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(*Turn to page* 31)

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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: **1102 16th Street, N. W., Washington 6, D. C.**

VOLUME XL NO. 5

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Better Crops with PLANT FOOD

PUBLISHED BY THE AMERICAN POTASH INSTITUTE, INC., 1102 SIXTEENTH STREET, N.W., WASHINGTON 6, D. C., SUBSCRIPTION, $1.00 FOR 12 ISSUES; 10¢ PER COPY.

VOL. XL | WASHINGTON, D. C., MAY 1956 | No. 5

Happily related to . . .

Many Good Mothers

Jeff McDermid

(ELWOOD R. MCINTYRE)

LOTS of pretty good fellows do not know very much about the Mother's Trade. Many a conceited and aggressive chap will receive plaques and plaudits on the platform for careening through a career without stopping to acknowledge that Super Sales Week, More Mazuma Month, or Beat Your Quotas Quarter contribute far less by comparison to real success beside Mother's Day. Anyone who has been richly endowed with family living that includes the influence and counsel of a few good mothers, natural and acquired, has surely been favored among men.

For a long time, many such fortunate fellows have treasured those privileges in silence because few of us plain-spoken guys can ever hope to recount our debt to mothers, both then and now, as the subject deserves. It takes a heap of having through the years to accumulate this balance in the bank of memory. From five maternal sources comes our own private fund of grateful remembrance.

I can boast but five. Other men may credit more. Left to me in memory are my own mother, then my wife and her mother. Left to me still as tangible proof that the example of good motherhood carries on, are two daughters—family-tried mothers in their own right, dedicated to the greatest job in the universe and by all odds the hardest to do well.

A good mother is something that was created to look after others. In doing this, she is supposed to include the Old Man himself much of the time, as well as a cute collection of kids of her own of all ages, besides small fry from the neighbor's, who come over regularly to upset the household and gobble up all the snacks she planned for the family lunch. She has to skate around over marbles and crossword and picture puzzles and have the living-room turned into a circus, a doll laundry, or a suburban building boom.

A good mother isn't supposed to sit down much—except maybe to put on and take off numerous boots and panties seventeen times a day, or darn socks or mend busted toys with a hairpin, or take howling infants on her lap to rub on salve or wipe off noses.

A GOOD mother is always supposed to be sweet tempered and lavish of her praise and affection, even though the house seems to be in the tornado scatter-belt, with everybody hungry and sassy and the Old Man glum with some grouch about God-knows-what-or-why. If she raises her voice or slaps a kid where the fat parts are, that's strictly against the general rules, and she gets remorse and feels real sinful for awhile —until it's time to stop a fight in the yard or pull a fallen tricycle off a toddler.

A good mother must never be ready to get sick herself, because you see there isn't time for it, really. And who in Hector would want to come in and try to run things with a sick person around? So a successful mother holds back on complaints about an aching head or a bum back. She soon learns to forget the fatigue with drugstore pills and a lot of very helpful daily exercises.

A very successful mother should stay home constantly and never read up on gaudy travel folders and get absent-minded thinking about some faraway "delectable mountains" which she has never seen, but darn well wants to. She must be on deck from cock-crow to bat-flying time, always ready and eager to change diapers, wash and iron dresses, get good meals, bathe the crockery, and dunk the kids in the detergent. Then when the day's havoc is over, she should read them to sleep out of some dog-eared animal pranks comics that the Old Man buys but seldom prefers to his own reading matter on professional improvement.

A good mother must be able to fix up real cute and look superbly snappy whenever she and the Old Man trot out to some card party or social shindig that will keep the fortunes of the family on the upgrade. Her fingernails must not show the pin jabs and bruises incident to a regular day's routine, and her hair must be fluffy and done up in the latest coiffure. That fetching get-up she wears should be one she made herself with the help of some midnight oil and the Penney store patterns. A bright, angelic smile must be worn also, to enliven the ensemble—even though she has done a maternal marathon that day and had to phone six places before locating a third-rate, untried baby sitter!

AND above everything, a good mother must always look as slick a chick as she was when they both marched on the carpet to the strains of Lohengrin; must never show signs of wear and tear; keep charming and ducky-wucky; and bring the Old Man a good snack along with his pipe and slippers at eventide. She pays the heaviest penalty here for any breach of the rules, while many times the Old Man just sits on the sidelines and keeps the score, without bothering to shave or change his shirt for dinner.

A mother is a person who goes down into the valley of the shadow trying to save herself and another new person, or maybe two or three sometimes, and bring them up in the love of God and the service of mankind. She is a creature that is part animal and human and part soul and spirit, part selfish and part generous, part wise and part foolish, part skillful and part awkward, part hopeful and part fearful—but always conscious of her destiny as one who is really indispensable, so that she cannot fail.

She knows with the wisdom of the ancient monk, Thomas A' Kempis, that we are born to bear each other's burdens, for it is said that "none is faultless, none without a burden, none sufficient unto himself, nor wise enough in himself; but we must bear with each other, help, teach, and advise each other. For the strength that each has is best seen in the hour of adversity. Because such hours do not make a man weak, but show what kind of man he is."

A mother is a thing that seldom wavers or desponds in the time of stress and the time of poverty. She is a

partner of her helpmeet in the arrangement of family affairs, and on her shoulders falls the weight of upholding the balance—low income on the one hand and warm raiment and proper nourishment on the other.

So when you and I say that we had a blamed fine mother ourselves, and acquired a great wife-mother, a kind mother-in-law, and some real good daughter-mothers, you can see what that spells for a happy lifetime.

Of course, we older sons of good mothers remember them for the hardships they went through in domestic duties. In those days it took the tuck out of many mothers to do washboard scrubbing, kerosene lamp cleaning, and wash-water toting—a heavier physical drain than we have in most of our homes at present.

But when it comes to a lot of extra pressures and constant family demands to fit the current times, I surmise that when we count those in we are not giving our present mothers so much advantage over the "pioneers." The fundamental jobs and duties are still expected of mothers, besides a mess of special new responsibilities that this rushing age has added to the maternal sphere.

THE comparative "freedom" that many kids have today is not all praiseworthy and progressive, even though the word is part of our national birthright and the favorite theme of the tall-talking politico. The newspapers are full of escapades by juvenile hoodlums, and it's not unlikely that some of our own offspring will come into their destructive orbit. "Mom" as the central core of the average household is often—more than Dad—the parent who has to be watchful and prompt to rescue youngsters from bad company.

Willing to meet the situations halfway at least, she plays along with the antidotes that furnish excitement, adventure, and hero worship. She togs the kids out in coonskin caps, Injun headdresses, mouse-ear hats, space helmets, and atomic age accoutrements, and works hard with the brownies and the cub scouts and teaches a juvenile class in Sunday school.

But, hold on! We've given considerable tribute to the greatness of motherhood and how it has filled our lives brimful of uncounted benefits. Yet we haven't turned the page to say that a good mother cannot do her best without the help and approval of a good father.

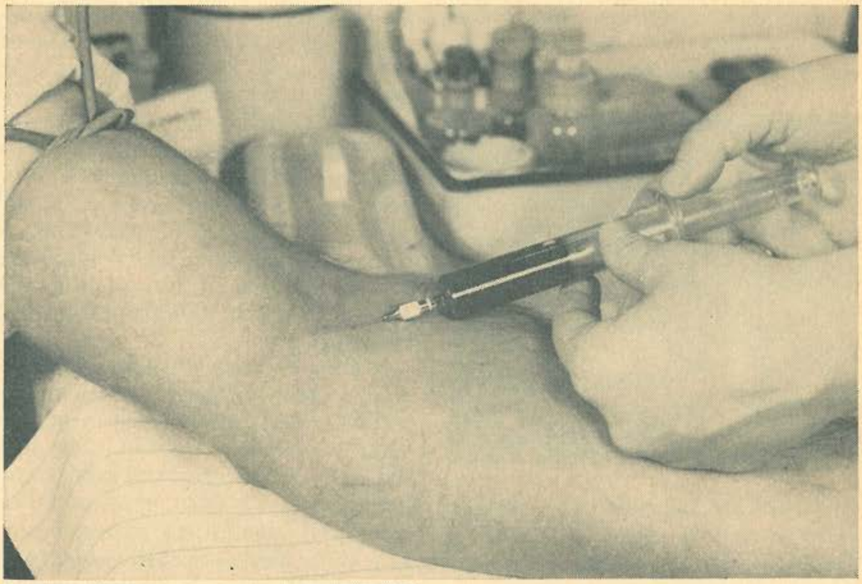
Every head of a family worth his salt not only accepts the grave responsibility of earning the wherewithal, but he contributes manly and courageous qualities needed in family welfare. A mother cut off from these has a lonely and frustrated task. Hence, while praising the mothers we have known and loved, we must not fail to credit their fond and steadfast husbands with

(Turn to page 50)

Give Your Plants a Blood Test[1]

Guide to Quick Tissue Tests

By N. D. Morgan, Shreveport, Louisiana, and G. A. Wickstrom, Columbia, Missouri



ANEMIA in human beings may be due to any one of a number of physiological disturbances. Usually the first cause suspected is a deficiency of iron. The iron content of the blood is simple to determine. If it is below a certain level, the preliminary diagnosis is verified and iron in the diet is prescribed. In a sense, plants can also become "anemic," and can be checked for levels of nitrogen, phosphorus, and potassium. Because these nutrients should be present in certain amounts for proper growth, a better diet for the plants can be determined if needed.

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[1] This is the first of two articles on quick field testing. An article on quick soil testing will appear in a later issue. While the tests and procedures outlined in these articles have been found useful by the authors, other satisfactory tests are available.

Whole plants or parts of plants can be taken to the laboratory for analysis, or tests can be made on plant tissue in the field. Recent refinements of field tissue tests make them very desirable as a means of diagnosing nutritional problems. They are simple, quick, and convenient. A test for nitrogen, phosphorus, and potassium can be completed in less than two minutes, and the testing materials can be carried in a small box. An additional advantage is that the diagnosis can be made on the spot where the trouble exists while the facts related to the problem are fresh at hand.

Uses of Quick Tests in the Field

1. ***To Call Attention to the Need for Laboratory Soil Tests***—Quick field tests do not replace good laboratory tests, nor are they used for making fertilizer recommendations. When quick field tests locate nutrient deficiencies, the grower is urged to get his soil tested in the laboratory and to follow the recommendations of his agricultural adviser. The field testing is used as a tool to show him that he needs a soil test.

2. ***To Supplement Soil Testing by Checking to See if the Fertilizer Recommendation Was Adequate***—Official agricultural workers can follow up on their recommendation with field tests. Should the grower use less than recommended amounts of fertilizer, the quick tests serve a useful purpose in actually demonstrating to him that his crop is in need of better nutrition. The graph in Fig. 2 shows the results of a tissue test survey of 125 cornfields in Montgomery County, Missouri, where the recommendations based on soil tests were followed to varying degrees. Those growers having nutritional trouble were those who were not following the recommendations of the county agent.

3. ***To Verify Deficiency Symptoms***—When an apparent N, P, or K deficiency appears on a plant, tissue tests can disclose whether or not it is the deficiency suspected. Through tissue tests the deficiency can actually be detected before symptoms appear.

4. ***To Survey Large Areas Quickly***—In the Montgomery County survey previously mentioned, 125 cornfields over the county were surveyed by three teams of two men each in a period of 3½ days. In addition to obtaining valuable information on an individual field basis, the over-all picture of the nutritional status of the area was available. In the graph, Fig. 3, the results of the survey are compiled for all fields. At the time the plants were sampled, all nitrogen readings Medium and Below, and all phosphorus and potassium readings Low and Very Low were considered deficient. This survey helps to give the agricultural worker an idea of the fertility needs in his area.

5. ***To Follow the Uptake of Nutrients in Research Field Plots***—Once fertilizer has been applied on test plots, checks can be made to determine if and when the nutrients are taken into the plant. The results of this additional information can better the understanding of the yield results.

Tissue-Testing Technique

1. ***Materials and Equipment Needed***—(See Appendix for source or directions for preparing).

Potash test papers
Bray nitrate powder
P-K reagent No. 1
P reagent No. 2
(Tin rod optional)
Needle-nose pliers
Sharp knife

(CAUTION: Do not keep test papers in same container with chemicals. **Avoid Skin Contact With Chemicals.**)

2. ***Sampling***—Plants can be sampled at any time from the early stage of growth until maturity, but because the percentage composition of N, P, and K varies in plants during the growing season, a lot of experience is necesary to interpret the readings. The following generalities can be made:

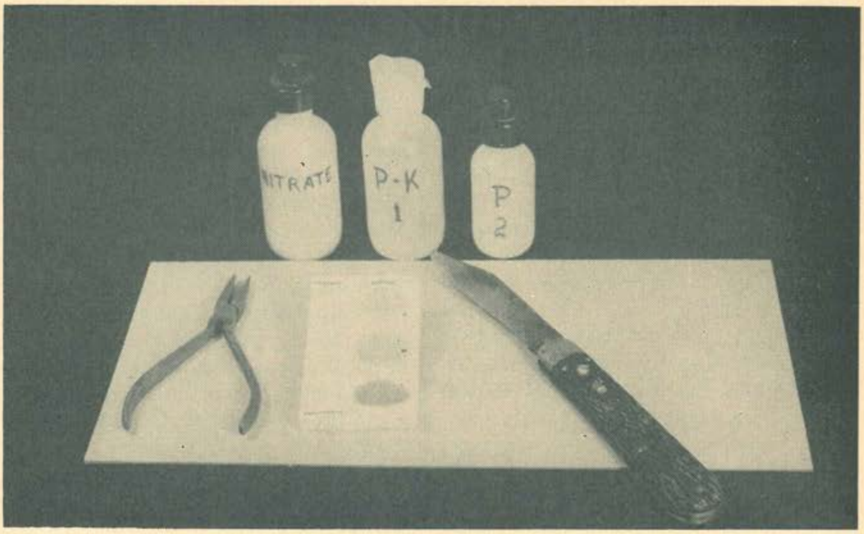


Fig. 1. The materials needed for tissue testing.

a. N, P, and K contents of plant saps measured by tissue tests are higher in the early part of the season than toward maturity. At maturity they drop off sharply.

b. The use of a starter fertilizer may provide young plants with adequate nutrients, but when these have been exhausted the plants may suffer.

c. In early spring, plants are using nutrients accumulated in the soil over winter. Tests in early spring may not accurately reflect a sufficient supply at a later date.

d. With inadequate nutrition, the plants go through a period of stress. At this time the nutrient requirements of the fast-growing plants are such that the soil has difficulty supplying them.

The ideal time to sample plants is during this period of stress. In most cases it comes about the time of flowering and early seed formation. For example, corn should be sampled during the period from tasseling to early dent. Alfalfa is best sampled just before bloom of the second cutting. Of course, a more thorough understanding of what is happening in the plants can be obtained if the field is sampled 5 or 6 times during the growing season.

Since one plant may differ from another in the same field due to its feeding ability or due to soil variation, it is essential to sample any one field in from 6 to 10 or more different locations, depending on the size and variability of the field. Only then can one obtain a true picture of the nutritional status of the field. Care must be taken to sample average plants and to avoid the edges of the field. Bad spots in the field must be considered separately. The brief table that follows can serve as a guide to the part of the plant to sample:

CROP	NITROGEN	PHOSPHORUS AND POTASSIUM
Corn	Cut stalk above ear node	Mid-rib of leaf below ear
Small Grains	Main stem	Main stem
Alfalfa	No test	Cut stem half-way up plant
Other Legumes	No test	Petiole of leaf one third from top
Other Plants	Petiole from recently matured leaf	Petiole from recently matured leaf

(Note: Avoid older leaves at base of plant and younger immature leaves at top.)

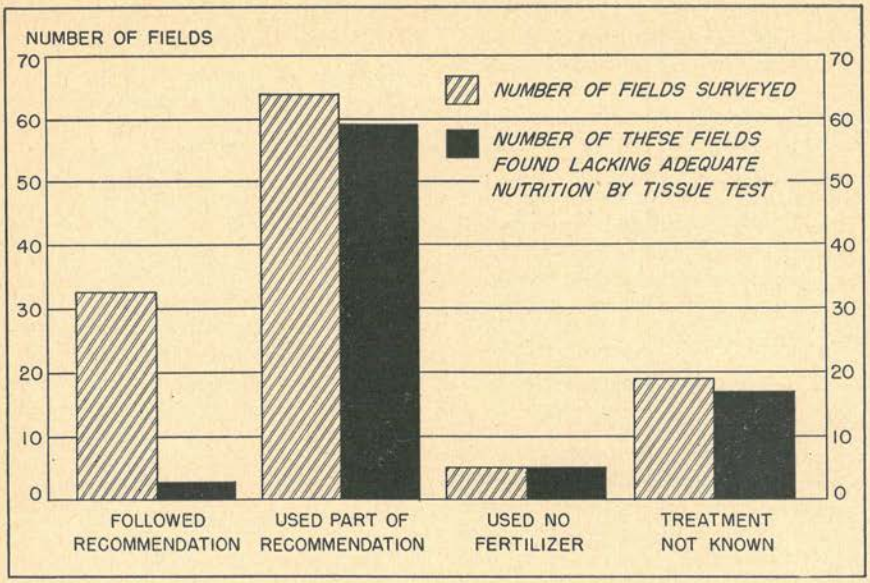


Fig. 2. Number of fields found deficient in nutrients by tissue test as related to treatment.

3. ***Use of the Test Papers***—If the test papers (directions in appendix) are large enough, the potassium test can be made on one half of the paper and the nitrogen and the phosphorus tests on the other half. The dots on

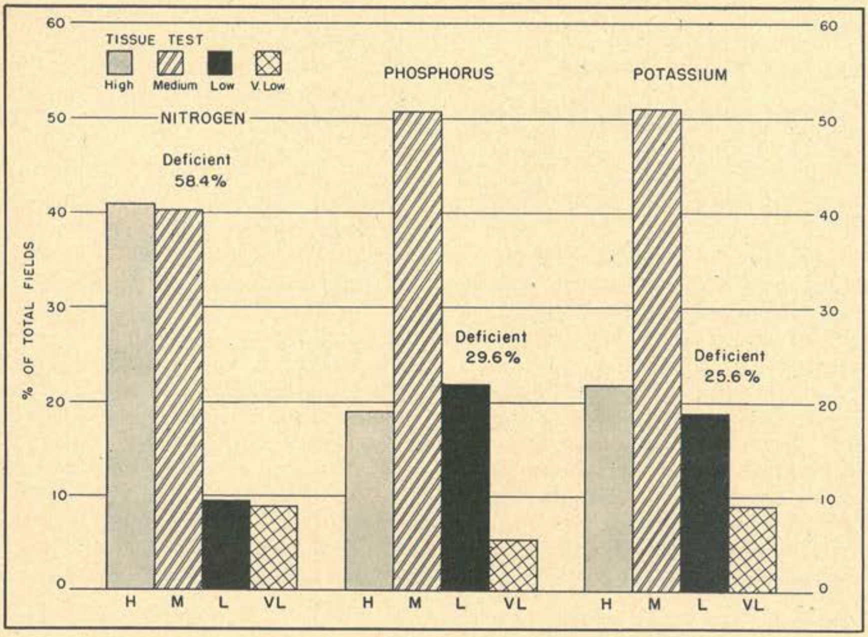


Fig. 3. Percentages of fields falling into each classification by tissue test.

the potassium side represent concentrations of 1,000, 2,000, and 3,000 ppm. (parts per million) of potasium when the test is run.

The picture on the first page of this article demonstrates the process of extracting plant sap with the pliers. Note that as near as possible the sap is extracted from the cut end of the petiole without undue mashing of the plant material. For each of the tests, (N, P, & K) cut or break a new section of the petiole.

Nitrate-Nitrogen

Cut or break the petiole or stem, fold a corner of the test paper, lay the petiole or stem in the fold, and sprinkle a small amount of the nitrate powder on the plant material. Squeeze the folded paper and plant material, making sure the powder is in contact with the sap. In the presence of nitrate, the powder turns red. The readings follow:

READING	LEVEL	INTERPRETATION
Remains white	Very low	Extreme deficiency
Faint pink	Low	Deficient
Pink to light red	Medium	Questionable level. May require additional nitrogen
Red	High	Sufficient nitrogen

The test can be made directly on plant material, as on the cut cornstalk. After the powder has been applied, use a clean knife blade to work it into the tissues.

Some plants, like cotton, (except when plants are very young) contain red pigments which may mask the true nitrate reading on the test paper. In his tissue-testing work, R. Maples of the University of Arkansas describes the following method for the nitrogen test on cotton:

1. Take 3 or more petioles, cut off and discard 1 inch of the large ends. Slice off thin segments (1 mm.) until 1/4 teaspoon is collected.

2. Place the segments with about 1/5 as much Bray nitrate powder in a test tube and add distilled water to just cover. Tamp with a stirring rod to bring powder and plant sap together in solution.

3. Add distilled water until the test tube is 1/4 full. Stir, and allow to set for 5 minutes before reading. Color intensity increases (very slowly after first 5 minutes) for about 30 minutes. Readings can be successfully made at 5 minutes if the tester has experience with the test. Color range is from white or light pink for very low to cherry red for high with increasing amounts of nitrate present.

Testing plants in early morning hours is not advisable. This test measures the readily available nitrate form of nitrogen, and nitrate is being converted into other forms of nitrogen in the plant. Even plants growing under low nitrogen conditions may have some nitrate present until the day warms up and plant processes are in full swing. Nitrogen uptake can be influenced by weather conditions. If the reading is doubtful, repeat the test in 2 or 3 days.

Phosphorus

Squeeze sap from the cut end of the plant material onto a blank portion of the test paper, add a drop of the P-K reagent No. 1, then a drop of P reagent No. 2. (Shake before using.)

A bright tin rod or spoon can be used in place of P reagent No. 2, but the tester is cautioned to rub the phosphorus test area with the tin immediately after adding the drop of P-K No. 1 to insure contact with the wetted paper. Do not touch the test areas with the fingers as they are likely to cause phosphorus or nitrate contamination.

(Turn to page 45)

The Placement of Fertilizers for Peanuts

By J. G. Futral[1]

Department of Agricultural Engineering, Georgia Agricultural Experiment Station, Experiment, Georgia

YEARS of work with peanut fertilizers have produced a mass of unsatisfactory and inconsistent data. The problem is admittedly one of the most difficult ever tackled by research workers. However, a few facts seem to be well established.

It is known that peanuts are highly susceptible to injury when fertilizers are placed too near the seed. A high concentration of some fertilizer elements in the pegging zone will damage seed quality, yet a high concentration of calcium is needed in the top 2″ of soil for good yields of large-seeded peanuts. Also, the application of moderate amounts of complete fertilizers may cause reduced yields when insufficient calcium is present.

Most of the fertilizers used in the Georgia peanut research work were applied in a furrow, stirred into the soil, bedded, and allowed to remain in this state for two weeks, or until it rained, before the seed were planted. In a few cases fertilizers were applied 4″ deep and 2″ to one side of the seed at planting. Under these conditions, fertilizer injury was seldom visible.

This technique of fertilizer application gave variable results. Without calcium amendments, phosphate decreased the yields of Spanish peanuts in over half the tests. Most of the increases from fertilizer came from applied nitrogen or from a combination of nitrogen and potash. When calcium was applied as either limestone or gypsum, responses to phosphate and potash were much higher, while those to nitrogen were lowered. On runner peanuts all fertilizers usually decreased yields when no supplemental calcium was applied.

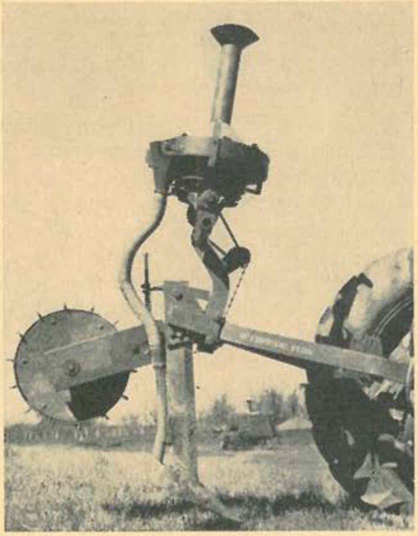


Fig. 1. Precision fertilizer metering hopper on subsoil plow for accurate placement of fertilizer at any depth to 14 inches.

Other investigations showed considerable differences between peanut types in their response to fertilizers. Spanish responded only to nitrogen, while larger-seeded peanuts responded to phosphate and potash when calcium was supplied. Their nitrogen response was about half that of Spanish. A very

[1] This work is being carried out with the cooperation of the Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, S. A. Parham, Agronomist, Coastal Plain Experiment Station, Tifton, and N. D. McRainey and O. L. Brooks, Superintendents of the Southwest and Southeast Branch Experiment Stations at Plains and Midville, respectively.

Paper No. 300 Journal Series, Ga. Experiment Station, Experiment, Ga.

TABLE I.—SPANISH PEANUT FERTILIZER PLACEMENT TESTS.

Treatment [1]	Acre yield peanuts in pods				
	Plains 1952	Plains 1953	Plains 1954	Tifton 1953	Average
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
No fertilizer	1,310	1,071	1,089	1,837	1,327
Fertilizer 4″ deep, 2″ to side	1,378	1,219	1,240	1,724	1,390
No fertilizer, chiseled 8″ deep	1,356	1,166	1,102	1,840	1,366
Fertilizer 8″ deep, under	1,525	1,259	1,223	2,017	1,506
No fertilizer, chiseled 14″ deep	1,353	1,020	1,366	1,969	1,427
Fertilizer 14″ deep, under	1,418	1,290	1,408	2,051	1,542

[1] Fertilizer used was a 30-40-30 equivalent to 500 lbs. of a 6-8-6 per acre. In addition, 500 lbs. of dolomite per acre were mixed with the fertilizer. Spanish peanuts were planted.

definite relationship was shown between seed size and response to calcium. By tailoring fertilizers and calcium amendments to the known responses of different varieties, an improvement was made in consistency of results.

High yields are frequently made when peanuts follow a heavily fertilized crop, whether or not fertilizers are used specifically for the peanuts. Since a peanut plant has an extensive taproot system and shows responses to zone placement of calcium, it was decided to investigate the effects of depth of fertilizer placement on yields.

The apparatus used consists of a precision fertilizer hopper designed by engineers at the Georgia Experiment Station, and a subsoil plow with a thin straight shank. The fertilizer hopper meters fertilizer with less than 2% error at any point along the row. The plow is hydraulically controlled and will accurately maintain any depth from surface to 14″.

A placement 4″ deep and 2″ to the side of the seed was selected as a check. Compared with this were placements 8″ and 14″ deep, directly under the seed. To measure any effect of soil disturbance or subsoiling independently of the effect of the fertilizer, the plots were paired so that for each plot receiving fertilizer, another was used with the plow running at the specified depth without fertilizer. Results are shown in Table I.

The soil at Plains is a Greenville clay loam, very stiff and difficult to work. A deep phase of Tifton sandy loam was used at Tifton. To obtain an accurate 14-inch depth at Plains it was necessary first to run the plow as deep as the tractor could handle it, usually about 12″ inches, then to return in the same furrow, placing the fertilizer at the 14-inch depth.

Climatic conditions varied widely during the three years reported. The year 1952 started off with fair rainfall but finished dry. Rainfall was excellent in 1953, but 1954 was one of the driest years on record. In 1954, yields at Plains were among the highest reported in the State, but the Tifton test was lost because of drought conditions. In spite of the extreme variation in climate and soils, with one exception, yields were higher following the 8- and 14-inch placements than on the conventional placement. Results are summarized in Table II where increases over the no-fertilizer treatment are shown.

The highest average response to fertilizer was at the 8-inch depth, but chiseling the soil to a depth of 8″ failed to produce any significant increases. The effect of chiseling the soil to a 14-inch depth was variable, but a highly significant increase was shown by this treatment in the drought year at Plains. The only significant increase from fer-

(Turn to page 42)

Fertilizer Placement for Corn in Minnesota[1]

By John M. MacGregor[2] and Virgil H. Johnson[3]

Agricultural Experiment Station, St. Paul, Minnesota

THE question of how and where fertilizer should be placed in the soil for most economical returns on succeeding crops is of perennial interest. Placement is a relatively minor expense in comparison to initial fertilizer cost. If a farmer could obtain only a slight yield increase over a number of years by more efficient fertilizer placement, the cost of improved fertilizing equipment would be well justified, provided additional power and labor requirements were not substantially greater than with present equipment.

The beneficial effects of fertilizer phosphate for early development of the plant are well known. This suggests that maximum effectiveness would be secured if phosphate placement close to the seed could be provided. It is well

[1] Paper No. 910 of the Miscellaneous Journal Series, Minnesota Agricultural Experiment Station.
[2] Associate Professor of Soils, University of Minnesota.
[3] Formerly Assistant Professor of Agricultural Engineering, University of Minnesota. Now Engineer, Caterpillar Tractor Company, Decatur, Illinois.

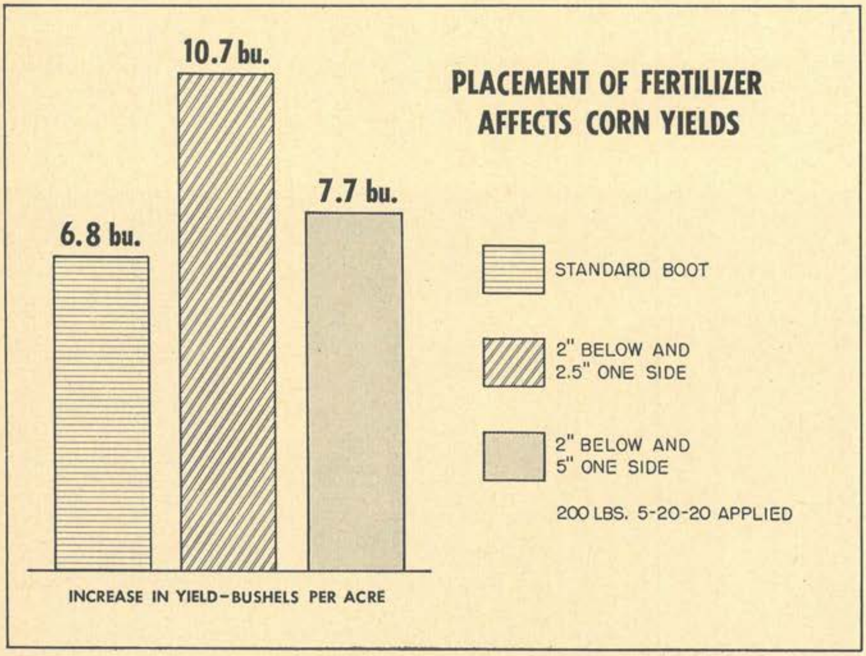


Fig. 1. Placement of 200 lbs. of 5-20-20 in bands 2.5" to one side and 2" below the seed increased yields of corn 3.9 bushels more than did the standard boot placement. Corn stands may be seriously reduced by placement of starter fertilizer in contact with the seed.

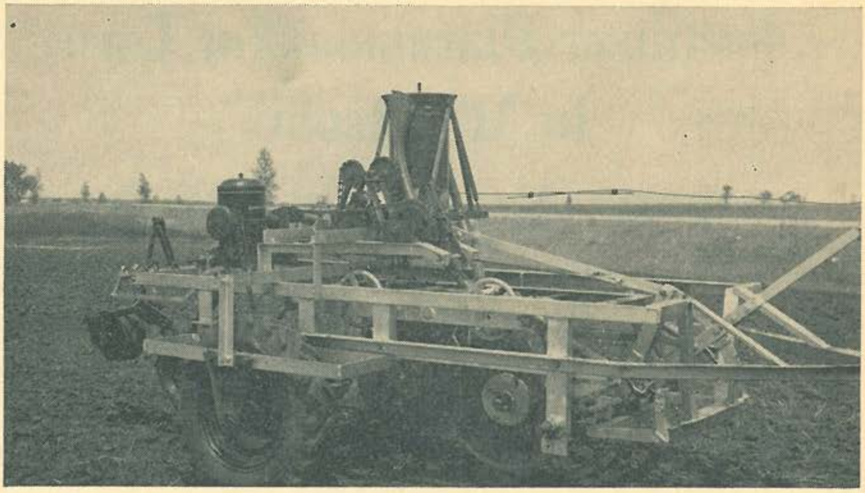


Fig. 2. Experimental one-row corn planter with two 24" discs for different lateral and vertical fertilizer band placement. Designed and constructed by the Department of Agricultural Engineering, Minnesota Agricultural Experiment Station, St. Paul.

known that most solid phosphate fertilizer materials now available have little caustic or salt effect on germinating seeds.

Since nitrogen and potash salts are usually considerably more soluble in the soil than most phosphatic materials, and are not required in such large amounts in the early growing season, it is important that large amounts of either nitrogen or potash are not applied close to the seed. If complete fertilizers could be applied a few inches away from the seed, there would be little or no seedling damage from high concentrations of either nitrogen or of potash and yet the application would be sufficiently close for maximum phosphate effect. It is well known that corn stands are often seriously reduced by improper placement of the starter fertilizer in contact with the seed. In-

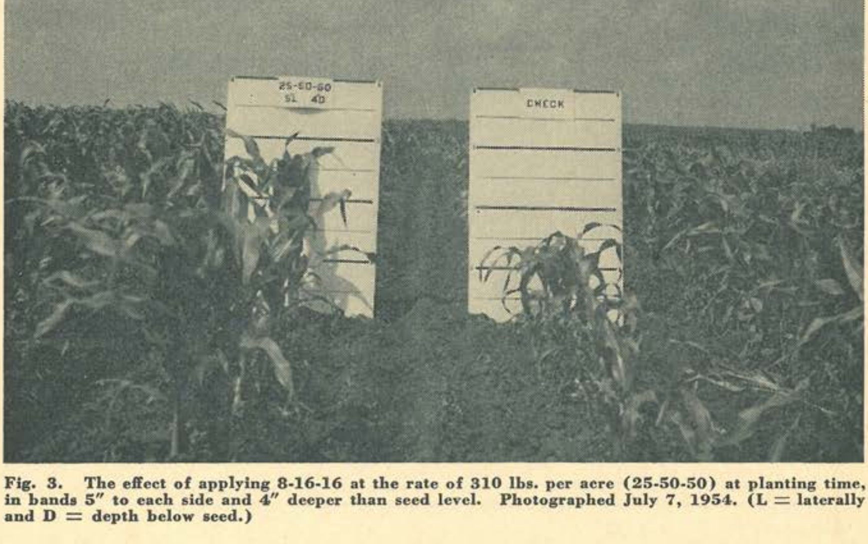


Fig. 3. The effect of applying 8-16-16 at the rate of 310 lbs. per acre (25-50-50) at planting time, in bands 5" to each side and 4" deeper than seed level. Photographed July 7, 1954. (L = laterally and D = depth below seed.)

Fig. 4. Deeper fertilizer placement appears to stimulate early corn growth. Fertilizer applied to both rows of corn 1" on each side of seed at planting time. Left—2" deeper than seed level. Right—fertilizer bands level with seed. Photographed July 7, 1954.

adequate corn plant population is known to be one of the common reasons for unsatisfactory yield response to fertilizer applications in Minnesota.

A few years ago, emphasis was being given to applying fertilizer in a band on the plow sole, especially if heavy application rates were to be used. Caldwell, MacGregor, and Rost (1) reported that such application was not any more promising on the fertile fine-textured soils of southern Minnesota than was broadcasting and plowing down the fertilizer, nor was it superior to the application of lesser amounts of fertilizer in the hill or in the row at planting time. Subsequently, MacGregor (2) reported on the comparative effects of plow-sole applications and hill-dropped fertilizer using up to 40 pounds per acre of each of the three major fertilizer nutrient elements on

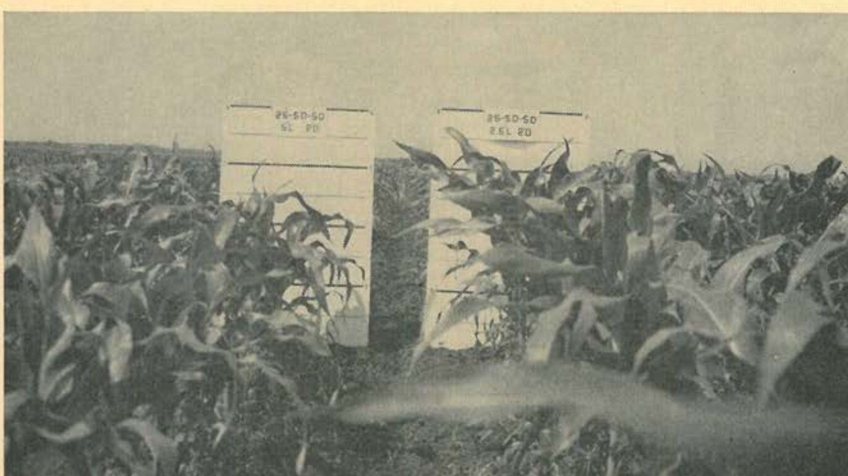


Fig. 5. Fertilizer can be placed too far laterally for early corn development. Fertilizer banded 2" below seed level on each side of seed on both corn rows: Left—5" to each side of seed; right—fertilizer bands 2.5" on both sides of seed. Photographed July 7, 1954.

the less fertile sandy soils of the State. Hill-dropped fertilizers produced essentially the same corn yields as the plow-sole applications.

If fertilizer placement relatively close to the seed is as efficient in corn production as that applied to the plow sole, would fertilizer placements somewhat farther from the seed be advantageous? Or is the commonly used standard fertilizing shoe on the corn planter relatively efficient in fertilizer placement?

Experiments in 1951 and 1952

In the spring of 1951 a standard commercial two-row corn planter was equipped with a positive feeding fertilizer hopper and regulating mechanism, (through the courtesy of the late G. A. Cumings of the U.S. Department of Agriculture). The fertilizer was placed in bands by means of stub coulters. Waukegan silt loam was selected as the experimental soil both for reasons of convenience and its medium texture. However, it is somewhat droughty in dry seasons because of underlying sand and gravel at approximately a 24-inch depth. The pH is approximately 6.5 and soil tests have shown a medium supply of available phosphate and potash.

The plot design in all years was a randomized block with six replications. Each plot consisted of one 40-inch row, 100 feet in length, thickly planted and later thinned to a stand of approximately one plant per lineal foot. This gave a stalk population of 13,068 plants per acre. Both 1951 and 1952 experiments were the same, except that in the latter year the experimental field was on the same soil type at Rosemount, some 20 miles south of the 1951 location at University Farm in St. Paul. Two different fertilizers were used as follows:

1. 5-20-20 at the rate of 200 pounds per acre (10-40-40),
2. 10-10-10 at the rate of 200 pounds per acre (20-20-20).

The two fertilizers were placed in three different positions in respect to the planted corn seed. These were:

1. Standard boot placement (in bands),
2. Two inches below and 2.5″ to one side of the seed (in bands),

TABLE I.—THE EFFECT OF FERTILIZER PLACEMENT IN WAUKEGAN SILT LOAM (MINNESOTA) ON THE 1951 AND 1952 YIELDS OF FIELD CORN.#

Nutrients applied (lbs/A)	Band placement to one side of seed	Yield of ear corn—15.5% moisture (bu/A)		Two-year average yield (bu/A)
		1951 (St. Paul)	1952 (Rosemount)	
None		65.4	78.3	71.8
		Increase above unfertilized yields		
10–40–40	std. fert. boot	6.8**	6.7**	6.8**
20–20–20	std. fert. boot	7.7**	7.2**	7.5**
10–40–40	2″ below and 2.5″ lateral to seed	11.0**	10.3**	10.7**
20–20–20	2″ below and 2.5″ lateral to seed	4.1	10.5**	7.3**
10–40–40	2″ below and 5″ lateral to seed	6.1*	9.2**	7.7**
20–20–20	2″ below and 5″ lateral to seed	2.7	9.2**	6.0**
* Significant (5%)		4.7 bu.	4.1 bu.	3.3 bu.
** Significant (1%)		6.7 bu.	5.6 bu.	4.3 bu.

Corn population = 13,068 stalks per acre.

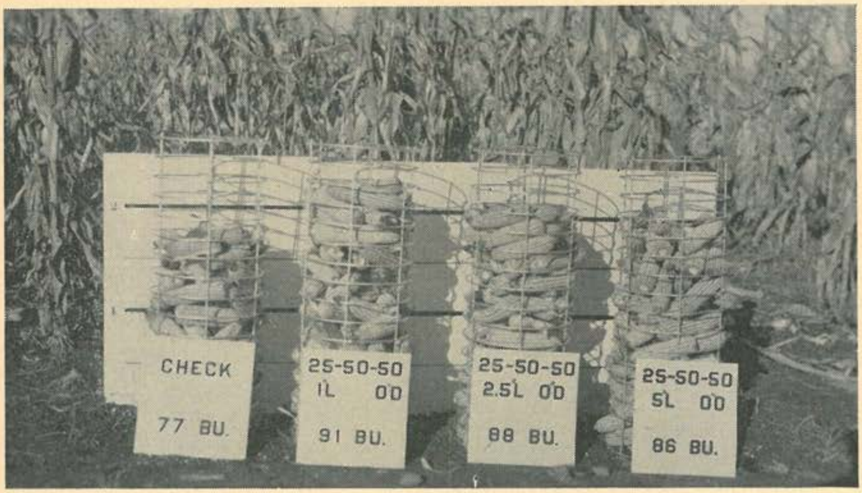


Fig. 6. Ear corn yields in 1954. As in all four years of harvest, fertilizer significantly increased yields of ear corn. Although fertilizer placement appeared effective until mid-July, there were only small differences in corn yield due to lateral placement of fertilizer.

3. Two inches below and 5″ to one side of the seed (in bands).

Both fertilizers produced a marked effect on vegetative growth with all three placements, the fertilized corn being considerably taller than the unfertilized plants until the corn tasselled late in July. Placement 2 (2″ below and 2.5″ to one side of the seed) appeared to be somewhat more effective at this time than the other two placements, especially where the 5-20-20 was applied. After tasselling, however, corn growing on all three fertilizer placements appeared to be essentially the same height.

The effect of the three placements are shown in Table I. It is evident that the two fertilizers were effective for increasing corn yield, all of these increases being highly significant when averaged over the two-year period. The 5-20-20 fertilizer produced sig-

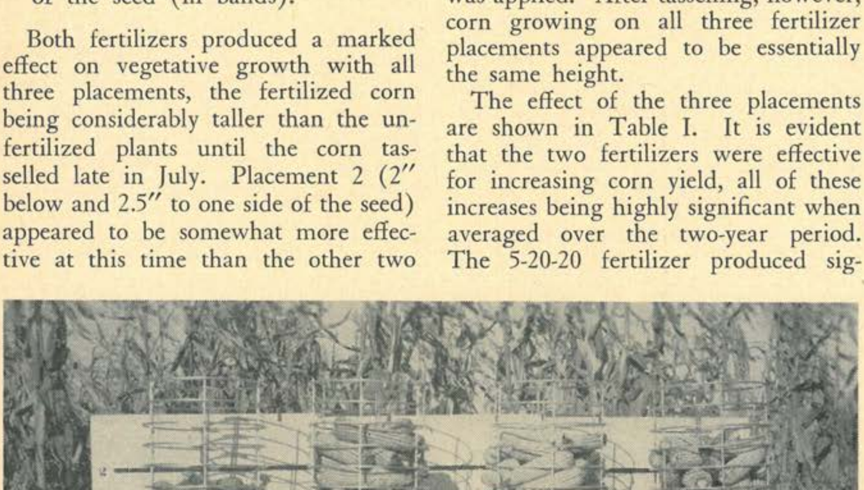


Fig. 7. Ear corn yields in 1954. There were no significant increases in corn yield with deeper fertilizer placement.

TABLE II.—THE EFFECT OF FERTILIZER PLACEMENT IN WAUKEGAN SILT LOAM (MINNESOTA) ON THE 1954 AND 1955 YIELDS OF FIELD CORN AT ROSEMOUNT.#

Nutrients applied (lbs/A)	Band placement on two sides of seed	Yield of ear corn—15.5% moisture (bu/A)		Two-year average yield (bu/A)
		1954	1955	
None	....	76.6	84.7	80.7
		Increase above unfertilized yields		
25–50–50	Level with seed and 1″ laterally......	14.2**	−0.6	6.8**
"	2″ below seed level and 1″ laterally...	13.4**	3.4	8.4**
"	4″ below seed level and 1″ laterally...	13.6**	5.0	9.3**
"	Level with seed and 2.5″ laterally....	11.8*	4.8	8.3**
"	2″ below seed level and 2.5″ laterally..	13.0**	11.9*	12.5**
"	4″ below seed level and 2.5″ laterally..	11.2*	5.1	8.2**
"	Level with seed and 5″ laterally.....	9.2*	9.5*	9.4**
"	2″ below seed level and 5″ laterally...	12.9**	6.5	9.7**
"	4″ below seed level and 5″ laterally...	15.3**	7.6*	11.5**
* Significant (5%)........................		9.1 bu.	7.6 bu.	5.0 bu.
** Significant (1%)........................		12.1 bu.	....	6.6 bu.
# Corn population = 13,068 stalks per acre.				

nificantly higher corn yields for the two years when placed 2″ below and 2.5″ to one side of the seed than did the split boot or the more distant 5-inch lateral placement. This is graphically shown in Figure 1.

Experiments in 1954 and 1955

The Department of Agricultural Engineering constructed an experimental one-row corn planter which, by utilizing two adjustable 24-inch double discs allowed the fertilizer bands to be placed up to 5″ laterally on both sides of the seed and as much as 4″ below seed level. The experimental fertilizer-planter is shown in Figure 2.

During the past several years there has been a steady trend toward using larger amounts of starter fertilizer per acre on corn. The nitrogen content of these fertilizers is increasing. With the new experimental planter and fertilizer applicator available, it seemed advisable to apply 8-16-16 slightly in excess of 300 pounds per acre (25-50-50).

As in 1951 and 1952, the corn was thinned to a population of 13,068 plants per acre, but the fertilizer was banded on both sides of the seed. The fertilizer placements, of which No. 2 would be the placement most closely resembling that of the split boot now most frequently used, were as follows:

1. Check — no fertilizer,
2. Level with the seed and 1″ laterally,
3. Two inches below seed level and 1″ laterally,
4. Four inches below seed level and 1″ laterally,
5. Level with the seed and 2.5″ laterally,
6. Two inches below seed level and 2.5″ laterally,
7. Four inches below seed level and 2.5″ laterally,
8. Level with the seed and 5″ laterally,
9. Two inches below the seed and 5″ laterally,
10. Four inches below seed level and 5″ laterally.

Precipitation was ample and reasonably well distributed in 1954, but the spring of 1955 was relatively dry. As in the previous years, there were not

(Turn to page 44)

Soil Testing and Fertilizer— A Night Course for Industry

By William A. Seay

Department of Agronomy, University of Kentucky, Lexington, Kentucky

ADULT night classes have been conducted for years in many colleges and universities. However, most of these classes have been in typing, business administration, salesmanship, etc. Most land-grant agricultural colleges conduct one- or two-day short courses in many subject matter areas, including fertilizers. The Kentucky Agricultural Extension Service has been active in this type of instruction, including district dealer and distributor meetings. Last year, however, several Kentucky fertilizer salesmen pointed out the problems they had in trying to keep up with the progress in soil fertility and fertilizer technology. They pointed out that they could take night courses in sales, etc., but that a course in fertilizers would more nearly fit their needs.

First Night Course In Fertilizers

The University of Kentucky's new College of Adult and Extension Education is well designed to meet the needs of this type group. If enough interest is evident, the college arranges for a university professor to teach a night course in the desired subject. Last fall, due to the interest in fertilizers and soil fertility, such a course was arranged to be taught by the writer, a professor of soils at the university. This was the first agricultural course taught by the College of Adult and Extension Education and one of the first, if not the first, night course in fertilizers and soil fertility taught by a land-grant college.

Although a course in soil fertility and fertilizers has been taught for many years in the agronomy department for full-time students, obviously such a course should be modified somewhat to fit the needs of people who have a fairly good background in fertilizers. On the other hand, it was expected that the educational background of the students would be quite diverse. Some would be graduates of agricultural colleges, some would have been commerce or general arts majors, and some would have had little or no college training.

Students From Many Backgrounds

The class which was finally organized consisted of 24 students—and the instructor, for he learned much more than the students! The students' backgrounds were really diverse, ranging all the way from no college training to some graduate work. College graduates had majored in political science, business administration, history, animal industry, general agriculture, and agronomy. Other students who had not finished college had been majoring in engineering and commerce. A farm manager, soil conservationist, and a vocational agriculture teacher were in the group. Two full-time students enrolled in the course; one was a graduate and one an undergraduate. The rest of the group were dealers, salesmen, plant managers, office managers, and public relations men of the fertilizer industry. This course was the most interesting the instructor has ever taught, the class the most attentive, and not one lagged behind or had trouble. Two prime factors were present. Fertilizers and soil fertility were bread and butter to

Fig. 1. Class members were: (front row from left) Earl Thompson, Cooperative Fertilizer Service (CFS), Earl Miller, Owingsville Farmer Supply, Richard Snelling, SCS, Vincent Bailey, CFS, Rue Wallace, International Minerals; (second row from left) Reed Cromer, Knoxville Fertilizer, Eugene Cecil, CFS, William Harlin, graduate student, Clyde Jeffrey, CFS, Dr. William A. Seay, professor of soils and class instructor, Frank Ecton, Kentucky Fertilizer Works, Billy Dickerson, Kentucky Fertilizer Works; (standing from left) Robert Rouse, Knoxville Fertilizer, Harold Browning, Armour Fertilizer Works, Russell Lewis, student, Floyd Douglas, Knoxville Fertilizer, Ralph May, CFS, Robert Allgood, CFS, Othel Adams, CFS, William Gayle, Federal Chemical, John Cooper, farm manager, and William Holbrook, vocational agriculture teacher. Maurice Williams, CFS and Barney Tucker, Knoxville Fertilizer were absent.

these men. They had an intense desire to learn. Some came a distance of 85 miles to class.

Since travel was a problem, class was held only once each week, but three instructional periods were covered each evening, so that the course carried three hours' credit. Ten students took the course for credit. The other students elected to take the course without credit. Monday was selected as the meeting night. This interfered least with those having a sales route to cover. It is likely that such a course would be attended by fertilizer industry representatives only in the fall semester as the spring season is too busy for them.

Certain textbooks are very helpful in teaching the usual college course in fertilizers. However, for a group interested in current problems, a textbook is not suitable. By the time an author collects his material and the publisher gets this material published, the information is a few years behind the times. Collings' "Commercial Fertilizers" (McGraw-Hill) was suggested as a reference but most of the information was gained from current periodicals and from publications of the Kentucky Agricultural Experiment Station. Sources of material, reprints, and information were from the National Plant Food Institute, Chilean Nitrate Educational Bureau, Agricultural Ammonia Institute, American Potash Institute, TVA, USDA, and a host of individual companies and current periodicals. One of the first periods was devoted to "Fertilizer Literature" during which the students learned where to find information. A 3-page mimeograph of periodicals and books was prepared and distributed. Much material was extracted and mimeographed for use in various subject matter areas in the course.

The course was divided into five parts —introduction, soil fertility and acidity, special uses of fertilizers, technical problems with fertilizers, and "social" problems with fertilizers. The introduction included five periods on review of fertilizer terminology, fertilizer literature, location of Kentucky manufacturers, fertilizer and lime organizations, and field days and farm meetings conducted by the experiment station.

Soil Fertility and Acidity

This section made up the bulk of the course. Included were deficiency symptoms, correcting soil acidity, recommendations for liming and fertilizing Kentucky crops like tobacco, corn, forages, vegetables, etc. Also included were organic matter, irrigation, soil testing, test plot demonstrations, and use of soil maps. Agronomy department circulars, bulletins, and other publications were most useful.

This part of the course might well be considered the most important. Here industry representatives find out how soil fertility experiments are conducted by the experiment station. They see the results of fertilizer and lime applications. They gain confidence in the recommendations made by the experiment station, and questions are answered concerning "why" various results are obtained.

Equally important is acquainting industry with soil testing and how it can be used to aid in selling the correct grade and ratio for best results. Kentucky has more than 100 county soil-testing laboratories and many dealers encourage farmers to test their soil at the local laboratory before ordering their fertilizer. The soil-testing laboratory and fertilizer-control laboratories at the experiment station were visited, the methods used were demonstrated, and the use and mission of these laboratories explained.

Special Uses and Technical Problems

New products and techniques were introduced in part of the course concerned with special uses of fertilizers. Liquid fertilizers, slowly available materials, foliar application, fertilizer-pesticide mixtures, and the use of radioactive fertilizers for research purposes were discussed.

Nine periods dealt with technical

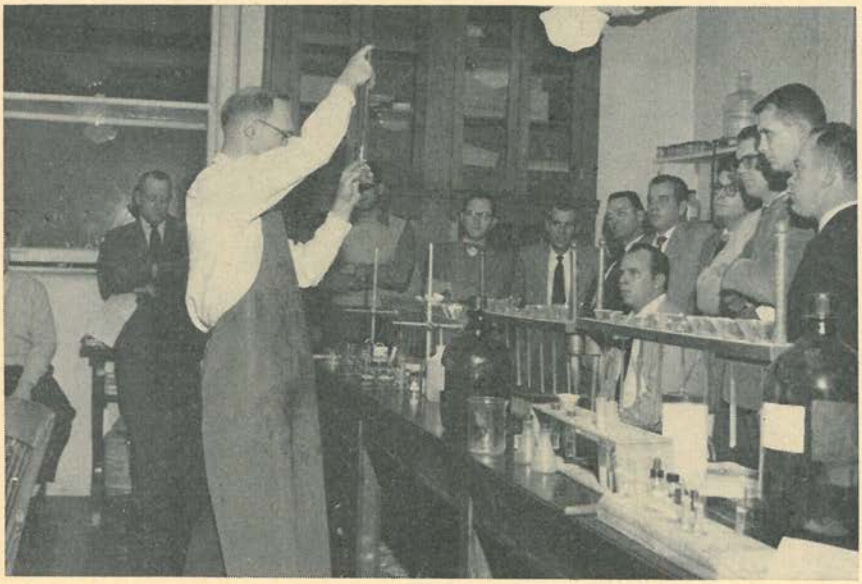


Fig. 2. Students watch John Harrison of the University of Kentucky's Department of Agronomy demonstrate procedures used in testing soils at the Kentucky Agricultural Experiment Station.

problems such as manufacturing research, 1955-56 production facilities, ammoniation, calculating formulae, granulation, conditioners, and distributing machinery. The use of minor elements was discussed and method of producing some of the nitric, aluminum, and other new phosphates was explained.

"Social" Problems With Fertilizer

In some 10 periods many of the controversial questions in fertilizers and soil fertility were covered. Such topics included "organic farming," seasonal application, high vs. low analyses, changing guarantees to the elemental basis, and fertilizer control. Other topics were TVA, fertilizers vs. farm surpluses, fertilizer trends, sales techniques and fertilizer's future, progress, and problems.

This latter part of the course resulted in much discussion. Some preconceived opinions were modified somewhat when both sides of the questions were presented.

Appreciation of Problems of Others

The course, without doubt, gave the fertilizer industry representatives an appreciation of some of the problems confronting the research worker in agricultural experiment stations. Much respect for and understanding of the vast amount of work behind experiment station recommendations were apparent by the end of the course.

On the other hand, the instructor certainly received a liberal education concerning the problems facing fertilizer dealers, salesmen, and manufacturers. Much appreciation had been gained previously at "one-night-stand" dealer meetings and at one-day annual joint meetings of Kentucky Agricultural Experiment Station and fertilizer industry representatives. However, the close contact during an 18-week semester was even more helpful.

The writer heartily recommends such a course for closer ties between industry and experiment stations as well as a teaching method of soils and fertilizers to industry representatives.

Fig. 3. Harry Allen of the Feeds and Fertilizers Department at the University of Kentucky shows students how fertilizers are analyzed in the Fertilizer Control Laboratory.

Watershed Protection and Flood Prevention

By Donald A. Williams

Soil Conservation Service, U. S. Department of Agriculture,
Washington, D. C.

THE tragedies of the "little" floods that sweep down the nation's small streams are coming to light in requests for help under the Watershed Protection and Flood Prevention Act of 1954. These floods are "little" only because, individually, they bring suffering and damage to many times fewer people than the headline-making disasters that roll across state after state toward the Gulf of Mexico or the oceans. But the total loss is huge—about $700 million each year from the frequent floods in the upper reaches of river basins.

Farm and town people alike are the victims. Look what happened in 1950 in Wild Horse Canyon of Morrill County, Nebraska:

"The Farmers Irrigation District had the makings of one of the most successful operating seasons in the history up to August 25, and that afternoon nature sent almost a year's allotment of water in a few hours. The rain piled up walls of water, in some places 3 and 4 feet deep over the top of the main canal banks. There were four breaks in the main canal. This same flood washed out and destroyed a large number of highway bridges, which will require many thousands of dollars to replace.

"There was a judgment suit of $22,500 filed against the district, resulting from this flood. The claim was for damages to homes. The district won this lawsuit, but these parties were poor people, and most of their belongings were lost."

That excerpt from a report of the Four States Irrigation Council meeting in January 1954 is quoted in the application of seven local organizations in Wild Horse Canyon Watershed for flood prevention help from the Soil Conservation Service.

The 1950 flood is only one of many which for years have plagued the people of the 28,200-acre watershed. These are among the damage figures cited by local people in support of their application:

Since 1918—and mostly since 1950—irrigation districts there have spent more than $200,000 to repair flood and sediment damage. "This amount is entirely inadequate, like putting salve on a cancer," the application said. Land capable of producing $20,000 in crops each year has been lost to cultivation.

Main Street Under Water, Too

The City of Bayard many times has seen Main Street under water. The county estimates $150,000 spent in the last 10 years because of flood damage to roads, culverts, and bridges.

The Morrill County Soil Conservation District was organized by local farmers in 1940 to attack erosion and water conservation problems on farmlands. This district provides technical and other help to landowners in planning and carrying out soil and water conservation farming programs. Progress is being made. More than 40 per cent of the land in the watershed is under conservation farming plans with the district. Much of the planned work is on the land.

But the flood problem remained bigger than any individual alone could solve, whether a farmer, a citizen of the City of Bayard, or a taxpayer elsewhere in Morrill County. That's why the seven organizations decided to start a watershed project, and to ask the federal government to help under the new Watershed Protection and Flood Prevention Act. Signing the application for assistance were officials of Morrill County Soil Conservation District, Farmers, Pathfinder and Alliance Irrigation Districts, Morrill County, the City of Bayard, and the North Platte Valley Flood Control Association.

The application went to the State of Nebraska as required by law, was approved, and then was sent to the Secretary of Agriculture. The Soil Conservation Service authorized watershed planning assistance, and the first steps are now being taken toward development of a complete watershed work plan.

New Hope in Many Watersheds

Wild Horse Canyon is only one of the many watersheds where local people have taken new hope since the passage of the Watershed Protection and Flood Prevention Act. The Soil Conservation Service already has received 402 applications from 41 states. Each request for help was approved by a state agency. Probably as many more applications are pending before state agencies.

Of the 402 requests, 110 watersheds in 41 states had been authorized by late July for planning assistance by the SCS. The problems in these 110 watersheds differ only in detail or degree from those of Wild Horse Canyon.

The bottomlands of High Pine Creek in Alabama, one of the 110 watersheds are flooded two to three times a year, according to the application of the Piedmont Soil Conservation District and the governing bodies of Chambers and Randolph Counties. Because of frequent overflows, about 2,500 acres of potentially productive bottomland once cultivated are now in brush.

Erosion and run-off damage on the uplands reach on down High Pine Creek. The City of Roanoke completed a 26-acre water supply lake in 1946. The request for help said eight acres already were lost for water storage because of sedimentation. Local people reported the depth of the creek channel had decreased from six feet to one foot in the last 25 years. County roads and railway bridges and fills also were damaged by floods.

That explains why farm and urban people joined in the watershed protection request. The application is endorsed by the Roanoke Chamber of Commerce; the Pilot, Rotary, and Lions Clubs of Lafayette; the Lafayette Junior Chamber of Commerce; and the Chambers and Randolph County Farm Bureaus.

We All Live in Watersheds

For years there has been a growing recognition that land and water problems are grouped within natural boundaries—within the divides of watersheds. And watersheds come in all sizes. The land that drains into a gully or a grassed waterway is a watershed. Numerous small watersheds make up the big river basins of the country.

Whether you live on a farm, a ranch, or on a town lot, you are within a watershed. In your watershed, you share with all others there the tragedies of floods, washed-away lands, mud-filled lakes, and water shortages. You also share with others in your drainage basin the fruits of watershed protection, development, and flood prevention. An understanding of that fact is bringing rural and urban people together, as in Wild Horse Canyon and High Pine Creek, for a united attack on watershed improvement and flood prevention.

The Watershed Protection and Flood Prevention Act provides a way for federal help with these local projects. And the words "local projects" should be underscored. Federal assistance can be given only when local people decide to initiate, operate, maintain, and bear a share of the cost of their own small watershed project. In short, any work undertaken will be done as a local project with federal help; not as a federal job with local assistance. The new law supplements and supports, but does not replace already existing federal assistance with land and water problems.

Land Treatment Basic

Soil and water conservation practices applied by farmers and ranchers on their own lands will continue to be the foundation of watershed protection work. Conservation, management, and improvement of water resources must begin where the raindrop or the snowflake first reaches the soil. Floodwater-retarding structures and other flood prevention improvements would be less effective, more costly, and in some cases useless without proper use and treatment of the farm and ranch lands above them. That's the reason Congress in this new law requires that the local sponsors shall obtain agreements from landowners to carry out recommended soil and water conservation measures on at least half of the lands in a drainage area above each floodwater-retarding structure before federal help will be given.

The Soil Conservation Service already is providing technical help to farmers and ranchers in soil conservation districts who wish to plan and carry out conservation programs. This assistance will be continued, of course, in authorized watershed projects. It even may be increased if necessary to complete the land treatment work within the agreed timetable of the project.

Farmers and ranchers also will continue to have the cost-sharing help of the Agricultural Conservation Program Service, the educational assistance of Extension Service county agents and vocational teachers, and the help of many other local, state, and federal agencies. Where necessary to help meet project deadlines, these types of aid may also be speeded by agreement between the local watershed sponsor and the agencies.

When Federal Help Given

Federal assistance under the new law begins when local people have done, are doing, or are ready to do everything possible with existing assistance to protect and improve their watersheds. In this way, Congress paved the way for a joint attack on the really tough watershed problems which individuals cannot solve with technical, cost-sharing, credit, research, and educational help already available. Solution of these bigger problems usually requires the teamwork of groups of landowners, whole communities, towns, cities, and local, state, and federal governments.

Depending on the problems, two types of measures may be used: 1—Structures for flood prevention; and 2—improvements for agricultural water management. Some form of federal help is available for both. Groups of landowners, communities, and the general public must benefit before this help can be given.

For Flood Prevention

Dams, other structures, and special measures will be used to reduce damage from erosion, flood water, and sediment. There are two kinds of flood prevention measures. One type prevents the destruction of land and, therefore, reduces the movement of huge and damaging amounts of silt, sand, and stone to stream channels and lower lands. An example is the healing of the larger gullies and larger areas of severely eroding lands by planting trees, grasses, legumes or building structures as necessary. The other type of measure controls waterflow and water-borne sediment that cause damage to groups of landowners, communities, and the general public. An example is the floodwater-retarding dam.

For Agricultural Water Management

Help is available for three types of agricultural water management: 1—Drainage; 2—irrigation; and 3—measures to provide a more uniform supply and distribution of water.

Drainage measures will provide for more efficient land use on existing farms and ranches. The work can include all parts of a group drainage system, either open ditch or tile.

Irrigation measures include: Diversion dams, wells, pumping plants, sluiceways, canal headworks, canal laterals, and main distribution pipelines to carry project water to farms. Local people are responsible for the cost of providing capacity in a structure for any purpose other than flood prevention.

Help also may be given to provide a more uniform supply and distribution of water for agricultural use by two or more landowners if the improvements are a part of the watershed plan. These measures will be designed to make annual streamflow more stable, to increase recharge of groundwater reservoirs, for community-wide distribution of water for livestock, orchard and crop spraying, and for other agricultural purposes.

Drainage or irrigation of land not previously or presently used for agricultural production must be incidental to, and not a primary purpose of, the measures for which federal help is provided.

Steps in Getting Help

The law specifies certain requirements before federal help can be given. One is that the local sponsoring organization have authority from the state to start, carry out, maintain, award contracts, and share the costs of upstream watershed conservation and flood prevention. Another is that the application be sent to an agency of the state designated by the governor.

Help can be given only in watersheds and watershed areas smaller than 250,000 acres, and then only when the benefits of the proposed work are greater than the costs. However, more than one such area may be planned together upon request of local organizations.

In most states, soil conservation districts have authority to sponsor small watershed projects, their attorney generals have ruled. Municipalities, counties, flood control, conservancy, drainage, irrigation, and other special purpose districts may also have this authority.

Since passage of the Watershed Protection and Flood Prevention Act, many states have reviewed their laws to determine what legislation if any is required to enable state agencies and local organizations to participate in watershed development. Some states found that their local agencies lacked needed authority, and already have passed or are preparing to enact enabling legislation.

If the watershed crosses state lines, as many do, the application must be sent to the appropriate agency of each state. An example is Walnut Creek Watershed which contains about 72,000 acres in Kansas and about 3,500 acres in Nebraska. The application was approved by both Governor Fred Hall's Agricultural Watershed and Flood Protection Prevention Review Committee and by Governor Victor E. Anderson's Advisory Committee on Watershed Protection and Flood Prevention Act.

Policy of the federal government is not to consider an application for planning assistance if the state disapproves it. The law provides for federal help with watershed works of improvement only after it has been "determined that the benefits exceed the costs."

Benefits from some measures will be figured in dollars and cents. Department policy is to require a favorable ratio of monetary benefits to costs for

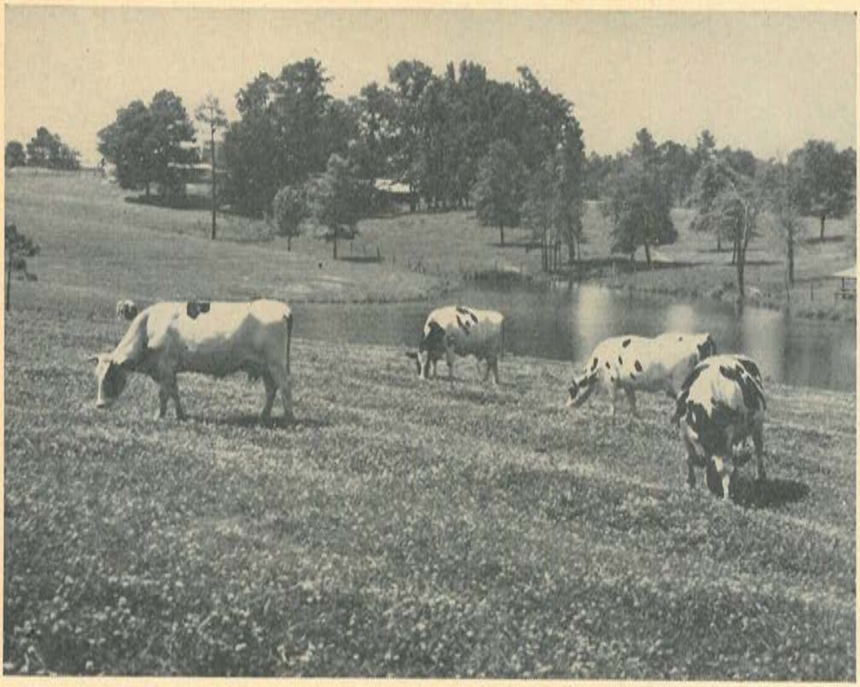
(Turn to page 41)

Above: Water sweeping topsoil and plant food from this field rushes to join uncontrolled water from other bare lands.

Below: It takes the public's tax dollars to repair damage to highways, and farmers' loss of income hurts Main Street.

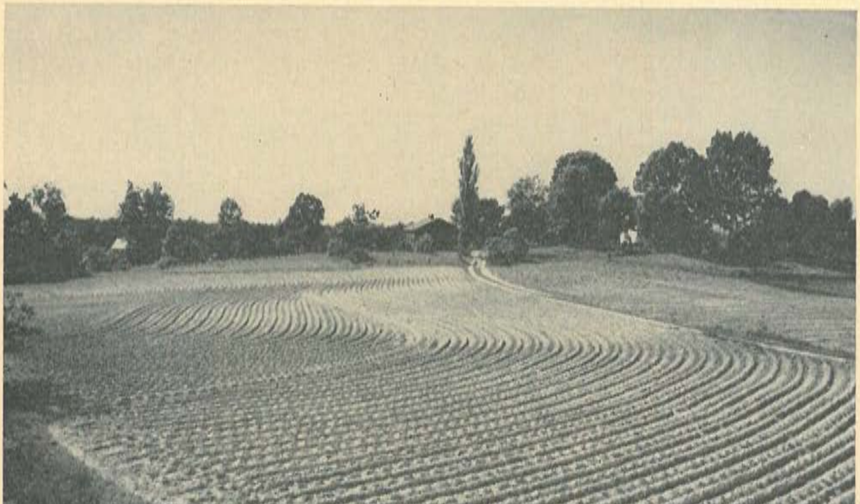
Above: Flood prevention begins here, where gullies speed the raindrops to the creeks.

Below: Trees are healing the land wounds (see above) and slowing down run-off water.



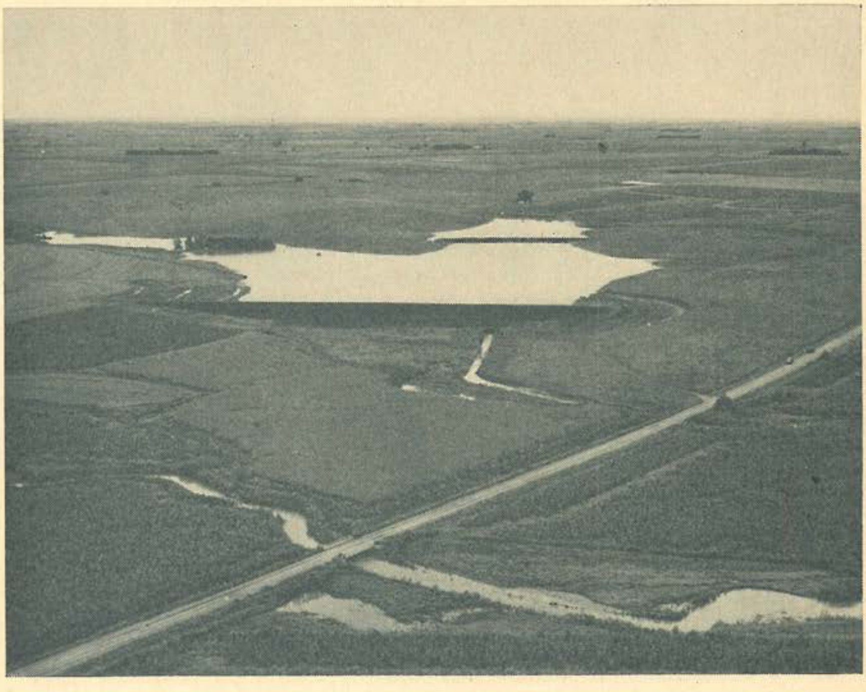
Above: Pasture on this slope uses water to produce feed, and the pond stores water for livestock.

Below: Flood prevention also begins here, with conservation practices on fields suited for cultivation.



Above: The water that isn't stored in the soil flows safely down a grassed waterway to the creek.

Below: Floodwaters are released slowly through 18-inch "trickle pipe" into the creek below this dam.



The Editors Talk

Our Cover Picture

One of the relatively new developments in modern agriculture is the use of tissue tests to aid in the diagnosis of "sick" crops. It sometimes is difficult to determine whether the "sickness" is due to a disease organism, an insect pest, a nutrient deficiency, or some other unfavorable factor. Many times the trouble the crop is experiencing has been erroneously ascribed to unfavorable weather conditions.

Development of the recognition of nutrient deficiency symptoms in plants has helped to run down difficulties due to insufficient supplies of the various plant foods. However, it sometimes is impossible to distinguish with certainty these symptoms from the effects of other factors that may be adversely affecting the crop. By the use of rapid tissue tests it often is possible either to confirm these deficiency symptoms or to uncover other deficiencies not readily apparent from the appearance of the plant. This latter use of tissue tests is of paramount importance since it frequently enables the grower to detect incipient deficiencies and take corrective steps before the starvation has reduced crop yield and quality.

Tissue testing is no magic solution to diagnosing plant ills, and its limitations should be recognized. A moderate deficiency of one nutrient may be hidden by the still greater deficiency of another. Even an apparent copious supply of the nutrient may merely be a result of other deficiencies limiting the plant's ability to use this nutrient. Seasonal and even daily fluctuations in a plant's capacity to absorb and utilize nutrients must be given consideration, and the proper part of the plant to be tested must be learned. Correlations between observed results and actual performance must be worked out. After one has gained experience in running the tests and interpreting the results, tissue testing becomes a valuable tool to be used along with deficiency symptoms and soil testing in diagnosing trouble and determining fertilizer requirements. Any one of these three tools probably is of maximum usefulness when it can be used in conjunction with the other two.

In this month's issue, an article—"Give Your Plants a Blood Test"—describes a system of tissue testing and gives specific directions on the preparation of samples, the purchase of chemicals and other materials needed, the conducting of the tests, and the interpretation of the results. The authors show how the system can be used for trouble shooting in the field.

The cover illustration shows an actual case history in which a tissue test revealed that the normal leaf on the left was high in nitrate, high in phosphate, and high in potash, indicating a healthy plant sufficiently supplied with plant nutrients. On the right to compare with the normal leaf is a leaf from a plant which, from typical potash starvation symptoms, appeared to be deficient in potash. This was confirmed by the results of the tissue tests shown in which the nitrate is high, phosphate high, and the potash is low, as indicated by the color reactions of the plant sap on the chemicals impregnated on the test papers as illustrated.

With Us Again

You do not have to wander far afield on one of these nice days or nights to realize that the insect army is with us again. Flies, gnats, mosquitoes, ticks, etc. make us insect-conscious and interested in every control measure developed by research. But this consciousness is largely associated with our physical discomfort. What too few of us can comprehend are the economic losses caused by the vast hordes of insects attacking our farm crops and animals.

There have been many statements, probably most of them more or less guesses, on the size of the insect army, such as—the total weight of insects on the earth today is greater than the weight of all land animals; there may be more than 200 million insects on a single acre of farmland; etc. In 1952 the U. S. Department of Agriculture devoted its Yearbook to "Insects." Concerning numbers, it is reported that recent guesses vary from 2,500,000 to 10,000,000 different kinds. How many of the different kinds? "Maybe we shall never know. But wherever we go and whether we see them or not, we are surrounded by countless millions of insects. Every forest, every field, every backyard, every roadway is a gigantic insect zoo."

After citing many estimates of stupendous losses of various sorts by various insects, it is stated: "Such figures give us pause. They are figures for fewer than 100 of the 600 or more injurious species of insects of primary importance that are known to occur in North America. They emphasize that everyone is affected in many ways by many insects, even though he might go for months without seeing or noticing an insect or any signs of insect damage. Losses caused by all insects in the United States add up to a staggering amount whether we regard it in terms of dollars, lost food and fiber, or time and materials used in combatting them. That amount, in the opinion of entomologists, is at least 4 billion dollars for an average year."

So—Let's get out our weapons against the insect army. Farmers already are busy with their poisons to protect their investments in good seed and fertilizer. Everyone can help. But before we swat and spray it might be well to read up on and learn to recognize a few of the few insects which can be classified as friends of man. Among the common ones which urbanites probably will run into are the bees, the praying mantids, and the lady beetles.

"THE American people don't very often call on the farmer and rancher to stand up and take a bow—certainly not as often as they should—but I want to say here and now that we take off our hats to you, and all our farmers, for the wonderful job of food, feed, and fiber production you have done over the years. You have contributed immensely to the health, vigor, and happiness of all our people. And you have helped industry, too. We have only 6 per cent of the world's people and 6 per cent of the world's land—yet our industrial output is equal to that of all the rest of the world combined. We could not have the cars, the steel, the electric power, the ships, the coal, the oil, the houses, the radios, the bathtubs, the running water, the clothing, and the recreation we now possess if one half, or one third, of our working force were engaged in agriculture—instead of only one ninth."—Ezra Taft Benson.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	28.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952	34.6	49.9	198.0	338.0	153.0	209.0	19.95	69.60	....
1953	32.3	52.2	78.1	244.0	148.0	204.0	17.45	52.60	....
1954	33.6	51.4	123.0	216.0	143.0	214.0	17.35	60.30	....
1955									
May	31.51	46.0	223.0	315.0	140.0	213.0	17.45	53.10	....
June	31.43	39.5	121.0	392.0	140.0	206.0	16.35	52.00	....
July	32.11	38.0	88.0	279.0	140.0	197.0	15.25	54.00	....
August	32.74	50.6	75.2	179.0	130.0	190.0	15.25	50.10	....
September	33.77	51.5	71.3	142.0	124.0	192.0	15.55	43.70	....
October	32.83	55.0	72.3	144.0	114.0	194.0	15.75	43.50	....
November	32.42	52.5	82.9	168.0	109.0	194.0	16.05	44.30	....
December	31.19	57.2	80.7	203.0	115.0	195.0	16.55	45.00	....
1956									
January	30.67	51.3	99.4	199.0	116.0	195.0	16.55	45.50	....
February	31.00	35.4	114.0	198.0	118.0	195.0	16.45	46.20	....
March	31.64	....	134.0	209.0	120.0	197.0	16.15	46.80	....
April	32.50	....	172.0	217.0	132.0	203.0	16.25	46.90	....

Index Numbers (Aug. 1909—July 1914 = 100)

Crop Year	Cotton	Tobacco	Potatoes	Sweet Potatoes	Corn	Wheat	Hay	Cottonseed	Truck Crops
1930	77	128	131	123	93	76	93	98	128
1931	46	82	66	83	50	44	73	40	107
1932	52	105	55	62	50	43	52	46	100
1933	82	130	118	79	81	84	68	57	90
1934	100	213	64	91	127	96	111	146	94
1935	90	184	85	80	102	94	63	135	116
1936	100	236	164	106	163	116	94	148	108
1937	68	204	76	89	81	109	74	87	114
1938	69	196	80	79	76	64	57	97	96
1939	73	154	100	84	88	78	67	94	98
1940	80	160	78	97	96	77	64	96	122
1941	137	264	116	105	117	107	82	211	138
1942	153	369	168	134	143	124	91	202	178
1943	160	405	188	235	174	154	125	231	270
1944	167	420	214	216	170	160	139	234	236
1945	181	366	205	232	198	170	127	227	240
1946	263	382	178	248	212	209	141	319	217
1947	257	380	232	248	336	259	148	381	262
1948	245	482	222	253	201	226	155	298	253
1949	231	459	184	244	193	213	139	192	232
1950	323	517	132	197	238	226	141	384	211
1951	306	512	233	346	259	239	164	307	269
1952	279	499	284	385	238	236	168	309	274
1953	260	522	112	278	231	231	147	233	240
1954	270	514	176	246	223	242	146	267	228
1955									
May	154	460	320	359	218	241	147	235	308
June	253	395	174	435	218	233	138	231	230
July	259	380	126	318	218	223	128	239	223
August	264	506	108	204	202	215	128	222	211
September	272	515	102	162	193	217	131	194	230
October	265	550	104	164	178	219	133	193	223
November	261	525	119	191	170	219	135	196	231
December	252	572	118	231	179	221	139	200	231
1956									
January	247	513	143	227	181	221	139	202	244
February	250	354	164	226	184	221	139	205	244
March	255	...	192	238	187	223	136	208	290
April	262	...	247	247	206	230	137	208	208

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land, pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953	.878	....	....	.410	.793	15.25	.200
1954	.895	....	....	.405	.791	15.27	.200
1955							
May	.895	....	....	.405	.825	16.00	.193
June	.895	....	....	.360	.720	13.45	.175
July	.895	....	....	.380	.735	14.00	.193
August	.895	....	....	.380	.735	14.00	.193
September	.895	....	....	.380	.735	14.00	.193
October	.895	....	....	.380	.735	14.00	.193
November	.895	....	....	.380	.735	14.00	.193
December	.895	....	....	.380	.735	14.00	.193
1956							
January	.895	....	....	.380	.735	14.00	.193
February	.895	....	....	.380	.735	14.00	.193
March	.895	....	....	.380	.735	14.00	.193
April	.895	....	....	.380	.735	14.00	.193

Index Numbers (1910-14 = 100)

1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953	164	...	...	73	83	63	83
1954	167	...	...	72	83	63	83
1955							
May	167	...	...	72	87	66	83
June	167	...	...	66	76	56	80
July	167	...	...	69	77	58	82
August	167	...	...	69	77	58	82
September	167	...	...	69	77	58	82
October	167	...	...	69	77	58	82
November	167	...	...	69	77	58	82
December	167	...	...	69	77	58	82
1956							
January	167	...	...	69	77	58	82
February	167	...	...	69	77	58	82
March	167	...	...	69	77	58	82
April	167	...	...	69	77	58	82

Wholesale Prices of Ammoniates * *

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish, scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17 % ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953	3.26	2.27	11.04	11.19	7.39	7.09
1954	3.07	2.20	11.50	11.63	9.72	9.85
1955						
May	2.98	2.16	9.97	11.92	6.19	6.25
June	2.98	2.02	9.91	11.55	6.23	5.92
July	2.98	2.02	10.01	9.43	6.68	7.14
August	2.98	2.07	9.88	11.12	7.04	6.86
September	2.98	2.05	9.30	11.60	6.75	6.53
October	2.98	2.07	9.17	13.01	7.47	7.16
November	2.98	2.07	8.71	13.10	6.14	6.23
December	2.98	2.12	9.21	12.93	5.66	6.00
1956						
January	2.98	2.12	9.43	12.75	5.58	5.58
February	2.98	2.12	8.69	12.15	5.77	5.69
March	2.98	2.12	8.30	11.89	5.92	5.92
April	2.98	2.12	8.31	11.66	5.77	5.71

Index Numbers (1910-14 = 100)

	Nitrate of soda	Sulphate of ammonia	Cottonseed meal	Fish, scrap	Tankage	High grade ground blood
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953	122	80	315	317	219	201
1954	114	77	329	330	288	280
1955						
May	111	76	285	338	184	178
June	111	71	283	327	185	168
July	111	71	286	267	198	203
August	111	73	282	315	209	195
September	111	72	266	329	200	186
October	111	73	262	369	222	203
November	111	73	249	371	182	177
December	111	74	263	366	168	170
1956						
January	111	74	269	361	166	159
February	111	74	248	344	171	162
March	111	74	237	337	176	168
April	111	74	237	330	171	162

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	130	127	86	56	130	120	77
1942	159	149	144	93	57	161	112	77
1943	193	165	151	94	57	160	117	77
1944	197	174	152	96	57	174	120	76
1945	207	180	154	97	57	175	121	76
1946	236	197	177	107	62	240	125	75
1947	276	231	222	130	74	362	139	72
1948	287	250	241	134	89	314	143	70
1949	250	240	226	137	99	319	144	70
1950	258	246	232	132	89	314	142	72
1951	302	271	258	139	93	331	152	76
1952	288	273	251	144	98	333	158	76
1953	258	262	247	139	100	269	164	77
1954	249	264	248	142	95	311	167	76
1955								
May	244	263	248	134	93	243	167	77
June	243	263	248	131	90	242	167	70
July	237	262	248	131	90	240	167	72
August	233	260	248	133	91	252	167	72
September	235	259	250	132	91	244	167	72
October	230	261	250	134	91	259	167	72
November	225	259	250	131	91	235	167	72
December	223	259	250	131	92	232	167	72
1956								
January	226	259	252	131	92	232	167	72
February	226	259	252	130	92	225	167	72
March	230	261	254	130	92	222	167	72
April	233	261	257	130	92	219	167	72

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947.

**** Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Commercial Fertilizers, Report for 1955," Agr. Exp. Sta., New Haven, Conn., Bul. 597, Nov. 1955, H. J. Fisher.

"Fertilizers, Fertilizer Materials, and Rock Phosphate Sold in Illinois, January 1, 1955 to June 30, 1955," AG1670, Oct. 1955; "Fertilizers, Fertilizer Materials, and Rock Phosphate Sold in Illinois, July 1, 1955 to December 31, 1955," AG1696, April 1956; Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., L. T. Kurtz and N. G. Pieper.

"Nitrogen Fertilizers, What They Are and How They Act," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., AG1571, April 1953.

"Maryland Fertilizer Facts for 1955," Inspection and Regulatory Service, College Park, Md.

"Inspection of Commercial Fertilizers and Agricultural Lime Products for the Season of 1955," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Control Series Bul. 166, Dec. 1955, J. W. Kuzmeski, et al.

"Guide to Fertilizer Use in Minnesota," Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., Ext. Bul. 277, Rev. March 1956.

"Missouri Commercial Fertilizer Inspection and Analysis, 1955," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 669, March 1956.

"Peaunt Fertilizer Tests," Agr. Exp. Sta., N. Mex. A. & M. College, State College, N. Mex., Res. Rpt. 1, May 1955, M. R. Pack and D. E. Buchanan.

"Nitrogen Pays for Field Crops," Agr. Ext. Serv., Pa. State Univ., University Park, Pa., Cir. 458, J. H. Eakin.

"The Influence of Nitrogen and Potassium on the Availability of Fertilizer Phosphorus," Agr. Exp. Sta., S. Dak. State College, Brookings, S. Dak., Bul. 453, Nov. 1955, L. O. Fine.

"Influence of Source of Nitrogen Fertilizer on Yields of Acala Cotton in the El Paso Valley, 1955," Prog. Rpt. 1851, Feb. 1956, D. E. Longenecker and P. J. Lyerly; "Grain Sorghum Fertilizer Trail, Amarillo Experiment Station, 1955," Prog. Rpt. 1854, March 1956, K. B. Porter; Agr. Exp. Sta., Texas A. & M. College, College Station, Texas.

Soils

"Soil and Water Conservation Studies in the Ozark Highlands Area of Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 563, Jan. 1956, G. W. Hood and R. P. Bartholomew.

"The Morrow Plots, America's Oldest Experiment Field, Established in 1876," AG-948, F. C. Bauer, C. H. Farnham, and L. B. Miller; "The Status of Minor Elements in Illinois Soils," AG1674, Jan. 1956, L. T. Kurtz; "Lessons From the Morrow Plots: The Oldest Experimental Plots in the United States," AG1686, Feb. 1956; Agr. Exp. Sta., Univ. of Ill., Urbana, Ill.

"Soils of Michigan," Agr. Exp. Sta., Mich. State Univ., East Lansing, Mich., Spec. Bul. 402, Jan. 1956, E. P. Whiteside, I. F. Schneider, and R. L. Cook.

"Surface Irrigation Development," Agr. Ext. Serv., Okla. A. & M. College, Stillwater, Okla., Cir. 571, R. B. Duffin.

"Effect of Irrigation Differentials and Planting Dates on the Growth, Yield and Fiber Characteristics of Cotton in the Lower Rio Grande Valley," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1866, April 1956, M. E. Bloodworth, C. A. Burleson, and W. R. Cowley.

"Soil Survey, St. Charles County, Missouri," USDA, Wash., D. C., Series 1939, No. 28, Jan. 1956.

"Soil Survey, Dutchess County, New York." USDA, Wash., D. C., Series 1939, No. 23.

"Soil Survey, Mecklenburg County, Virginia," USDA, Wash., D. C., Series 1942, No. 13.

Crops

"Matanuska Valley Memoir," Agr. Exp. Sta., Univ. of Alaska, Palmer, Alaska, Bul. 18, July 1955, H. A. Johnson and K. L. Stanton.

"Small Grain Managements Experiments in Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 566, Feb. 1956, R. L. Thurman.

"Arkansas Coastal Plain Corn Performance Test for 1955," Mimeo. Series 35, Dec. 1955, J. O. York; "1955 Corn Performance Test on Rice Prairie and Similar Soils," Mimeo. Series 36, Dec. 1955, J. O. York; "Arkansas Upland

Corn Performance Tests for 1955," Mimeo. Series 37, Dec. 1955, J. O. York; "Eastern Arkansas Corn Performance Tests for 1955," Mimeo. Series 38, Jan. 1956, J. O. York; Arkansas Coastal Plain Cotton Variety Test for 1955," Mimeo. Series 39, Jan. 1956, C. Hughes and J. O. Ware; "Tomato Production Experiments in Bradley County, 1955," Mimeo. Series 40, Jan. 1956, J. McFerran and G. A. Bradley; "Small Grain Fertilizer Trials, 1954-1955," Agr. Exp. Sta., Mimeo. Series 42, Feb. 1956, R. L. Beacher, R. Maples, L. H. Hileman, and J. C. Noggle; "Eastern Arkansas Cotton Variety Tests for 1955," Mimeo. Series 43, Feb. 1956, C. Hughes and J. O. Ware; "Northeast Arkansas Cotton Variety Tests for 1955," Mimeo. Series 44, Feb. 1956, B. A. Waddle, C. Hughes, and J. F. Jacks; Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark.

"Tomato Varieties for the Northeast Georgia Piedmont," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 2, Jan. 1955, F. E. Johnstone, Jr. and R. T. Holmes.

"Truck Crops for the Coastal Plain of Georgia," Ga. Coastal Plain Exp. Sta., Tifton, Ga., Mimeo. Paper 72, Rev. Feb. 1956, O. Woodard and S. A. Harmon.

"Sudan Grass," AG1623, June 1954, J. A. Jackobs and W. O. Scott; "1955 Winter Barley Variety Trial," AG1662, Aug. 1955, R. O. Weibel; "1955 Northern Illinois Field Winter Wheat and Rye Variety (Combine) Trial," AG1663a, Aug. 1955, R. O. Weibel and R. E. Bell; "1955 Spring Oat Variety (Combine) Trial," AG1666a, Sept. 1955, C. M. Brown, R. M. Takeshita, and R. E. Bell; "1955 Winter Oat Yield Data," AG1667, Sept. 1955, C. M. Brown; "1955 Illinois Oat Variety Demonstrations," AG1673, Dec. 1955, J. C. Hackleman, J. W. Pendleton, W. O. Scott, and E. C. Spurrier; "1955 Soybean Production Survey in Illinois," AB1682, Jan. 1956, J. C. Hackleman; "1955 Illinois Wheat Variety Demonstrations," AG1683, Feb. 1956. J. C. Hackleman, J. W. Pendleton, W. O. Scott, and E. C. Spurrier; Agr. Exp. Sta., Univ. of Ill., Urbana, Ill.

"Experimental Corn Hybrids Tested in 1955," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 597, Jan. 1956, R. W. Jugenheimer and A. F. Troyer.

"1955 Illinois Corn Tests," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 598, Jan. 1956, E. R. Leng and B. Koehler.

"Spring Oat Varieties for Illinois," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Cir. 754, Feb. 1956, C. M. Brown, J. W. Pendleton, W. M. Bever, O. T. Bonnett, and G. E. McKibben.

"1955 Iowa Corn Yield Test," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Bul. P120, Feb. 1956, C. D. Hutchcroft and J. L. Robinson.

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"Annual Progress Report of the Red River Valley Agricultural Experiment Station, Box 5008, Bossier City, Louisiana, 1955," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

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"Vegetable Varieties in Minnesota," Ext. Fldr. 154; "Getting Started With Your Vegetable Garden," Ext. Fldr. 164; Agr. Ext. Serv., Univ. of Minn., St. Paul, Minn., March 1956, O. C. Turnquist.

"1955 Results of Corn Variety Tests at 10 Locations," Cir. 201; "1955 Cotton Variety Tests in Hill Section," Cir. 202, Jan. 1956, J. F. O'Kelly, S. P. Crockett, B. C. Hurt, B. C. Murphy, and R. E. Coats; Agr. Exp. Sta., Miss. State College, State College, Miss.

"Making Silage from Pasture and Hay Crops," Agr. Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Cir. 389, Aug. 1955, S. H. Dobson, et al.

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Economics

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"Economic Relationships Involved in Retailing Citrus Products," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 567, Aug. 1955, L. A. Powell, Sr. and M. R. Godwin.

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"Marketing Georgia Vegetables," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Bul. N. S. 16, Jan. 1956, K. E. Ford.

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Good Pastures Are Cheapest Farm Crop

WISCONSIN dairymen are proving that good pasture fields are the cheapest "feed producers" on the farm.

Vic Burcalow, Agronomist, and George Werner, Dairy Cattle Specialist at the University of Wisconsin, report that a hundred Badger State grassland farmers last year got an average yield of 2,440 pounds of total digestible nutrients (T.D.N.) per acre of improved pasture, at an average production cost of one cent per pound of T.D.N.

This yield of "feed nutrients" is equal to 2½ tons of high quality hay, 56 bushels of corn, or 110 bushels of oats. And cost for producing a pound of T.D.N. with these crops is higher—two cents per pound for hay, and three cents per pound for corn or oats.

The one-cent figure is just for pastures that are grazed for one year. Graze the pastures two years in a row, say Burcalow and Werner, and the cost for producing the T.D.N. is cut almost in half.

On these pastures, a 1,200-pound cow could get all the nutrients needed for high milk production from one acre—during a four-month pasture season. Some farmers found that even better pastures would produce up to 5,000 pounds of T.D.N. per acre, meaning each cow would then need only a half acre for the entire summer.

By figuring the amount of milk each of these 100 farmers' herds produced from pasture nutrients alone, Werner and Burcalow found that the average "milk yield" was 3,185 pounds of 3.5 per cent milk, or enough to fill about 40 10-gallon milk cans, from each acre.

Fertilize Pecan Trees During Late Winter Months

PECANS require a fertile soil to produce a good crop of nuts every year. Soil which will produce a bale of cotton per acre is capable of producing high yields of pecans.

Pecans cannot compete with tall grass and weeds for moisture during the summer months. However, if pasture crops in pecan orchards are grazed closely during summer months, pecans will produce satisfactorily when properly fertilized.

Pecan trees begin growing in spring when the soil warms up. It has been said many times that one of the most accurate methods of determining when winter is past is to check the pecan tree. When it begins growing, spring is definitely here. So, we see the soil warming up and the soil water, containing plant-food elements, being taken up by the tree to satisfy its hunger and help it grow.

Apply fertilizer to the soil during late January, February, or March. When a winter legume is grown and plowed under in early spring or late winter, very little commercial fertilizer will be needed. The amount and analysis are governed to a great extent by soil type and condition of the soil. Generally, an 8-8-8, 6-8-8, or 5-10-5 analysis is recommended. Apply this fertilizer at the rate of 25 to 30 pounds per square foot cross-sectional area of the tree trunk, or apply 2 pounds for each year age of the tree. If the square foot cross-sectional area of the tree trunk is used, determine the square footage at about 2 feet above level.

There are various ways and means of applying fertilizer to trees where you have only a few around the house for shade purposes and for pecan production. By punching a series of holes in the ground with a pipe around the tree and applying fertilizer in the holes, you make this plant food available to feeder roots of the pecan and this reduces growth of the grass on top of the ground. If this is done, roots can benefit from this application. Apply it well away from the trunk beginning half way between the trunk and tips of branches, and ending slightly beyond the tips of the branches.

In late April and May, pecans like readily available nitrogen. Young trees which have been planted only a year or two should get one pound of nitrate of soda, or its equal. Five-year-old trees like about 2 or 3 pounds and 10-year-old trees will respond best when about 5 pounds are applied. Older trees need more, but remember that this is dessert and too much could be harmful.

Always remember that pecan trees are ready for this fertilizer in late April and May. Later applications of fertilizer have not given good results. . . *John A. Cox, Extension Horticulturist, Louisiana State University.*

Watershed Protection and Flood Prevention

(From page 26)

all structural measures or groups of measures for which the federal government shares in the cost.

Monetary evaluations are not required for benefits from soil and water conservation measures applied to the land, however. Long experience has fully shown that private and public benefits from land treatment measures are greater than their costs.

Planning the Watershed Project

Each watershed has its own combination of problems. And solutions must be tailored to fit these problems. This is watershed planning. In many ways it is similar to soil and water conservation planning as being done in soil conservation districts for individual farms and ranches.

As funds are available, the SCS will help local sponsors to develop watershed work plans. Within-state priority recommendations by the state agencies will be considered.

During all planning stages, the SCS technicians will work closely with the local group and all others concerned. Full participation by local people is necessary to develop a work plan that can and will be carried out promptly with benefits to residents of the watershed and the general public. Information on problems, costs, benefits, and needs will be obtained with the help of local people and presented to the community as facts on which to base decisions.

Work Plan Is a Proposal

The watershed work plan is a proposal by the local organization and the U. S. Department of Agriculture to Congress for specific improvements to support and supplement present and future soil and water conservation measures. The plan becomes a guide for the local organization in all its efforts to protect and develop land and water resources. It will be a basis for all state and federal help. After the plan is sent as required to Congress, it becomes an official document for budgeting and using federal funds when appropriated.

Cost Sharing

Cost-sharing proposals and arrangements will be included in the watershed work plan. The cost-sharing formula, under Department of Agriculture policy, is flexible. It is designed to take into account the widely varying conditions in watersheds throughout the country. Generally, the local group will be expected to pay for improvements directly benefiting people within the watershed, and the federal government will pay for measures that help the public-at-large, people below the watershed and federal property.

These costs will be borne by local

people through their organization or as individual landowners and operators:

1. Land, easements, and rights-of-way needed on privately owned land for structures or other improvements.

2. Acquisition of water rights required by state laws.

3. Capacity in structures provided for any purpose other than flood prevention.

4. Operation and maintenance of structures and other improvements on privately owned land.

5. Administration of contracts let by the sponsoring organization.

6. Application of soil and water conservation measures on individual farms and ranches.

7. All construction costs for water distribution and other facilities for purposes other than flood prevention.

The federal government will pay for these services:

1. Planning services.

2. Technical assistance to landowners who plan and apply soil and water conservation measures on their own farms or ranches.

3. Installation services. This type of help includes surveys, site investigations, layout, design, preparation of specifications for structures, and supervision of construction.

4. Soil and water conservation measures applied on federal lands.

Under Department of Agriculture policy, the federal government may share a part of the costs which otherwise would be borne by the sponsoring local organization or its members. For example, the local group may propose that the government assume a part of the cost that would accrue to it because of costs recently borne or expected for land protection measures. If the watershed is severely damaged through years of misuse, and financial ability or credit is lacking, this fact also will be considered.

Work Plan Goes to Congress

After the watershed work plan is completed, it is sent by the President to the Congress. The plan must be in the hands of the Senate Committee on Agriculture and Forestry and the House Committee on Agriculture for 45 days before its final authorization for federal help in carrying out the plan.

Of the 83 watersheds which in late July had been authorized for planning assistance, the SCS expected a number of work plans to be ready for submission to Congress.

The Placement of Fertilizers for Peanuts

(From page 12)

tilizer at 14″ was at Plains in the wet year. Since it is obviously impossible to place fertilizer deep without chiseling, the two effects complement each other and a high average increase from deep placement resulted.

Averages for the four tests show highly significant increases from the 8- and 14-inch placement. Fertilizer at 4″ and chiseling to a depth of 8″ produced no significant results. The effect of fertilizer at 8″ was slightly higher than at 14″. Its yield increase was also highly significant. It would seem, therefore, that the optimum placement of this fertilizer for Spanish peanuts would be between 8″ and 14″ deep in the row.

Mention has been made of the extremely high power requirement for depths of 14″. Even in sandy soils, the average two-row tractor will handle only one plow. Consequently, for economical reasons, this placement can be recommended only where subsoiling is known to be of benefit, and then only when heavy and powerful equipment is available.

The experiment was revised in 1955 to determine the practicality of fertilizing at the 8-inch depth and planting in one operation with commercially available equipment. Also, changes were made in the fertilizer ratios to determine the effect of phosphate at different

Fig. 2. Peanut test at the Southwest Georgia Branch Experiment Station, Plains, Georgia.

depths. To obtain further information on soils and varieties, a third test was located at Midville on a Norfolk soil where Virginia Bunch peanuts were planted.

A light two-row tractor was equipped with chisel or deep fertilizer applicators, with disk hillers to cover the furrow made by the fertilizer foot and leave a bed. This bed was either flattened by wings on the planter or allowed to remain when a pre-emergence herbicide was applied. No difficulty was experienced on properly prepared soil regardless of texture.

Since the revised test has been run only one year, detailed results will not be given. However, for the benefit of research workers, the following results are noted as being of particular interest.

The 8-inch placement of a complete fertilizer again produced the highest yields on the average. It was as effective for Virginia Bunch peanuts as for

TABLE II.—INCREASES IN SPANISH PEANUT YIELDS FROM FERTILIZERS AND SOIL TREATMENT AT DIFFERENT DEPTHS.

Increase from	Increase per acre				
	Plains 1952	Plains 1953	Plains 1954	Tifton 1953	Average[1]
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Fertilizer, 4″ deep	68	148*	151	−113	63
Fertilizer, 8″ deep	169**	93	121	177	140**
Fertilizer, 14″ deep	65	270**	42	82	115*
Chiseling, 8″ deep	46	95	13	3	39
Chiseling, 14″ deep	43	−51	277**	132	100*
Chiseling and fertilizer 8″ deep	215**	188**	134	180	179**
Chiseling and fertilizer 14″ deep	108*	219**	319**	214	215**

[1] The interaction between treatment and location was not significant in 1953, therefore the one-year results from Tifton are included in the average.
* Significant at the 5% level.
** Significant at the 1% level.

Spanish. At the 4-inch depth a 6-0-6 fertilizer outyielded a 6-6-6, showing that phosphate decreased yields. However, at the 8-inch depth the complete fertilizer far outyielded the 6-0-6. Not only did phosphate increase yields at this depth, it was responsible for most of the yield increase from fertilizer. In other words, a difference of 4″ in depth changed the phosphate response from a 3% decrease in yield to a 10% increase.

These results indicate that the early work with different fertilizer rates and ratios should be repeated at an 8-inch depth. Also, the possibility exists that nitrogen and potash would be more effective in specific zones just as is calcium. This does not imply that peanut farmers may have to use complex machinery for fertilizer placement, but it does imply that modifications in the cropping system and fertilizer practices on crops preceding peanuts may be of value.

Fertilizer Placement for Corn in Minnesota

(From page 18)

only differences in the development of the corn due to the fertilization (Figure 3), but there was a marked difference in corn growth with different placements until the corn tasselled in late July, as shown by Figures 4 and 5. All of the fertilized corn looked much the same by the first of August. Some of the resulting 1954 yields are shown in Figures 6 and 7.

The same experiment was repeated in 1955. As previously mentioned, the growing season was marked by relatively dry weather until mid-July, and it might be expected that the deeper fertilizer placement should be more effective. This was evident by the differences in early corn growth until the corn tasselled, as in the three previous years of the experiment. The yields of ear corn in both 1954 and in 1955 are shown in Table II.

A slightly higher level of soil fertility in the 1955 location produced generally higher yields than in the previous year, even with the unfavorably dry spring which lowered effectiveness of fertilizer for additional yield increases. While fertilizer placement close to the seed (level and 1″ to each side) was one of the most effective under moist soil conditions in 1954, this placement was not satisfactory in the spring drouth of 1955. If the average of the 1954 and the 1955 yield increases are considered, it is of interest to observe that the only significant placement superior to the one closest to the seed is the banding 2″ below and 2.5″ to each side of the seed. This is in agreement with the 1951 and 1952 results.

Conclusions

1. Four years of fertilizer placement studies for corn on Waukegan silt loam in Minnesota have shown substantial differences in plant growth until the corn tasselled in late July. At that time, however, the growth differences from the different placements disappeared. However, the fertilizer placed in bands 2″ below and 2.5″ to one or both sides of the seed produced a higher yield of corn than fertilizer placements closer or more distant from the seed. With the dry spring in 1955, placement of the 8-16-16 only 1″ to each side of the seed was the poorest placement.

2. If the soil is relatively dry following corn planting, corn populations on many Minnesota soils are often reduced and are not adequate to make effective use of the applied fertilizer. This reduction in corn population can often be traced to a defective or worn fertilizer shoe on the corn planter, allowing the starter fertilizer to come in contact with the later germinating seed. This hazard to the germinating seedling has been accentuated in recent years by the growing practice of using larger amounts of higher nitrogen starter fertilizer. For this reason, mixed fertilizers of high nitrogen content should

never be in contact with salt-sensitive seeds such as corn. The placement of fertilizer somewhat deeper and slightly more to the side of the seed than is now accomplished by the split fertilizing boot could be accomplished by the farmer with improvements to fertilizing and planting machinery.

Fertilizer placement some 4″ or 5″ below and/or to the side of the seed is not advantageous and would require the development of heavier and more expensive fertilizing and planting machinery. In addition to this, the banding of fertilizer 4″ or 5″ below the seed level involves additional power requirements. Deeper and more lateral placement would also be more time-consuming to the operator, with the additional hazard of equipment plugging with crop residues.

3. It is concluded that manufacturers should develop foolproof fertilizing equipment which would apply the fertilizer in bands or pockets 1″ to 2″ to the side of the corn seed and preferably the same distance below the seed level. Such equipment would essentially eliminate seedling corn damage from starter fertilizer under most soil and climatic conditions.

Literature Cited

1. Caldwell, A. C., J. M. MacGregor, and C. O. Rost. Shall we apply fertilizer with the plow? *Minnesota Farm and Home Science,* Vol. III, No. 2, 6-7. 1946.
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Give Your Plants a Blood Test . . .

(From page 10)

READING	LEVEL	INTERPRETATION
No color	Very low	Extreme deficiency
Light blue	Low	Deficient
Medium blue	Medium	Sufficient for grasses and corn but questionable for legumes
Dark blue	High	Sufficient for all plants

This test may also be made directly on plant material.

Saliva is high in phosphorus. For a comparison with the plant test, wet a corner of the filter paper with the tongue and run the phosphorus test.

It is necessary to constantly check the P-K reagent No. 1 since it may go bad in time, especially in hot weather. Run the test on blank filter paper, and if a blue color develops, the reagent is not good. Also check the P reagent No. 2 by running the saliva test mentioned above. If no color develops, the reagent is not good and fresh reagent must be made up.

Potassium

Squeeze a little sap from the cut end of the plant material on each of the potash test dots. Allow about 30 seconds for reaction, then starting at the 3,000 ppm. dot, wash each dot carefully with P-K reagent No. 1. Avoid using an excess of the reagent. Where potassium has reacted with the dot, a bright orange color will remain.

READING	LEVEL	INTERPRETATION
No orange in any dot	Very low	Extreme deficiency
Orange—1,000 ppm. dot	Low	Deficiency
Orange—1,000 & 2,000 dots	Medium	Sufficient for most agronomic crops but questionable for alfalfa and vegetable crops
Orange—All three dots	High	Sufficient for all crops except potatoes and tomatoes

GROWER:	John Jones	CROP:	1954 Lespedeza & Red Top 1955 Corn
LOCATION:	Route 3, Buell	DATE:	8-3-55
COUNTY:	Montgomery	TIME:	5:00 P. M.

		N	P	K	pH	Notes
Soil test 1-19-55		2.3%	16 lb. (P_2O_5)	140 lb.	6.3	BEC—11.0 m.e., Rolling Prairie
Recommendation		80 lb.	160 lb. (P_2O_5)	50 lb. (K_2O)	LIME 0	
Fertilizer 1954		0	0	0	0	6 T Lime—1947
Fertilizer 1955		6	1,000 Rock 18 P_2O_5	6	0	
Tissue test	1	L	M	L		Corn—roasting ear stage
	2	VL	M−	L		
	3	L	M	L		
(Locations in field)	4	M	M	VL		
	5	VL	M−	M		
	6	L	M	L		
Quick soil test		1	L L L L M	1	6.0 7.0 5.8 5.8	Soil Moisture-medium
		2	H M L L L	2	6.0 ... 6.5 ...	
		3	L M L L L	3	5.8 6.0 6.0 ...	−Less than pH 5.8
(Locations in field)		4	H L L L VL	4	6.0 6.8 6.0 ...	
		5	M M L L L	5	5.8 6.5 6.5 ...	
		6	L L M L L	6	6.0 6.2	
			2 4 6 8 10 inches		2 4 6 8 inches	

Fig. 4. Sample recording sheet for quick tissue and soil tests.

The potash test papers are generally good for one season. Beyond this time, or in cases of questionable results, check the dots with standard solutions containing 1,000, 2,000, and 3,000 ppm. K.

Suggested Order of Testing

To save time, squeeze the sap on the potash dots first, and while allowing to react, run the phosphate test. Complete the potassium test, and run the nitrogen test.

Recording of Data

To evaluate the field-testing results it is necessary to gather as much information on the field as possible. For the purpose of recording this information and the results of the tests, a record sheet such as shown in Fig. 4 is suggested.

Interpretation of Test Results

The soil and tissue test results in themselves mean very little without proper interpretation. One must remember that in tissue testing for N, P, and K, he is testing for just some of the many factors that can limit plant growth. Some of the other factors are:

1. Other plant nutrients
2. Soil moisture and temperature
3. Thickness of stand
4. Plant disease
5. Insect damage
6. Drainage and aeration
7. Cultural practices

Any of these factors may influence the interpretation of tissue-testing results. For example, if soil moisture is limiting or insect damage is heavy and the tests are low, it is difficult to decide whether the results are low due to a lack of moisture, insect damage, or insufficient soil supply of nutrients. Under such conditions you will save time by not running tissue tests. The tissue test procedures as described in this article are designed to determine the general level of nitrogen, phosphorus, or potassium in the plant sap. If the tests are high, these elements can be discarded as factors limiting plant growth. If the tests are low then nutrition is a factor but the cause may not necessarily be a lack of nutrients in the soil. The tester has to determine the cause by additional observations.

In working with tissue testing one must acknowledge the effect of a deficient nutrient as a limiting factor in the growth of the plant, thus changing the total requirements of each of the other nutrients necessary to maintain this limited growth. In other words, less total potassium is required to grow a plant already stunted by a lack of nitrogen or phosphorus. Therefore, there tends to be an increase in the concentration of potassium in that plant. A tissue test showing high nitrogen, low phosphorus, and medium potassium means only that the phosphorus is a limiting factor. With the application of phosphorus to that soil, the potassium reading may be changed to low if the soil is not capable of supplying enough potassium to keep up with the increased growth.

Tissue testing helps in the search for the limiting factor. Should the tissue test show no deficiency of N, P, or K, even though there is something obviously wrong with the crop, a search should be made for the limiting factor, whatever it might be. The use of the data sheet with all the information that it is possible to obtain on it will aid in this search.

In the recording sheet in Fig. 4, an actual case history, it will be noted the tissue test results indicated a deficiency of nitrogen. On examination of the nitrogen data it will be readily seen that the soil test recommendation for nitrogen was not followed and the tissue test is substantiated. The same is true for the potassium. The phosphorus tissue test on a field like this cannot be evaluated until the other deficiencies are corrected.

In order to fully explore the reasons for the field test results, it is imperative that the interpretations be made before the field is left. Once away from the field the farmer cannot be asked the questions that might come up later, nor can the results be rechecked if something appears to be in error.

The beginner in the use of field tissue and soil tests is apt to become discouraged because he is not getting the results he thinks he should get. He should remember that these tests are accurate in differentiating between high, medium, and low levels in the plant. By tissue tests he can eliminate a lack of N, P, or K as a factor responsible for poor growth. If he cannot find his answer to the problem through these tests, he must search for it elsewhere. There is always an answer. As he becomes more experienced he will more fully appreciate the value of quick field soil and tissue tests.

Appendix A

Following are the materials and equipment needed for quick field testing as outlined in this article, approximate sizes to order, and some of the sources from which they may be obtained:

Complete Test Kit—includes materials and equipment for N, P, and K tests for plants similar to that described in this article, also, P and pH for Soils. Denham Laboratory, Denham Springs, Louisiana. Order "Plant-Aid Test Kit." Complete kit or any portion of the kit available, including potash test papers.

Tissue Test Kit—for N, P, and K in plants. Urbana Laboratories, 406 N. Lincoln, Urbana, Illinois. Order "NPK Plant Testkit." Potash papers and supplies available separately.

Bray Nitrate Powder
(See Appendix B for directions for making.) Urbana Laboratories, Urbana, Ill. Order small vial.

P-K Reagent No. 1
(Ammonium Molybdate)
(See Appendix B for directions for making). Soil Test Kits, Department of Agronomy, Purdue University, Lafayette, Indiana. Order 8 oz. bottle of "Phosphate Solution No. 1 (Concentrated)." NOTE: Reagent as ordered from Purdue is in concentrated form. To make P-K reagent No. 1, dilute the concentrated solution one part to four parts of distilled water.

P Reagent No. 2
(Stannous Oxalate)
Soil Test Kits, Department of Agronomy, Purdue University, Lafayette, Ind. Order small vial of "Phosphate Reagent No. 2."

Potassium Test Papers
(See Appendix B for directions for making.) Denham Laboratory, Denham Springs, La. Urbana Laboratories, Urbana, Ill. Order in batches of 100.

Extracting Pliers
Any hardware store. Buy electrician's needle-nose pliers.

Wash Bottle
Can be obtained from chemical supply houses or local drug stores.

Dropper Bottles

Distilled Water

Appendix B

Following are the directions for making up the chemical solutions and papers listed in Appendix A:

Nitrate Powder

(a) 100 gms. $BaSO_4$
(b) 10 gms. $MnSO_4.H_2O$
(c) 2 gms. finely powdered zinc
(d) 75 gms. Citric Acid
(e) 4 gms. Sulfanilic Acid
(f) 2 gms. alpha-naphthylamine

Grind any coarse materials to a fine powder. Mix (b), (c), (e), and (f) separately with portions of the $BaSO_4$. Then thoroughly mix the whole, including (a) and (d). Use extreme care to have room, table tops, and equipment free of nitrate and nitrite. Store in a thoroughly blackened bottle, as light affects the alpha-naphthylamine.

P-K Reagent No. 1 (Concentrated)—Dissolve 4 grams of ammonium molybdate in 80 ml. of distilled water and add slowly and with constant stirring a mixture of 63 ml. of concentrated hydrochloric acid and 57 ml. of distilled water. Store in a glass bottle. This concentrated solution keeps better under field conditions than the diluted solution, P-K No. 1.

P-K Reagent No. 1—Dilute 10 ml. of the above with 40 ml. of distilled water.

P Reagent No. 2—Place approximately 2 grams of stannous oxalate powder in 30 ml. of distilled water. Shake before using.

Potassium Test Papers—Order 10 or 25 grams of 2, 2′,4,4′,6,6′, Hexa-nitrodiphenylamine (Dipicrylamine), Catalog No. 4402, from Distillation Products Industries, Eastman Organic Chemical Department, Rochester 3, N. Y.

Order large sheets (18¼″ x 22½″) of Whatman No. 1 filter paper from chemical supply house. Cut into strips approximately 2″ x 3½″ or as desired.

CAUTION: **Avoid Skin Contact with Dipicrylamine.**

Make up potassium standards of 1,000, 2,000, and 3,000 ppm. K by using 0.1907, 0.3813, and 0.5720 gram respectively of CP potassium chloride, each made up to 100 ml. with distilled water.

Melsted Procedure

Solution A

Weigh 0.60 gram of dipicrylamine and 0.60 gram of Na_2CO_3 into a 100 ml. beaker. Add 15 to 17 ml. of distilled water, stir, and bring to a boil. Then cool and filter using a small (7 cm.) filter paper. Wash the residue on the filter paper with distilled water and make the volume up to 25 ml. (For convenience, filter and wash directly into a 25 ml. graduate.) This reagent, when used as a spot on the filter paper, is sensitive to concentrations of about 1,000 ppm. (or more) of potassium in solution.

Solution B

Transfer 8 ml. of solution A into a 25 ml. graduate and dilute to 25 ml. with distilled water. This reagent, when used as a spot on the filter paper, is sensitive to concentrations of about 2,000 ppm. (or more) of potassium in solution.

Solution C

Transfer 10 ml. of solution B into a 25 ml. graduate and dilute to 15 ml. with distilled water. This reagent, when used as a spot on the filter paper, is sensitive to concentrations of about 3,000 ppm. (or more) of potassium in solution.

Because crystals may precipitate out of solution A when it becomes cold, it is necessary to keep this solution warm while making the potassium test papers. A modified procedure is suggested for solution A by B. N. Driskell, Louisiana State University: Use 0.20 gram of Na_2CO_3 instead of the 0.60 gram as in the Melsted procedure. This tends to prevent the precipitation of solution A. However, solutions B and C must be made from the Melsted solution A.

Preparation of Papers

Before making any sizable number of potassium test papers it is necessary to calibrate the dipicrylamine by using potassium standards of 1,000, 2,000, and 3,000 ppm. K. First make some papers according to the directions that follow. When they are thoroughly dry, test the dots with the standard solutions, allow 30 seconds to react, and wash with the P-K reagent No. 1. Adjust the dilutions of solutions A, B, and C accordingly. For example, if the 1,000 ppm. K standard gives a reaction in the 2,000 ppm. test dot on the paper, and the 2,000 ppm. K standard gives a reaction on the 3,000 ppm. test dot, then the dipicrylamine solutions must be diluted until they are accurate. This may require dilutions up to one half the concentration of dipicrylamine in the Melsted directions. The calibration is necessitated by the variations in different shipments of the dipicrylamine and changes occurring with time. Therefore, calibrate the dipicrylamine at the beginning of the testing season and when a new bottle of the material is used.

For speed of operation, lay flatly-ironed dish towels on a table surface and place 50 or more of the filter paper strips in rows on the towels. Starting with solution A in a dropper bottle, place one drop on the lower right hand corner of each paper. Repeat with solution B on each paper one inch above the drop of solution A. Repeat again with solution C on each paper one inch above solution B. Let the papers dry until they start to wrinkle, then gather in groups of 50, stack neatly, and place a weight on the stack to press the papers. The top edge of each stack may be brushed with liquid latex if a pad of papers is desired.

Unless papers are to be used within a few months, a good practice is to wrap and place in a freezer. When taken out they will be nearly as fresh as when they were made.

Many Good Mothers

(From page 5)

some of the atmosphere that makes happy homes easier to maintain and manage.

This brings us to another point. In spite of the wear and tear mothers undergo, the census always shows a big majority of widows over widowers. Maybe it's some kind of a compensation, or else the feminine fiber is tougher than all get-out. My own hunch is that women can maintain their interests and contributions to society longer than most men. Perhaps we should start some courses to train the menfolks on living with themselves with more enthusiasm and keeping up their interest in families after their own kids have grown up.

I've always believed that a confirmed widower has much to communicate to a first-time bridegroom, especially when the widower is past 65 and the bridegroom is half that age. Such communication would be dedicated to a long and pleasant journey through married life, hoping that the hopeful young fellow hearkens and heeds it.

The Bible contains very little comment on the wisdom of the widower—except possibly for King Solomon—and he had so many wives that a demise among them now and then couldn't affect his philosophy as a widower very long.

WIDOWS, on the contrary, fare well in Holy Writ. The widow's mite is a favorite topic for fund-raising sermons, and many of us have become familiar with the adventures of the Widow's Son on Mount Moriah and profited by the lessons.

At least three notables of Israel were listed as widowers. There was Jacob, who mourned the death of Rachel in giving birth to Benjamin. Samson belongs to the list because he slew hosts of Philistines for the burning of his wife. Then, of course, there was the unfortunate Lot, whose spouse turned to salt, perhaps in symbolism of the tears shed by bereaved widowers forever since.

If I were to address this young bridegroom on assignment, I'd touch only on a few topics we might regard as essentials, always knowing that he will bob up against some quite different problems that he must solve for himself.

The first one is no joke, despite the silly ones too often perpetrated about it. Get to know and like your mother-in-law. Seek her best qualities and play up to them. After succeeding in doing this for 35 years, I found out that a helpful mother-in-law is a bulwark of strength. It's nice to chat with her about old times and old faces and learn her attitude on life, and where she worked, and what she did to raise her family.

From her you can get traditions of the family she belonged to, and see the obstacles she experienced and the joys and sorrows she has had. It's more important to do this when your wife's mother is a widow. She'll be more apt to come into your life under those circumstances than if she and father-in-law are both living.

TELL your bride from the start that frankness and open discussion will prevent many of those tricky snares that beset the path of any partnership. If you've been compromised or made a fool of, or had bad luck, never cringe and hide the facts. Talk it over right away. Maybe there will be tears and a little scene, but she'll respect you for it and trust you more thereafter. Start right that way, and you'll keep your love and mutual respect intact through the years.

Take your wife as an income-planning partner—if she has any gifts for earning, saving, and wise spending. Sometimes wives like to keep the family accounts and write the checks for insurance premiums, rent, or interest and taxes. Share the experience with her, but don't neglect it yourself and let her assume all the burden. After a good wife passes on, her carefully kept records of receipts and expenses seem like a vivid history of mutual struggles to make ends meet and raise the children. Maybe you'll also keep that old, battered Winthrop desk, along with the sewing basket and the long box of her knitting needles.

If your wife is a church member or else wants to join one, be ready to encourage the idea, and make it a double privilege if you can. You yourself need the strength and confidence that often comes by "leaning on the Everlasting Arm."

As for the often-mentioned little amenities of married life, the expressions of love, and words of appreciation or admiration, most of us remember most poignantly the times we neglected them. But my idea is that good husbands and good wives by their daily attitudes and conversation are able to acquaint one another quite well of their continuing love and reliance. To the understanding ones there is no sense of failure or regret and few reasons for tears.

Try to find a pastime or a hobby that you two newlyweds can do together. Maybe it's cards or home craft work, or such outside interests as bowling or skating. Little home sidelines are a great source of happiness in getting acquainted and staying that way.

I'd not go into detail over cooking, housekeeping, or furnishing a home. That I'd leave to the couple themselves. Tastes and talents differ and folks don't have a standard to suit all alike. Besides an old widower is so busy finding out for himself what these home-making elements mean in his life alone that he doesn't feel competent to discuss the issue further. All he knows is that he had a wife who could excel in all the household arts and crafts, but the secret of how she got that way must be imparted by more skillful authorities whose job it is to help lay the cornerstone of domestic economy.

AT the outset, I wrote that many fellows know little about the Mother's Trade. Yet in my time I have seen brave men and eager broods of children carry on together after the mother died. One farmer in my home state joined forces with eight children, the smallest an infant, and raised them to successful maturity without remarrying. Other fellows with overmastering paternal instincts have taken in groups of orphans and adopted them.

In closing may I add one thought to cover this rambling essay. It simply is that not all good women are good mothers but all good mothers are fine women. Maybe the same can be said for "Dad."

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The plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

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The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

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THE AMERICAN POTASH INSTITUTE

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A frustrated motorist had tried to pass a huge truck for many miles. Every time he tried to go around, the truck driver increased his speed or swerved toward the middle of the road. Finally, at a stop sign, the motorist pulled alongside the truck.

"Well?" growled the truck driver.

"Nothing important," was the reply. "I know what you are—I wanted to see what one looks like."

* * *

Several little girls were out picking May flowers when they "met" a skunk. When they came back to the house the youngest of the girls said she didn't mind getting skunky smell on her clothes and hair but, "Was I ever mad," she said, "I had to spit out my gum."

* * *

A drunk came into a bar and said to the bartender, "Set 'em up all around, give me a drink, and have one yourself."

This went on for several rounds and the bartender told the drunk he owed him $17.50.

"I don't have any money," said the drunk amiably. The bartender reached across the bar, hit him in the nose, and threw him out of the bar. In a little while the drunk returned.

"Well, what do you want now?" growled the bartender.

"Set 'em up all around and give me a drink, but you can't have one this time. You get mean when you drink."

An Easterner was motoring through a sparsely settled section of Arkansas when he noticed a sign of civilization up ahead. When he arrived at a cluster of four houses, he hailed a man rocking on the front porch of one of them.

"Can you tell me how to get to Cripplebush?"

"Yup," drawled the native. "Don't move a durn inch."

* * *

A couple of sailors laying over for a day or two in Sweden decided to go to church. Knowing no Swedish, they figured to play safe by picking out a dignified-looking gentleman sitting in front of them and doing whatever he did.

During the service the pastor made a special announcement of some kind, and the man in front of them rose. The two sailors quickly got to their feet, too—only to be met by roars of laughter from the whole congregation.

When the service was over and they were greeted by the pastor at the door, they discovered he spoke English and naturally asked what the cause of the merriment had been.

"Oh," said the pastor, "I was announcing a baptism, and asked the father of the child to stand."

* * *

She—"Don't you love driving on a moonlight night like this?"

He—"Yeah, but I thought I'd wait till we got farther out in the country."

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