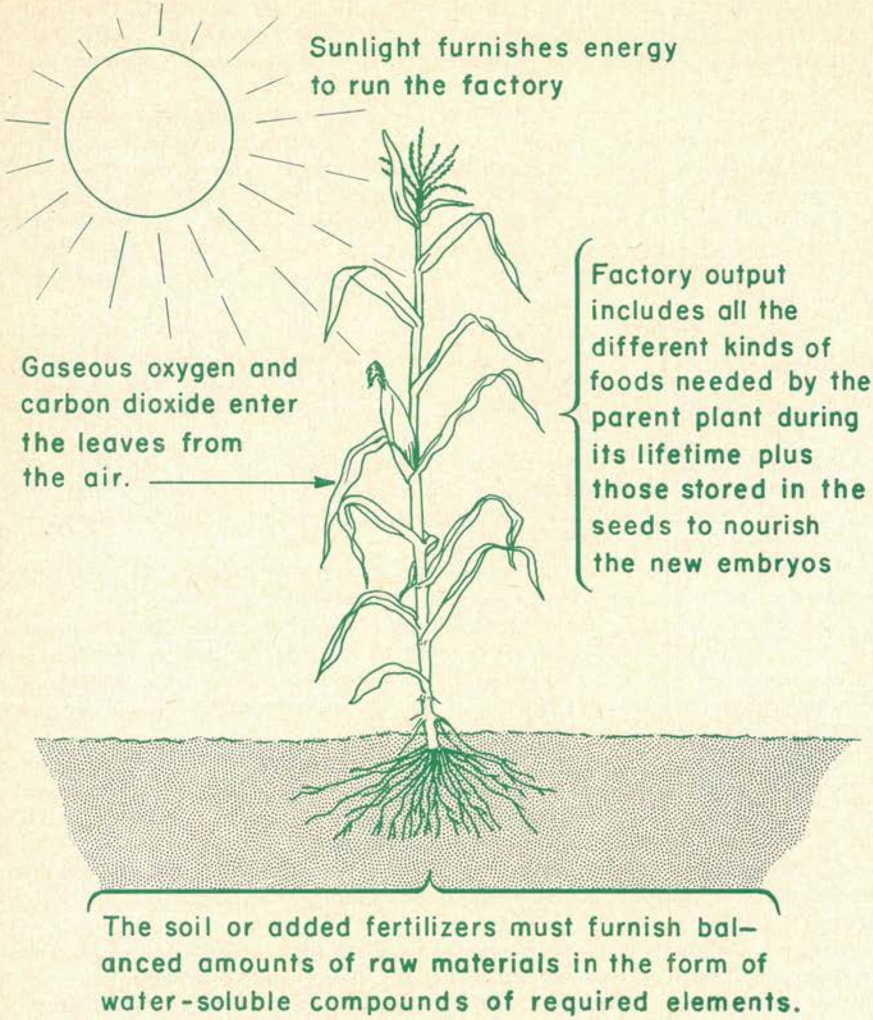
The sugars produced from the starch dissolve in water, move into the embryo, and supply its needs for food. In a similar way, the cells produce other enzymes that cause the proteins and oils to be digested into soluble substances, which can be used by the growing plant. Some of the stored minerals also dissolve in water and stand ready to perform a variety of functions as the plant grows.

Using energy released when the sugars are oxidized by its respiring cells, the germinating embryo forces its primary rootlet downward into the soil and its stem and first leaves upward into the air above the soil. Soon after the leaves emerge from the soil they develop the green pigment, chlorophyll, and, when the sun is shining on them, they begin to carry on the chemical process called photosynthesis.

In this process, which is exactly opposite in effect from respiration, carbon dioxide, a colorless gas that enters the leaves from the air through little mouth-like openings called stomata, and water absorbed by the roots from the soil, combine into sugars and set oxygen free into the air again. Chlorophyll acts as a catalyst for the reaction, and sunlight furnishes the energy to make it go. Some of this energy is stored in the sugars as food energy, which can be used by the plant for respiration and growth. Because of their different relationships with respect to oxygen, respiration is called an oxidation reaction and photosynthesis a reduction reaction.

While the new leaves become green and start to carry on photosynthesis, secondary roots push out into the soil and begin to absorb mineral nutrients. At this stage the corn plant becomes an independent chemical factory capable of forming the food it needs to live and grow. For the remainder of its life, as it grows, matures, and dies, it will carry on a whole series of complicated chemical reactions in addition to photosynthesis. These reactions, regulated by many catalysts and enzymes, enable the plant to convert simple materials obtained from the soil and air into the complex compounds composing its roots, stems, leaves, and new seeds.

As every factory must do, the corn plant provides for bringing in raw materials and for storing finished products. In its stalk, streams of water carry minerals from the roots to the leaves, while others moving in the opposite direction remove the products of photosynthesis from the leaves and carry them to where they are needed as food for hungry cells, or to where they are to be stored. Some of the sugars first formed in photosynthesis are used directly by the cells of the plant for respiration. Some are changed to starch or oil and stored as reserve food. Others are converted to cellulose to form the structural parts of the plant. And still others by the addition of



A growing corn plant is a chemical factory that operates without noise, smoke, or blazing furnaces.

nitrogen are made into proteins, which are needed by the protoplasm of the growing plant.

When necessary the plant can reverse these reactions and change the starch, oils, and proteins back into sugars. All of these reactions except photosynthesis can go on in the dark, and many of them go on at night as well as during the daytime to clear the way for the new substances to be produced by photosynthesis during the daylight hours of the following day.

Research has shown that at least fifteen elements—boron, calcium, carbon, copper, hydrogen, iron, magnesium, manganese molybdenum, nitrogen, oxygen, phosphorus, potassium, sulphur, and zinc—are necessary for the metabolism and growth of a corn plant. Certain other elements, including aluminum, chlorine, and silicon, seem to perform useful functions for the plant under some conditions, and in time may prove to be essential for its optimum well being.

Oxygen is the only element that the plant uses in uncombined or elemental form, and as such it is obtained from the air. Carbon is supplied as carbon dioxide from the air and from water solutions of simple carbon compounds that enter through the roots of the plant. Water supplies the hydrogen and combined oxygen, and under natural conditions all the other necessary elements must be obtained in water-soluble compounds from the soil. It is these latter elements that can be supplemented when necessary by the use of inorganic fertilizers.

Because the chemical processes taking place in the metabolism and growth of the corn plant are so complex, it has been impossible to determine exactly what reactions each element takes part in and the specific role it plays. However, varying amounts of evidence, some of it still hypothetical, support the following information:

Aluminum influences the rate of photosynthesis and the rate at which starch is hydrolyzed. It affects the permeability of the protoplasm and acts as an antidoting agent against potassium by preventing it from collecting in toxic concentrations in the cell surfaces.

Boron is necessary for the proper functioning of calcium in metabolic activities, and is required in the growth processes of the plant.

Calcium is necessary for the translocation of carbohydrates from one part of the plant to the other, and for helping to regulate the acidity of the sap. It influences the physical condition of the protoplasm, serves as a component of the structural parts of plants, and acts as an antidoting reagent against excessive quantities of magnesium.

Carbon stores energy in photosynthesis and releases it in respiration, thereby playing a leading part in these vital processes. It is the central element of all organic compounds in the plant and as such makes up a large portion of its structure. It is also a constituent of all enzymes.

Chlorine appears to stimulate the activity of some enzymes and to influence carbohydrate metabolism, the production of chlorophyll, and the water-holding capacity of plant tissues.

Copper stimulates growth, acts as a catalyst or a component of enzyme systems, and helps to prevent chlorosis, the term used to describe the condition when green plants turn white or yellow due to lack of normal amounts of chlorophyll.

Hydrogen acts as an energy exchanger in photosynthesis and respiration, is a constitutent of all organic compounds and acids in the plant, and as a component of water it serves as the medium in which all of the chemical reactions within the plant take place.

Iron acts as an oxygen carrier, is required for the formation of chlorophyll, and aids in preventing chlorosis.

Magnesium is a constituent of chlorophyll, and as such it is required for photosynthesis and as a preventive against chlorosis. It acts as a phosphorus carrier, and helps maintain the proper degree of acidity in the sap.

Manganese participates in oxidation and reduction reactions, influences the oxygen-carrying capacity of oxidase enzymes, is required for carbohydrate metabolism and growth, and helps prevent chlorosis.

Molybdenum is involved in the reduction of nitrates during the formation of amino acids and proteins.

Nitrogen functions as a storer of energy, is a constituent of chlorophyll, proteins, enzymes, and structural materials, and is necessary for growth of the plant and the formation of new seeds.

Oxygen acts as an energy exchanger in photosynthesis and respiration. It is contained in nearly all of the organic compounds in the plant, including those which form its structure. As a constituent of water along with hydrogen it forms the medium in which all the chemical reactions within the plant are carried on.

Phosphorus functions as a storer of energy, is required for respiration, and influences the synthesis of proteins. It plays an important role in plant metabolism as an accelerator of oxidative enzymes, as a promoter of root development and a regulator of maturity, and as a component of many vital compounds.

Potassium serves as a catalyst, condensing agent and translocation regulator, is necessary for the formation of carbohydrates, oils, and proteins, stimulates enzyme activity, and is required for cell division, reduction of nitrates, and chlorophyll formation.

Silicon appears to influence the utilization of phosphorus by the plant. It serves as a constituent of its structural materials, and is probably required for photosynthesis.

Sulphur influences the formation of proteins and chlorophyll, is a constituent of the structural materials of the plant, and increases root development.

Zinc appears to be required for chlorophyll formation, since it can prevent the chlorotic condition known as white bud in the corn plant.

For about the first two months of their lives corn plants grow rapidly and busily produce food materials for the increased number of living cells. Their leaves become broad and long, and more cells containing chlorophyll are formed. This increases their capacity for carrying on photosynthesis, and on sunny days these busy factories work from dawn to dark at the business of combining carbon dioxide and water into new sugars and changing them into all of the combinations needed by the growing plants. Nor do they quit when the sun goes down, because during the night their busy cells carry away the excess products produced while the sun was shining, change them to the proper compounds for storage, and store these away for later use.

At this midway stage in the lives of the corn plants, the chemical miracles of reproduction begin. Silk bedecked shoots appear, and golden tassels emerge from the tops of the stalks to wave proudly in the breezes above the whispering leaves. Pollen grains from the tassels fall onto the silks, and are conducted down long, narrow tubes to the awaiting egg cells clustered around the cobs within the shoots. Here the male and female cells merge, and new embryos are begun. The major chemical efforts of the parent plants are now directed toward nourishing the developing embryos and surrounding them with stored foods in the new seeds.

Gradually the chemical processes within the parent plants diminish in vigor and finally cease. Their task is done, and the new ears await the harvest.

THE END

"What's the use of it all?" sighed the rooster as he leaned his head against the barn door. "Eggs yesterday; chickens today; feather dusters tomorrow."

A stork is merely an old bird—with young ideas.

And then there was the Scotchman who married the half-wit girl because she was 50 per cent off.

And now Gus the Gas man, in a skeptical mood, wants to know why we boil water to make tea hot, then put ice in it to make it cold, then lemon to make it sour, and then sugar to make it sweet.

Coroner: "What were your husband's last words, madam?"

Widow: "He said, 'I don't see how they can make much profit on this stuff at a dollar and half a quart.' "

A farmer once wrote to Sears Roebuck & Company to ask for the price of toilet paper. He received an answer directing him to look on page 307 of their catalogue.

"If I had your catalogue," he wrote back, "would I ask you for the price of sech paper?"

A colored girl was being delivered of a child. Downstairs waited her Sam. Mandy suffered a great deal of pain, and, altogether, had a hard time of it. Finally, when it was all over, she sighed and said: "Ef this yer is what married life is like, you go down and tell Sam our engagement is off."

A married man who had been "cheating" got in from his party, late but safe, and was all but undressed when his wife who had been watching him out of the corner of her eye, cried out, "Meyer! Where is your underwear?"

"Good gosh!" said Meyer, "I've been robbed!"

The colored preacher had announced as his text: "Adultery." Expanding on the subject he vehemently arraigned those brethren who made it a practice to secretly call on the wives of their friends and neighbors. In the middle of his address, one worshipper rose suddenly and made down the aisle.

"Whe'e you all gwine?" the minister asked him.

"Ah jes' remembered whah ah lef mah umbrella," the brother said, continuing on his hasty way.

There's something sort of pathetic about a horse-fly sitting on the radiator of a tractor.

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