Better Crops with PLANT FOOD

August-September 1956 10 Cents

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The Pocket Book of Agriculture

Better Crops *with* PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

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Off to a Good Start!

Better Crops with PLANT FOOD

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We Changed . . .

Swords Into Plowshares

Jeff McDermid

(ELWOOD R. MCINTYRE)

VETERAN training is probably the most outstanding benefit our government has provided in the wake of wars. It often gives more real educational opportunity to youth than the privileges of peacetime afford. When loyal soldiers of the Civil War and the Spanish fandango were discharged by Uncle Sam, that ended his contract in respect to them—unless they could wrangle a disability pension from a somewhat reluctant congress. Veterans of World War I fared a little better, but not much. It took the global horrors of World War II and the Korean aftermath to provide the most priceless boon of all to home-coming youth—a useful education in their chosen profession or trade.

We always learn the hard way. Thousands of the older veterans who survived the wars of the Sixties and Nineties took up farming or hard labor in town at meager wages, groped their way to a place in the community without government aid, often failed to reach their goals, and soon became disillusioned public burdens. Main reason behind this neglect is not hard to find. Education of any kind in a formal way was not prized highly. Men of the pioneer eras before the effect of the industrial and commercial fever was felt had less absolute need of specialized training. They could get along somehow and grab the main chance. Besides, there wasn't so much to learn, and few fellows ever finished high school.

In saying this, it is not argued that we can rely on means alone and forget methods and human values. Our present standards insist on providing veterans with the path to progress, but they also need a pathmaster. Veterans in training need more than books and facilities and tuition. They must have teachers and supervisors who regard them as individual personalities rather than as machines or assembly-line job elements. Luckily, the humanities have been recognized in most of our veteran courses.

Too few of us realize the magnitude of the veteran training that our government has added to other benefits open to "old soldiers." Ask the Veterans Administration and they will tell you the story.

THE World War II educational program ended July 1 this year insofar as applications go. Some 15,400,000 persons were listed as World War II veterans. Of this number, 51%, or 7,800,000, were trained more or less under the Servicemen's Adjustment Act of 1944. In the institutional on-farm training there were 700,000 veterans enrolled, for the 12 years that the GI bill was in effect. Total cost was more than two billion dollars. Agricultural training represented about 9% of all the personnel taking GI training courses.

So far, nearly 100,000 Korean veterans have received farm training. In their case the cost has been about $300 millions. Institutional on-farm training hit a peak of 325,000 enrolled in 1950 and has turned downward gradually, so that in May and June of this year only 700 World War II vets and 1,500 Korean soldiers were listed as taking the farm instruction.

Looking again at the 800,000 veterans who have taken farm courses in the wake of World War II and the Korean conflict, we find that it is quite startling by comparison. That is, the 800,000 men represent the same figure as all males on our farms in 1950, between the ages of 20 to 24 years. It equals 13% of all males on farms over 14 years old. That's not all either. Farm trainees from these two wars equal twice the farm population of all the New England States, almost the exact figure of all farm persons in the Mountain States, and the same total as all farm persons living in either Iowa, Pennsylvania, or Virginia.

Veterans in civil life today play a leading part in all the country's activities. Here again the total is impressive—more than 22 million persons. These are made up of some 15,400,000 World War II veterans, about 3,800,000 persons who served in the Korean war only, and a sizable remnant of World War I personnel still surviving, about 3,000,000 all told.

Disabled veterans of World War II received special training in vocations under the PL 16 program. The peak was reached in this field in 1949, with 43,000 enrolled as farm trainees. By early months of this year the estimated enrollment had fallen to about 800. Disabled Korean war men numbered about 1,500 engaged in on-farm training in May of 1956.

Some surprises bob up when the roll of the total World War II farm trainees by states under the GI bill is called. In order of numbers of veterans enrolled in this agricultural field, the states stand thus, up to tenth place: North Carolina, 49,000; Texas, 47,000; Tennessee, 41,000; Missouri, 35,000; Arkansas, 32,000; Illinois, 31,000; Alabama and Mississippi, each 30,000; Georgia and Oklahoma, each 28,000. Iowa, chief farm state, enrolled 21,000.

IT is profitable for us to likewise scan figures as to farm training (700,000) compared with three other major items involved in the service. In schools below college level, the total enrollment was 3,500,000 veterans. For institutions of higher learning, the figure was 2,200,000. On-the-job shop and industrial training attracted about 1,400,000. Percentagewise, it gives 44% enrolled in schools below college level, 29% in colleges, 18% in on-the-job training, leaving 9% to the farm field.

Percentages of all veterans who enrolled in farm training courses show the leading states in this respect to be Arkansas, 32%, with North and South

Carolina, Mississippi, and South Dakota each having 25%, and Kentucky 24%. The main Midwest agricultural states enrolled from 10 to 15% of their veterans in the straight farm training courses.

Under the GI bill, the ages of veterans who took on-farm training afford some interesting figures. The average

age was 29 years. This stood as the highest average age in all lines. In farm courses, those under 25 years represent 27% of all enrollments; those 25 to 29 years, 36%; those 30 to 34 years, 21%; and for 35 years and over, 16%.

Another important factor is the taking of training by men who have dependents. In all types of training, including agriculture, 38% had no dependents, 27% had one dependent, while 35% were responsible for more than one dependent. Note the vast difference in this matter when we consider the on-farm trainees. Here only 14% had nobody dependent upon them, 26% had one dependent, while 60% reported having more than one dependent relying on them for support. Thus the typical farm trainee after his long service in the country's cause came out an older fellow than the "mine-run" of the GI's and had much greater urge to do a good job in school because of his heavy load of family dependents.

Obviously, such men can't be dismissed with a smattering and a casual touch of useful education. Those who work side by side with them in on-farm management enterprises have to know the story behind each man and fit the lessons and the logic to the imperative needs of each. It called for the best talent and experience on the part of vo-ag teachers. It gave them a challenge that ordinary classwork and adult farming programs often lacked. And as a rule, these teachers made good.

WE heard some valuable comments on this theme by a Kentucky vo-ag teacher who has deeply rooted convictions on education. You will be glad to get his viewpoint. He says that a lack of knowledge of veterans, their needs, and material status is one of the great areas where weakness hurts the veterans training program.

"By needs," he says, "I mean his farming and living program. Material status includes his farm and equipment, financial condition and ability to pay debts. It takes a year or longer sometimes to learn these things. How to discover and develop the better side of the learner is often difficult. Any teacher who finds and holds the key to this has a secret of success. The comparable Indian term for it was to 'walk a mile in the other fellow's moccasins.' To fit into the learner's situation as far as possible and never to try to force him into your own pattern is one essential. Too often teachers and supervisors think every learner should be converted into their own peculiar pattern. We must always give the best before we expect the best from others. The kind of work we expect from others is reflected in ourselves.

"Without a genuine interest in individual learners, without a desire to first give our best and then expect the best, there is not much hope for success. Interest and appreciation of the learner and his own problems will bring out the better side when other methods fail. One cause for failure on all levels of education is an over-emphasis upon

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Virginia Experiments Emphasize Economy of Fertilization

By Russell K. Stivers, P. T. Gish, and G. D. Jones

Department of Agronomy, Virginia Polytechnic Institute, Blacksburg, Virginia

YOU might not believe it if someone told you that 60% muriate of potash or its equivalent was worth $618 per ton to produce hay grown in rotation. However, this was the case in one experiment conducted on Frederick silt loam in Virginia. At another location of the same experiment on Davidson clay loam, applications of potash fertilizer have resulted in little, if any, actual increase in yield of hay. Superphosphate fertilizer gave big yield responses on both soils. Twenty per cent superphosphate or its equivalent was worth $248 per ton in the production of red clover hay on Frederick silt loam and $397 per ton on Davidson clay loam.

Factorial fertilizer experiments upon which the above figures are based have been conducted on two areas—one near the Shenandoah Valley Research Station at Staunton and the other near the Piedmont Research Station at Orange. Both locations were on important soil types used in those regions. The Frederick silt loam near Staunton had only 29 lbs. of Truog phosphorus per acre as shown in Table I. It was fair to poor in available potash in the rapid test, and the 0.11 me. of exchangeable K told the same story. In comparison, the Davidson clay loam had 0.31 me. or about three times as much exchangeable K. On both of these areas corn, wheat, and red clover were grown in a three-year rotation.

Even though equal amounts of fertilizer were applied to corn, wheat, and red clover hay, responses of the three crops were quite different. Red clover had the largest percentage increase in yield to applied phosphate fertilizer as compared to no phosphate, and corn had the smallest on both soil types

TABLE I.—CHEMICAL ANALYSES OF TWO SOILS FOR AVAILABLE NUTRIENTS, COMPOSITE SAMPLES TAKEN FROM CHECK PLOTS IN EARLY SPRING, 1951.

pH	% Org. mat.	lbs./A. Truog P	Exchangeable cations me/100g. soil				Total exch. cations me/100g.	% Base sat.
			H+	K+	Ca++	Mg++		
Frederick silt loam, average of 3 series each of 4 reps.								
5.88	1.80	29.0	5.2	0.108	3.88	0.82	10.008	48.0
Davidson clay loam, east area average of 4 reps.								
5.66	1.94	7.6	7.7	0.310	3.37	1.12	12.495	38.2

TABLE II.—EFFECT OF FERTILIZER TREATMENT AND SOIL TYPE UPON THE PERCENTAGE INCREASE IN YIELDS OF CROPS.

Crop	Lbs. per A. of fertilizer applied	Frederick silt loam		Davidson clay loam	
		Years conducted	% increase in yield over the check	Years conducted	% Increase in yield over the check
Corn..........	60 P_2O_5*	'50–'54 inc.	19.7	'50, '52	33.3
Wheat.........	60 P_2O_5	'51–'54 inc.	53.7	'50, '51, '53, '54	110.5
Hay...........	60 P_2O_5	'51–'54 inc.	73.5	'51, '52, '54	191.4
Average.....	60 P_2O_5		49.0		111.7
Corn..........	50 K_2O**	'50–'54 inc.	7.9	'50, '52	−0.2
Wheat.........	50 K_2O	'51–'54 inc.	24.0	'50, '51, '53, '54	3.7
Hay...........	50 K_2O	'51–'54 inc.	43.8	'51, '52, '54	7.6
Average.....	50 K_2O		25.2		3.7

* Averages of 0, 25, and 50 lb. per A. levels of K_2O.
** Averages of 0, 20, 40 and 60 lb. per A. levels of P_2O_5.

(Table II). The calculation of the increased yields was based upon the average yields of the no-phosphate treatments which were with the 0, 25, and 50 lbs. per acre levels of K_2O.

When all crops were considered, the average increase from 60 lbs. of P_2O_5 per acre was 49.0% on the Frederick soil and 111.7% on the Davidson soil.

Responses to 50 lbs. of applied K_2O per acre were similar to those for phosphate except they were smaller percentages. The average percentage increase in yields of all crops on the Frederick soil was 25.2 for 50 lbs. of K_2O per acre as compared to 49.0 for 60 lbs. of P_2O_5 per acre. On the Davidson soil the comparable percentages were 3.7 for K_2O and 25.2 for P_2O_5.

Averages of the yields of all levels of phosphorus were used in calculating the response to a given level of potash fertilization because there were very few cases of meaningful interaction between phosphate and potash. Likewise, averages of the yields of all levels of potash were used in calculating the response to a given level of phosphate fertilization. Cases of meaningful interaction between phosphate and potash upon wheat and red clover yields on Frederick silt loam were found in two (1953-1954) of the four years (1951-1954). These meaningful relationships are shown in Figs. 1 and 2. Both figures show essentially the same thing —that yields of wheat and red clover hay were relatively lower without potash than with potash fertilizer when the higher rates of phosphate fertilizer were applied. No such meaningful interactions were found in corn yields on Davidson soil in any year. Since there were no significant yield responses to potash by any crop grown on the Davidson soil, there could be no meaningful interaction.

These responses to phosphate and potash fertilization occurred even though yields of all crops, particularly corn, were not high (Table III). Even so, 60 lbs. of P_2O_5 per acre applied on corn resulted in an increase in the value of the corn less cost of fertilizer (over that of the no-phosphate treatments) of \$12.98 per acre on the Frederick soil and \$23.19 per acre on the Davidson soil. The large response of corn on Davidson soil is shown in Fig. 3. In arriving at the increased returns, corn was priced at \$1.73 per bushel, 48% superphosphate at \$66.00 per ton, and

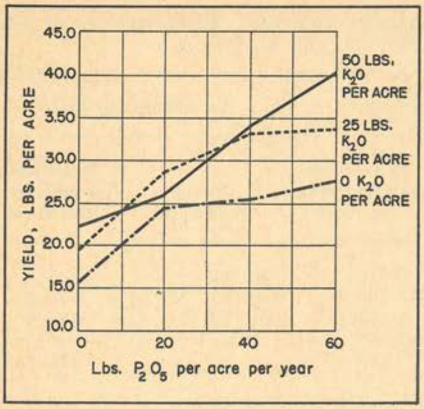

Fig. 1. Yields of wheat as influenced by fertilization. Fertilizer Factorial Experiment, Staunton, 1953-54.

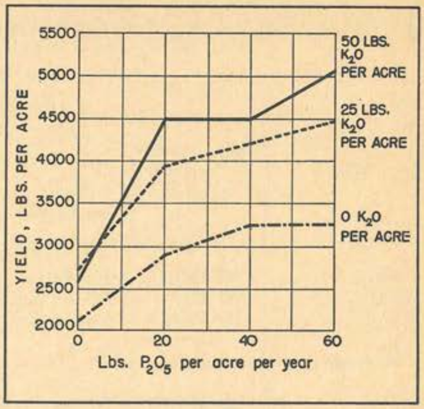

Fig. 2. Yields of red clover hay as influenced by rate of fertilization. Fertilizer Factorial Experiment, Staunton, 1953-54.

60% muriate of potash at $55.00 per ton. The estimated increased return with corn, from the use of 50 lbs. per acre of K_2O was $5.03 per acre on Frederick soil. One of the important evidences of this response was that of taller and more vigorous stalk growth (Fig. 4). On the Davidson soil this response to applied potash was not observed. On this soil, a small loss, or —$1.29, was obtained for the application of 50 lbs. of K_2O per acre. As mentioned before, the increased returns were over those of the no-potash treatments. Another consideration of importance is that the dollar values given in Tables III, IV, and V do not place any residual value on either applied phosphate or potash fertilizer. Had this been done it is most likely that there would not have been any calculated losses for corn. For wheat and hay, the increased returns would have been greater than those shown.

Growth responses of wheat to both phosphate and potash on the Frederick soil were quite large (Figs. 5 and 6). These differences were great early in the season, but they were not so evident after the wheat had headed. Differ-

Fig. 3. Response of corn to phosphate fertilization on Davidson clay loam, Orange, Virginia, 1955. The plot on the left received 100-0-50, and that on the right 100-60-50.

Fig. 4. Response of corn to potash fertilization on Frederick silt loam, Staunton, Virginia, 1955. The plot on the left received 80-20-0, and that on the right 80-20-50.

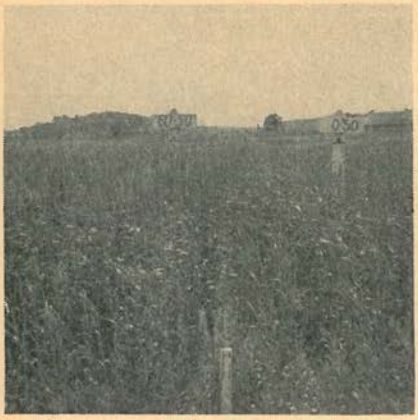

Fig. 5. Response of wheat to phosphate fertilization on Frederick silt loam, Staunton, Virginia, 1955.

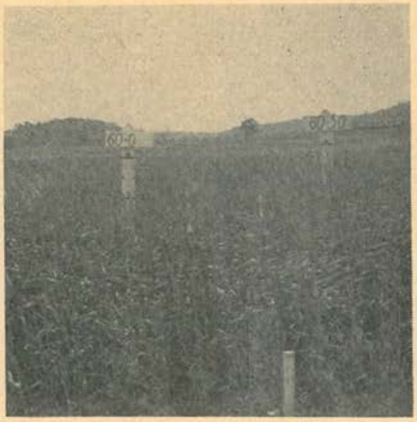

Fig. 6. Response of wheat to potash fertilization on Frederick silt loam, Staunton, Virginia, 1955.

ences due to rates of fertilization on the Frederick soil were evident in the yields which varied from 21.5 to 32.9 bushels per acre as a result of phosphate fertilization (Table IV). Likewise, increased returns rose from \$10.50 per acre for 20 lbs. of P_2O_5 to \$20.94 for 60 lbs. of P_2O_5 per acre on the same soil. Wheat was priced at \$2.20 per bushel. On the Davidson soil increased returns were even higher, going up to \$35.24 for 60 lbs. of P_2O_5 per acre. Increased returns for potash fertilization were quite profitable on the Frederick soil. They were \$10.74 per acre for 50 lbs. of K_2O per acre. Potash was of greater value than shown in these figures because of its significant interaction with phosphate in the 1953 and 1954 cropping years. Yields of wheat were relatively higher when both phosphate and potash were applied than when only one of the two was applied. On the Davidson soil the returns above the cost of potash fertilizer were either quite small or negative.

Responses of red clover hay to fertilizer were simliar to those of wheat, and the visual differences were just as great (Figs. 7 and 8). Increased re-

TABLE III.—RELATIONS BETWEEN YIELDS OF CORN AND INCREASED RETURNS AS INFLUENCED BY FERTILIZER TREATMENTS ON TWO SOILS IN VIRGINIA.

Lbs. per A. per year of P_2O_5–K_2O	Frederick silt loam		Davidson clay loam	
	Av. annual yields corn '50, '54	Increased return value of the increased yield less the cost of the fertilizer	Av. annual yields corn '50–'52	Increased return value of the increased yield less the cost of the fertilizer
	bu./A.		*bu./A.*	
0—(all levels)	50.2	\$ 0.00	47.4	\$ 0.00
20—(all levels)	55.3	7.44	58.8	18.34
40—(all levels)	57.1	9.17	59.6	18.34
60—(all levels)	60.1	12.98	63.2	23.19
(all levels)—0	53.0	\$ 0.00	57.1	0.00
(all levels)—25	56.9	5.63	57.6	−.25
(all levels)—50	57.2	5.03	57.0	−1.29

TABLE IV.—RELATIONS BETWEEN YIELDS OF WHEAT AND INCREASED RETURNS AS INFLUENCED BY FERTILIZER TREATMENTS ON TWO SOILS IN VIRGINIA.

Lbs. per A. per year of P_2O_5–K_2O	Frederick silt loam		Davidson clay loam	
	Av. annual yields wheat '51–'54	Increased return value of the increased yield less the cost of the fertilizer	Av. annual yields wheat '50, '51, '53, '54	Increased return value of the increased yield less the cost of the fertilizer
	bu./A.		*bu./A.*	
0—(all levels)	21.5	$ 0.00	16.2	$ 0.00
20—(all levels)	26.9	10.50	27.7	23.92
40—(all levels)	31.1	18.36	32.0	32.00
60—(all levels)	32.9	20.94	34.1	35.24
(all levels)—0	24.6	0.00	26.9	0.00
(all levels)—25	29.2	9.00	27.7	0.64
(all levels)—50	30.5	10.74	27.9	−0.04

turns from fertilizing red clover hay were unusually high compared to those of corn and wheat (Table V). They were unusually high partially because of the large percentage increase in yields and partially because of price. Red clover hay was priced at $38.40 per ton. Because of drouth this was approximately the price of hay during the period 1951-1954 in Virginia. Drouth limited yields somewhat, but in only one case, the no-phosphate fertilizer treatment on Davidson, were yields below one ton per acre. Increased returns were as high as $55.38 for 60 lbs. of P_2O_5 per acre on Davidson. As with corn and wheat, increased returns on Davidson were considerably greater for phosphate than those on Frederick. Increased returns of red clover from 50 lbs. per acre of potash were $23.49 on the Frederick soil. As with wheat, so with red clover hay the 1953-1954 yields were relatively higher when both phosphate and pot-

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Fig. 7. Response of red clover hay to phosphate fertilization on Frederick silt loam, Staunton, Virginia, 1954.

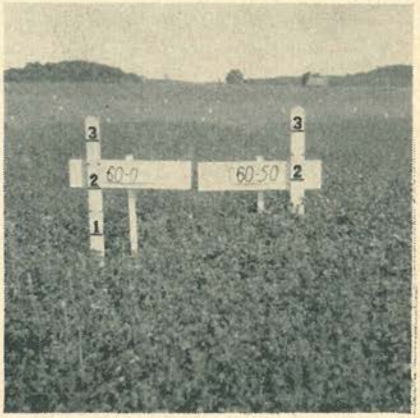

Fig. 8. Response of red clover hay to potash fertilization on Frederick silt loam, Staunton, Virginia, 1954.

Chemical Basis for Soil Testing[1]

By J. Fielding Reed

Atlanta, Georgia

THE PRACTICE known as "soil testing," including chemical analysis and biological studies for characterizing soil fertility, has developed over the past century. During the past 15 years, interest has increased greatly and soil testing laboratories and services have become established and accepted. This has gone hand-in-hand with educational programs promoting more effective use of fertilizers and lime by farmers. Improved analytical techniques and equipment have increased the precision of determining small quantities of elements and make soil testing possible in routine laboratories.

The history of testing soils and the underlying principles have been excellently discussed by Bear (1) and Peech (10) and will be only briefly mentioned here. Nor will biological methods of evaluating soil fertility be considered. It is the purpose of this paper to discuss the chemical methods in use today in this country and, briefly, the principles upon which these methods are based. While it is recognized that one of the very important aspects of a soil testing program is interpretation and recommendation once the soil test values are obtained, no attempt will be made to go into the various approaches used in establishing correlations between soil tests and crop requirements for nutrients.

Analyses commonly conducted in soil testing laboratories include pH or lime requirement, and phosphorus, potassium, calcium, and magnesium in the so-called "available" state. Some laboratories include determinations of organic matter, nitrogen in various forms, and certain of the trace elements.

Soil Acidity

Acidity, the first test used routinely, is still the property most widely determined. Instruments, involving the use of the glass electrode, have made pH a simple and precise measurement.

The pH value for a particular soil is not a fixed factor, but depends on the soil-solution ratio used in its determination; and even with a fixed ratio will fluctuate with season, stirring, and other factors, as discussed in detail by Reed and Cummings (12). In general, a narrow ratio of soil to water (1:2 or less) is used for providing an accepted figure for the pH value of the soil at any given time.

Mineral Element Determinations

Early analyses of soils for total content of elements did not indicate needs for fertilizer or lime. Attempts were made to get some measure of the rate at which these elements moved into solution, or became "available." Hence, the major problem has been to devise extracting solu-

[1] Reprinted from *Journal of Agricultural and Food Chemistry*, Vol. 4, page 116, February 1956.

tions and methods to measure availability with perhaps secondary emphasis on determining the elements once they are in solution.

Early work in England was based on attempts to simulate the action of acids secreted by root hairs which it was assumed had a dissolving effect on the soil particles. This use of weak solutions of citric, oxalic, and other organic acids later lost popularity in the U. S. In retrospect, some of the data obtained, although empirical, did show relationship with known crop-producing powers and fertilizer needs of the soils and were well advanced for their time.

Later strong acids came into use to dissolve the zeolite minerals, believed to be the chief source of the available mineral elements in soils. For some years constant boiling hydrochloric acid (Specific gravity 1.115) was used. An "official" method of the AOAC based on its use was shown to have little foundation.

At one time, considerable effort was devoted to obtaining and analyzing "natural soil solutions," as a method of characterizing soil fertility. Some very fundamental information was produced, but the results did not serve their purpose in fertility characterization. Analysis of the filtrate from a soil suspension containing little or no soluble electrolytes will not give the true ionic composition of the natural soil solution.

It becomes obvious that (1) there were difficulties associated with soil solutions and (2) total analysis or strong acid extractions failed to measure adequately the available supply of a nutrient. Hence, agricultural chemists have used empirical methods to extract from the total supply of a nutrient a fraction that is proportional to that part which the plant can utilize during its growing period. In the case of cations such as potassium, calcium, and magnesium, this has often involved the determination of all or a part of the "exchangeable" cation. In the case of phosphorus, weak acid or salt extractions are generally used.

Determining Exchangeable Cations

Since Thomas Way of England reported his discovery of the phenomenon of base exchange in soils, chemists have used this property as a basis for characterizing soil fertility.

The "cation capacity" is defined as the sum of all the exchangeable cations and is usually expressed in milliequivalents per 100 grams of soil. Total *exchangeable bases* refer to the sum of the metal cations (such as potassium, calcium, magnesium) plus ammonium, but exclusive of hydrogen, and the *percentage base saturation* is the percentage of the exchange capacity which is made up by the exchangeable bases.

Determining the exchangeable cations involves replacement with a concentrated salt solution or a dilute acid or the use of electrodialysis. The process of cation exchange is rapid, reversible, and stoichiometric.

The value for the exchangeable calcium, magnesium, or potassium is often used as a measure of the amount of that element "available" for crop use. The values for exchangeable hydrogen, exchange capacity, and percentage base saturation are used along with the pH value and some knowledge of the predominant type of soil colloid to arrive at the lime requirements of a soil.

Exchangeable calcium is a very useful value in acid soils containing no free calcium carbonate. It includes a large part of the total reserve supply of this element and is a good measure of the amount of calcium readily available for plant use. In soils containing free calcium carbonate, exchangeable calcium is difficut to determine accurately, but in such soils this is of little concern because calcium seldom needs to be added as a nutrient or to correct acidity.

In mineral soils, only a small fraction of the total magnesium is exchangeable, contrasting with the calcium situation. Some salt solutions and acids, as well as electrodialysis, used for determining exchangeable magnesium may remove appreciable amounts of the nonexchangeable. This may not be serious in estimating available magnesium as some nonexchangeable forms undoubtedly are used by plants. But the method is empirical. The measurement of "available" magnesium is often considered less accurate than that of other elements, partially because of errors inherent in its definition. Field and greenhouse correlation data on it are scarce and the average routine soil testing laboratory has difficulty in determination of small amounts of magnesium.

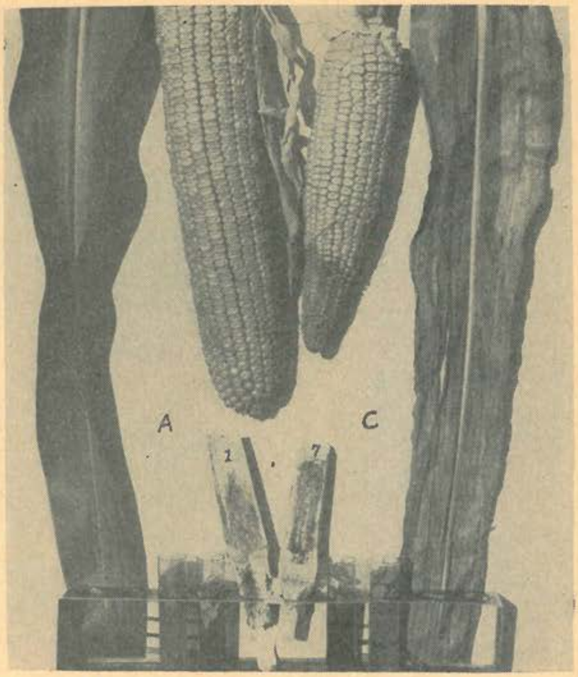

Fig. 1. Tissue tests do not measure quantitatively, but often are valuable guides in diagnosing deficiency symptoms. Deficient plant at right shows very high nitrate, very high phosphate, and low potash.

Potassium is an element determined much more frequently than calcium or magnesium, yet interpretations of available potassium are not without difficulties. It is not uncommon for a mineral soil to contain as much as 2% total potassium, yet respond profitably to potash applications. Most soil potassium occurs in silicate forms that break down too slowly to release potassium in amounts necessary for growing crops. So while exchangeable potassium is often taken as the best means available of estimating available potassium, it is recognized that conversion from nonexchangeable forms to exchangeable is constantly taking place and that soils differ in their ability to replenish exchangeable potash. Methods of measuring release of the nonexchangeable form have been proposed (13, 14), but have not been adopted for routine use.

Soils Can Fix Potassium

The reverse of this process of release is also to be considered, since soils have the ability to fix in nonexchangeable forms appreciable amounts of applied potassium. Wetting and drying of soils has been shown to influence this. In many soil laboratories, especially those dealing with soils containing certain types of colloid fractions, the degree to which the soil is dried will markedly affect the level of available potassium. Complete air-drying of soils prior to analysis is often practiced, but recent data indicate that with some soils this practice may result in increasing the apparent level of available potassium so that the results are higher than those worked out in the correlation studies with crop yields. It is possible that drying under conditions of controlled humidity may

Fig. 2. Samples are received and prepared for testing in North Carolina state laboratory at Raleigh.

be necessary for obtaining values that can be repeated.

These three elements, calcium, magnesium, and potassium, constitute those cations most frequently determined in soil testing laboratories. Generally these laboratories do not use long and detailed procedures for determining the actual amount of the exchangeable cation, but employ empirical methods designed to estimate a proportional amount of the cation in an exchangeable state. Narrow ratios of soil to extractant are used, short periods of contact by shaking, and relatively rapid methods of determining the element in the extract. In common use as extractants today are hydrochloric acid (0.025 to 0.7 N) and acetic acid (buffered with sodium acetate change). Some laboratories use simple salt solutions rather than acids. In using any of these extractants intended to remove a fraction of the exchangeable cation, it should be pointed out that the fraction of a particular cation removed is not always fixed, but depends on the nature of the complementary cation and of the soil colloid itself. These factors have been pointed out by Mehlich and Reed (7).

The fact that a fixed fraction of an exchangeable cation is not removed by these extractants is not necessarily an objection to their use, for in the presence of the growing plant, something of the same situation exists and it is with plant growth and response that these methods are standardized.

Determining Readily Soluble Phosphorus

Phosphorus exists in the soil in both inorganic and organic compounds. The inorganic compounds include the calcium phosphates and the iron and aluminum phosphates. There are a number of different compounds of these elements with phosphorus, some of which are readily available for plant growth and some that are extremely insoluble. Phosphorus is also held in the soil or fixed by the silicate clays. This is often referred to as "sorbed" phosphate since under cer-

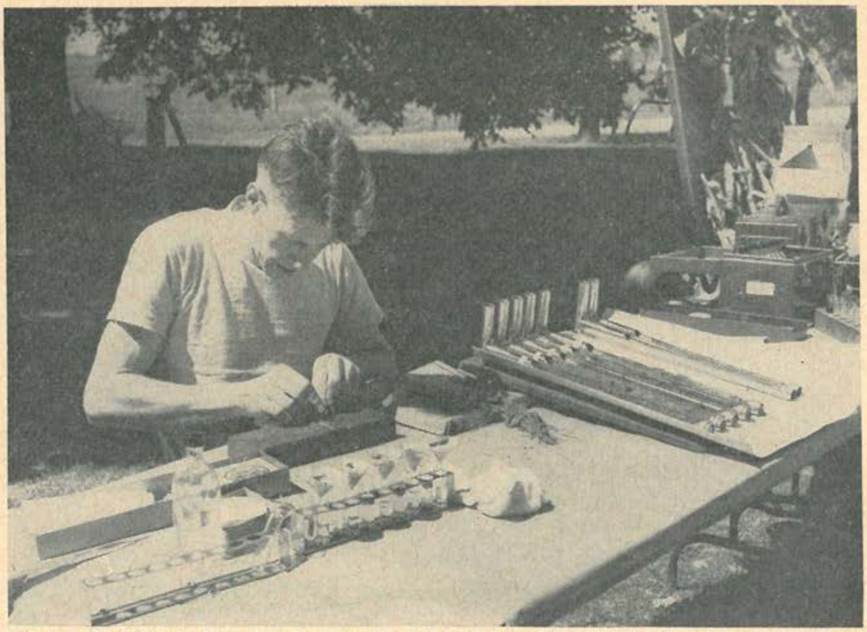

Fig. 3. Test kits, used for both tissue and soil testing, have been effective in farm demonstrations to convey the practicalities of soil testing.

tain conditions some of the phosphorus thus held is subject to replacement by other anions and may be plant available.

Phosphorus

Phosphorus occurs in the soil in many organic phosphorus compounds and this fraction may comprise more than half of the total soil phosphorus. Some of these compounds are available to plants while others are not. The compounds are quite complex and much remains to be done to understand them completely.

It has long been realized that total phosphorus in the soil is of little value in predicting phosphorus response or estimating phosphorus needs of a plant, since much of the soil phosphorus exists in relatively insoluble forms in the soil. While no method has been developed that will predict accurately the exact amount of phosphorus fertilizer to which a given crop will respond, there have been developed empirical laboratory methods that help greatly in assessing the level of available phosphorus in the soil. When standardized against known

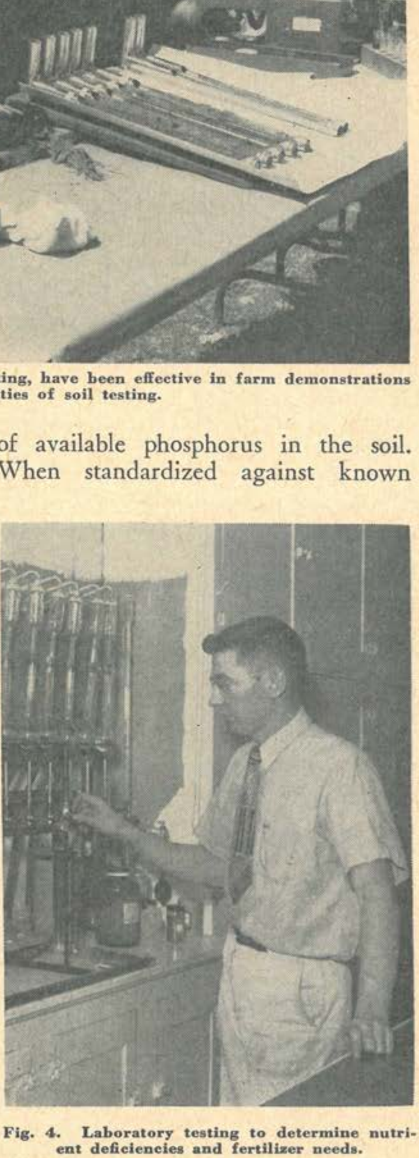

Fig. 4. Laboratory testing to determine nutrient deficiencies and fertilizer needs.

crop response, these methods are very useful in fertilizer recommendations.

Water, either alone or in equilibrium with known partial pressures of carbon dioxide, has been used. Ordinarily the values for phosphorus extracted by water alone are too low for accurate measurement and the range of values is too narrow for satisfactory standardization. On the other hand, water charged with CO_2 has been in use for some years as an extractant for soils of the West that are often alkaline and frequently calcareous. The nature of this solvent action has been discussed by Olsen et al. (9).

For many years dilute acids (hydrochloric, nitric, sulfuric, or citric acid) have been used for extracting soil phosphorus, more frequently with acid soils of the humid regions. Neutral salt solutions of monovalent cations extract about the same amount of phosphorus from the soil as does water. On the other hand, alkaline salt solutions generally dissolve larger amounts of soil phosphorus from both acid and calcareous soils. Solutions of potassium carbonate have been suggested with the recommendation that this is satisfactory for both acid and alkaline soils. However, the amounts of phosphorus removed from acid soils by potassium carbonate are usually considered greater than the amount available to plants.

In many laboratories strongly buffered acidic salt solutions are used in routine soil testing. An example is sodium acetate adjusted at pH 4.8 (8) or 5.0 (5). The theory behind their use is that a highly buffered solution would prevent any change of solvent action after prolonged contact with the soil, even if it contains some small to moderate amount of free carbonate. These solutions give clear extracts, and the extract can be used for determining cations also, thus providing a single extract for many available plant nutrients.

Most dilute mineral acids do not extract any appreciable amount of the so-called sorbed phosphate—that portion which is a part of the colloid make-up and which is removed by replacement with another anion. At least a portion of phosphorus so held is considered plant available. It may be determined by replacement with a solution such as ammonium fluoride, sodium arsenate, sodium hydroxide, and certain organic acids like citric.

Today the method outlined by Bray (2) is widely used for determining available phosphorus in soils, and involves an extractant combining dilute hydrochloric acid and ammonium fluoride. It is designed to remove from the soil a proportionate amount of the easily soluble and the replaceable phosphorus. A large amount of data, establishing standardization with field response to many crops has made this method particularly useful in the North Central States.

Recently a method for extracting soil phosphorus with 0.5 molar solution of sodium bicarbonate at pH 8.5 has been proposed (9). The extraction mechanism is based on the increased solubility of calcium phosphate as a result of lowering the calcium ion activity in solutions. Also the sodium bicarbonate extracts about one half of the amount of phosphorus on the surface of soil particles, which readily exchanges with phosphorus-32 in the soil solution. The method has been evaluated by use of 212 soil samples from greenhouse and 95 samples from field experiments. An excellent relationship has been established between the levels of available phosphorus determined by this method and the expected crop response to phosphorus.

Nitrogen and Organic Matter Determination

Much of the soil nitrogen useful to plants comes from decomposition of organic matter, a process influenced by many factors. Estimation of the

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Fig. 1. Taking leaf samples from potato field—Western Washington.

Nutrient Status Survey of Potatoes in Northwestern Washington[1]

By Harry A. Kittams

Junior Soil Scientist, Western Washington Experiment Station, Puyallup, Washington

THE production of potatoes, either for seed or table use, is an important agricultural enterprise in Whatcom and Skagit counties in northwestern Washington. Total production is usually about 4,000 acres. This represents about 14% of the total potato acreage in the State but 75% of the acreage in western Washington.

Seed potato production (about half the acreage in the area) is centered in Whatcom County. Production of potatoes for table use is centered in Skagit County. Even though western Washington is noted for its cool, damp climate, lack of moisture often limits potato production in both counties. Sprinkler irrigation is rapidly gaining favor, particularly for the soils of coarser texture. Growers prefer to plant potatoes in fields freshly broken out of sod crops. Seldom do they grow potatoes on the same land more than two years in succession, particularly if they are being grown for seed. The soils in this area generally contain low to medium amounts of available phosphorus and potassium, and most farm-

[1] This material is from an M.S. thesis prepared at the State College of Washington. Acknowledgment is made to Drs. W. P. Mortensen, C. D. Moodie, and S. C. Vandecaveye for guidance during the course of this investigation. This study was supported jointly by the American Potash Institute and the Washington Agricultural Experiment Station.

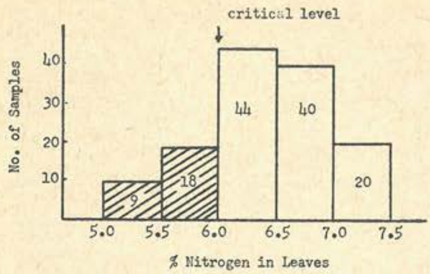

Fig. 2. Frequency distribution of percentage of leaf nitrogen in relation to the critical level for nitrogen.

ers use liberal amounts of complete fertilizers for crops like potatoes which have high fertility requirements. All fertilizers applied for potatoes are banded at time of planting.

Potatoes in this area are grown under similar climatic conditions but on a wide variety of soils. Relatively little information is available on the fertility status of these soils. As a consequence, the fertilizer recommendations for potatoes in Skagit and Whatcom counties are general and uniform in spite of the known diversity in soil conditions. Plant analysis has been used successfully for determining the fertility requirements of other crops—notably tree fruits, sugar beets, ladino clover, and peas. An extensive fertility status survey of potatoes by means of foliar analysis was undertaken in these two counties with the following objectives: (1) To delineate areas or soils that exhibit deficiencies of the major nutrient elements for the purpose of conducting future fertility experiments, and (2) to provide a basis for revising the present fertilizer recommendations in the area surveyed.

Potato Soils

The soils covered by this study fall into four general categories—(1) lowlands, (2) upland-depression, (3) upland, and (4) organic. These groups represent a division based primarily on topographic position. The characteristics of the soil series included in each group are very similar. These groups also provide a basis for a logical and practical division of the soils for making fertilizer recommendations. The lowland group is comprised of alluvial soils, (transported by water), situated in the stream valleys. They are usually fine-textured, high to medium in inherent fertility, and generally well-drained. The upland-depression group includes soils of the upland depressions and level basins of the terraces. These soils are commonly fine-textured, medium to low in inherent fertility, and so poorly drained that artificial drainage is usually necessary before they can be cropped intensively. The upland category includes the light-colored soils

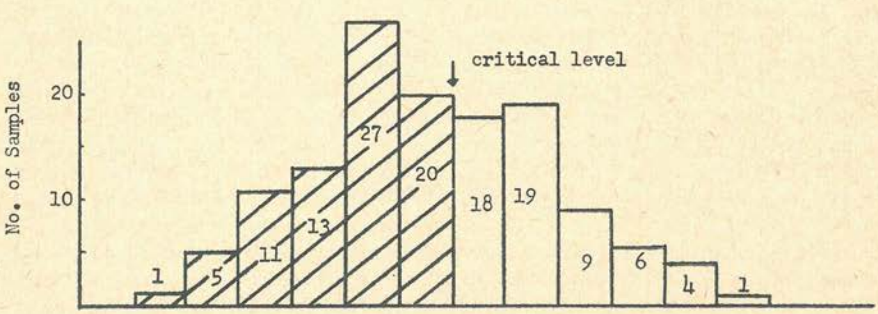

Fig. 3. Frequency distribution of percentage of leaf phosphorus in relation to the critical level for phosphorus.

of the uplands and terraces. Generally these soils have a friable, silty-to-sandy surface soil, are medium to low in inherent fertility, and are well-drained. The organic soils include peats and mucks that are found widely scattered throughout the basins and depressions of the lowlands, uplands, and terraces. Aside from nitrogen, these soils are generally low in inherent fertility and require artificial drainage before cropping.

Soil and plant samples were collected from 133 fields representing approximately 2,000 acres of potatoes. The number of fields falling in each category is as follows: 55 for the lowland group, 32 for the upland-depression, 31 for the upland group, and 15 for the organic group. The lowland fields were located predominantly in Skagit County, whereas the upland-depression, upland, and organic groups were predominantly in Whatcom County. A record of previous cropping history, analysis of the fertilizer and its rate of application, variety of potatoes, soil series and type, and yield of tubers was obtained for each field. Also, a record of soil moisture during the growing season was kept for selected fields.

Leaf and Soil Sampling

The plant samples were collected when the plants were approximately 8 to 10 inches in height. This corresponds to a period of 40 to 45 days from time of planting. Leaf blades from the fourth or fifth node down from the top of the plant were selected for analysis. The leaves were oven-dried, ground, and chemically analyzed for nitrogen, phosphorus, potassium, calcium, and magnesium. The interpretation of the foliar-analysis data in this study is based upon the critical level concept which states that the critical nutrient level (actually a range) is that minimum concentration of a plant nutrient necessary for normal plant growth. If the concentration of the nutrient is above the critical level, growth will not be improved by that excess. The results of field trials run in former years by F. T. Tremblay* indicate that the approximate critical levels for potatoes based on oven-dry weight of potato leaf blades are: nitrogen (total N) —6%, phosphorus (acetic acid soluble PO_4) —4%, potassium (total K) —4.5%. A tentative critical level for calcium has been set at 1%. No critical level has been set for mag-

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* Unpublished literature, WWES, Puyallup, Washington.

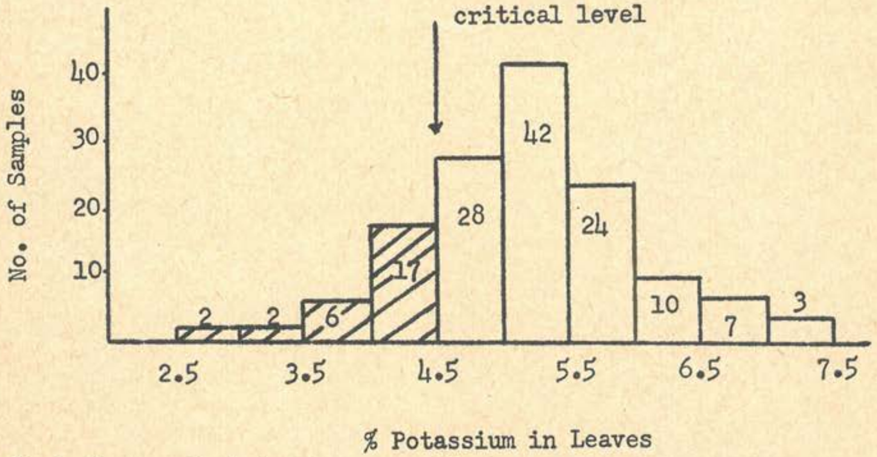

Fig. 4. Frequency distribution of percentage of leaf potassium in relation to the critical level for potassium.

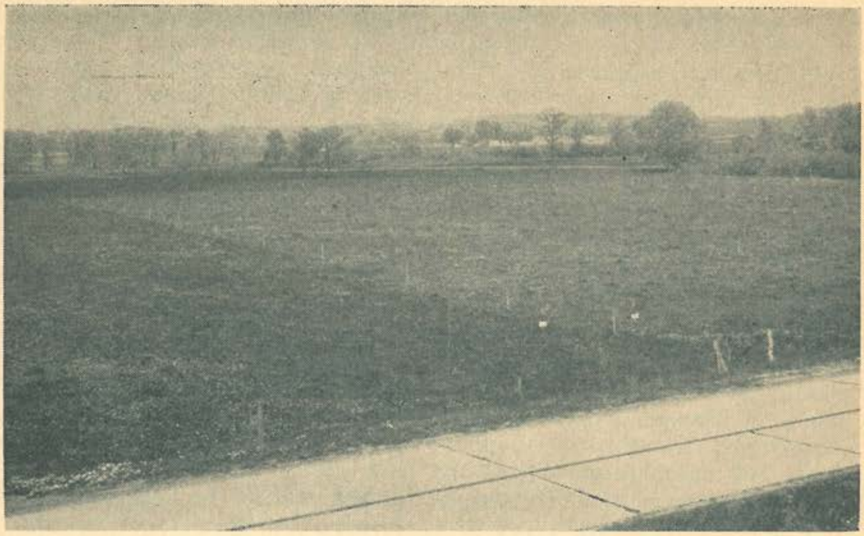

Fig. 1. Nitrogen fertilizer backed up with minerals applied as topdressing either in the early spring or late fall will give farmers a week to ten days' earlier grazing. It not only will furnish lush, early growth of pasture grasses, but will extend the grazing season into late July and may stimulate the growth of the native clovers in the fall. The rank, lush growth of fertilized pasture grasses will choke out many types of weeds and reduce damage from infestation of grubs.

Pasture Improvement by Direct Fertilization

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

MORE abundant pastures will give cheaper feed and in turn will make possible greater production of low-cost milk and meat. A few farmers have made a start in the renovation of their old grassland pasture. Many are providing some rotational pasture and every year use a certain portion of their legume acreage for pasture. Some farmers are growing an acreage of Sudangrass or other emergency crops for mid- and late-summer grazing. But even where pastures are renovated, they eventually "peter out" with June grass and bromegrass or timothy again taking over.

Low-cost Nitrogen Means Low-cost Protein Feed

I shall continue to recommend alfalfa, ladino clover, and bromegrass in a long-time program of pasture improvement by renovation. I heartily endorse a program for the introduction of alfalfa into permanent bluegrass pastures, even at the expense of liming and fertilizing. I shall continue to recommend rye for early spring and late fall pasture. But

I do believe there is a great opportunity for the improvement of our pastures through the use of nitrogen fertilizers. Science in the chemistry of explosives during the war period and the more recent advances in this field of synthetic-nitrogen fixation have given us cheaper methods of producing nitrogen fertilizer and have opened up a new approach to the production of protein feeds.

Nitrogen and Minerals for Pasture Improvement

We can supply the nitrogen and minerals for pasture improvement as solid mixed fertilizers such as 10-10-10, 12-12-12, triple 13 or triple 14, or in the liquid form as 9-9-9. Carriers of nitrogen such as ammonium nitrate, ammonium sulfate, cyanamid, urea, calcium or sodium nitrates, or any one of the several liquid forms such as N-32, N-41, or 82% anyhydrous ammonia can be applied direct, but we should back up this nitrogen with phosphate and potash. Actually, the kind of nitrogen makes little difference so far as results are concerned. The real factor is cost per unit of plant food applied.

In Wisconsin where straight nitrogen is applied, we suggest supplementing with from 300 to 500 pounds per acre of such mixtures as 0-20-10, 0-20-20, or 0-10-30. On the more fertile pasture lands, nitrogen fertilizers alone may be used for a period of two or three years before it becomes necessary to replenish the phosphate-potash reserves of these soils.

Lack of Nitrogen the Bottleneck

There are thousands of acres of poor, yellow, weed-infested, permanent grassland pastures in Wisconsin that are starving for nitrogen. The native white clover and other legumes do supply some nitrogen to the grasses, but these legumes are not too dependable. They may be here this year, but gone the next.

You can think of nitrogen for pastures as the alarm clock that wakes up these old, tired pastures in the spring of the year. It is an easy program to carry out because all you have to do is call a dealer on the telephone and order the fertilizer; tell him to haul

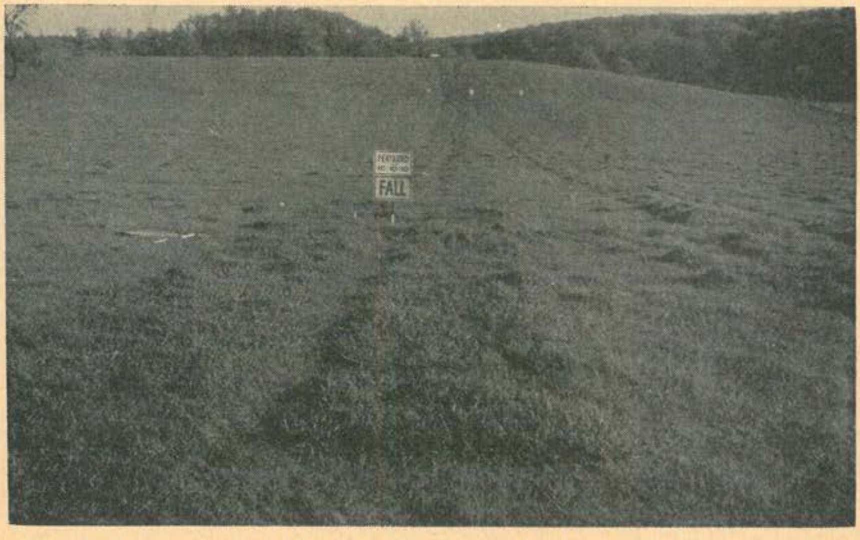

Fig. 2. In this comparison of fall vs. spring application of 10-10-10, the four strips on the left treated in the fall yielded 2,787 lbs. (dry matter basis). The four strips on the right treated in the spring yielded 2,404 lbs. In both cases the application was about 500 lbs. per acre. Where no fertilizer was applied, the yield was 840 lbs. The fall-treated pasture was ready for grazing a few days ahead of the spring-treated portion.

TABLE I.—AVERAGE YIELDS AND NET VALUE OF INCREASES IN YIELD FOR 348 PLOTS HARVESTED IN 1951, 1952, 1953, 1954, and 1955.

Treatment	Av. number of clippings	Yield per acre (lbs.) (dry matter)	Pounds increase	Value of increase	Cost of fertilizer	Net profit per acre
500# 10-10-10...	2	6,298	3,415	....	$18.00	$73.30
No fertilizer.....	2	2,883	....	....	....	....

it out and spread it. Wisconsin farmers have been literally astounded to see the tremendous response of pasture grasses to treatment with 10-10-10 or 12-12-12 fertilizer. Applied at rates up to 500 or 600 lbs. per acre, yields have been doubled and sometimes trebled.

Hundreds of Demonstrations with 10-10-10

Over a period of the past five years Wisconsin county agents have carried out several hundred acre-scale demonstrations which have proved without question that it does pay to fertilize these old grass pastures. Farmers who cooperated in this work applied the 10-10-10 or similar fertilizer on an acre strip clear across their pastures.

In order to secure yield data, farmer cooperators were asked to fence out 6 or 8 square-rod areas each of fertilized and unfertilized. Areas of like size were clipped from these plots at 2 or 3 different periods (each time from the same area). Green weight yields were calculated to the acre basis and 30% of this green weight was recorded as dry matter.

The protein content of nitrogen-treated pasture grasses as grazed by cattle in late May or early June will run from 20 to 22% on the dry-matter basis. In fact, the protein content for nitrogen-treated pasture grasses over the period of June and July will average about 18%. With 18% dairy feed costing about $70 per ton, we believe that it is fair to figure our increases in yield due to treatment with 10-10-10 at $50 per ton.

In most cases the 10-10-10 or 12-12-12 was applied at rates ranging from 450 to 500 lbs. per acre. We have observed in some cases a residual benefit from the phosphate-potash content of this fertilizer for two years following. Actually farmers could apply straight nitrogen fertilizer for one year following a 500-lb. per acre treatment with 10-10-10.

These high-nitrogen fertilizers can be applied in late fall or early spring. Late fall application is strongly recommended, in fact preferable in many respects by reason of firm footing for trucks and spreaders.

Light Rate Application of Nitrogen Fertilizer on Grassy Sod May Show Little or No Benefit.

Regardless of whether applied in the fall or spring, it should be observed that when there is quite an accumulation of dead grass in a pasture the apparent early response to light rate treatment with 10-10-10 or other nitrogen fertilizer may be hardly noticeable. The reason for this is that this dead grass is actually food or energy material for the fungi and bacteria responsible for its decomposition. In turn, a high percentage of the nitrogen applied is used up by these micro-organisms. But when a rather liberal application (400 to 600 lbs. of 10-10-10 per acre) is made, you not only bring about a rapid decomposition of the dead grass, but the plant food contained therein is liberated.

At the same time, you have supplied enough nitrogen to start the early lush growth of pasture grasses. Later on

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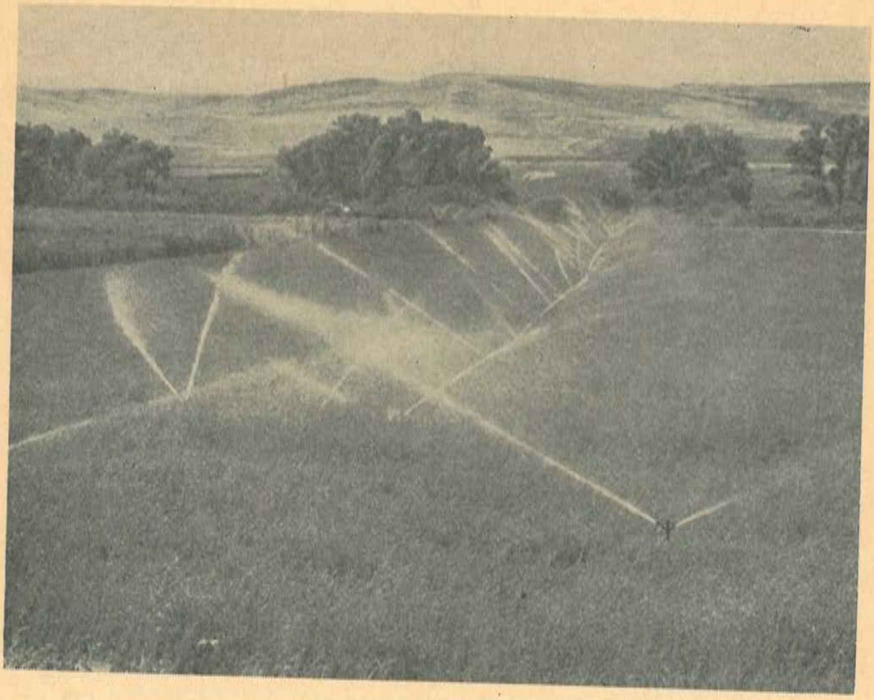
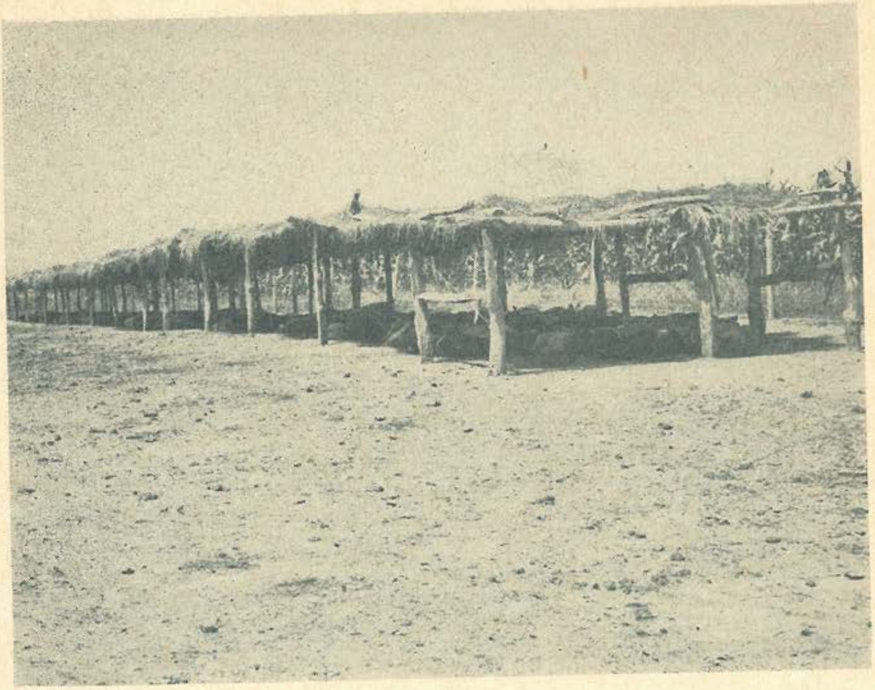
PICTORIAL

Dainty—But for How Long?

Ponds and rivers are natural supplies of water.



Modern irrigation helps man combat droughts.



Two good ways of providing animal comfort during heat waves.

The Editors Talk

Our Cover Picture

Wheat responds markedly to potassium at the lower levels of potassium availability, but requires relatively less potassium than corn or legumes. The picture on the cover of this issue illustrates wheat conditions just before harvest time, showing a difference in size and maturity of wheat due to potassium in 0-20-20 fertilizer on a very low potassium Cisne silt loam of southern Illinois. All plots received 40 pounds nitrogen (N) topdressed.

This difference in time of maturity of wheat from potassium additions seems to occur only under very low potassium levels, when other nutrients are adequate. The illustration was taken from a 1-year demonstration, but similar conditions show up year after year on long-time experiments in the area. The differences seem relatively greater in some seasons than in others. Hastening of maturity from potassium is relatively less than from phosphorus under comparable starvation conditions.

Potassium-starved wheat on experimental plots may show a series of so-called "symptoms" through its life cycle, as:

1—Stunted early fall growth,
2—Yellowing of tips and margins of leaves,
3—More browning of leaves on low-potash plots following fall or early spring frosts,
4—Restricted root growth and winterkilling,
5—Slower spring growth and uneven heights,
6—Delayed maturity as compared to well-fertilized wheat,
7—Weak straw which may cause lodged wheat,
8—Shortened heads,
9—Kernels that do not fill out into normal plump grains, resulting in "chaffy" wheat, low in test weight.

The final result is lower yields as well as poor quality wheat.

On the low potassium plots on these heavy soils, the wheat seems to grow more unevenly for some reason. Perhaps this is partly due to effects of localized organic residues, but sometimes it apparently is associated with slightly higher or lower soil levels within the plot, as left by discing operations before seeding. It has been suggested that temporary lack of oxygen in the soil in small drainage pockets may reduce potassium availability still further. At least, it is typical to have uneven growth of wheat on plots receiving no additional potash.

When legumes are to be seeded in wheat, the "wheat fertilization time" calls for thinking ahead a year or more. The wheat may require more phosphate than potash, but the legumes to follow may need more potash than phosphates. So again it is urged that soil treatments be planned on a rotation basis and if possible according to soil-test indications. Soil tests should be made about every four years to be sure to keep up with changes in nutrient needs.

Agriculture Needs More Students

Dr. Byron T. Shaw, Administrator, Agricultural Research Service, U. S. Department of Agriculture, before a meeting of the Northeastern Branch of the American Society of Agronomy this summer, said we must show our young people that the agricultural colleges offer training in a wide range of sciences, as well as farming. The growing need for research brings into ever sharper focus the need for trained personnel. We need more scientists, chemists, physicists, soils and crops scientists—to do the job. Agricultural research, like all other fields employing scientific and technical specialists, is faced with a big demand for trained people.

As an example of problems needing more attention, Dr. Shaw pointed out the changes in our eating habits that are affecting farming patterns. Today, there is a strong trend to more fruits, vegetables, meat, and meat products in our diets. Many farmers need to adjust their production in keeping with market demands. Some already are shifting to livestock. They need help in finding ways to make the change profitably.

In speaking specifically of the Northeast, he said, "Research has shown that 80% or more of the total feed nutrients consumed by dairy animals can come from forage. The potentialities, as well as the results to date, indicate conclusively that continued research along these lines is absolutely essential to the farm economy.

"You know, as well as I, that factors other than genetics affect our forage crops. What are we doing about more efficient production of our improved grasses and legumes? For instance what about the use of fertilizer on hay and pasture? Why is it that so little fertilizer is used on these crops? Is it lack of research?

"Studies show that farmers are willing to spend money and time to fertilize vegetables, while they practically ignore hay, pasture, and cover crops. A recent report shows that farmers use, on the average, 68 pounds of nitrogen per acre for green and yellow vegetables and 83 pounds for potatoes. At the same time they averaged only 1 pound of nitrogen for hay and four-tenths of a pound for pasture and cover crops.

"They used 129 pounds of phosphate per acre for vegetables and 156 pounds for potatoes, but only 7 pounds for hay and 5 for pasture. The same general differences are true with potash. Farmers used 92 pounds per acre for vegetables and 178 pounds per acre for potatoes. But for hay they averaged only 4 pounds of potash, and for pasture and cover crops only 2 pounds.

"What can we expect from heavier fertilization of forage crops? Do we have enough research data to supply nutritional and economic justification for this investment?

"These questions lead to another related problem. Although we are using five times as much nitrogen now as we did 15 years ago, we are using less lime. From a peak of 30 million tons applied in 1947, current use is down to 20 million tons. Unless the use of lime keeps pace with the use of nitrogen, we can develop serious problems of acidity in our soils. This is already showing up in some areas. This situation can be extremely troublesome, particularly in cases where the acidity may penetrate into the subsoils. It needs more research attention."

With the opening of our higher institutions of learning this fall, it is hoped there will be significant increases in enrollment in agriculture. The rapid strides in research that have resulted in the mechanization of our agriculture and increased efficiency in other phases of crop and livestock production must be held. Competition for the trained mind by other industries is keen. Meeting such competition calls for alertness on the part of everyone connected with agriculture.

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									
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	....
May........	31.96	54.0	219.0	231.0	139.0	200.0	16.15	47.30	....
June........	32.29	51.0	265.2	317.0	142.0	193.0	15.05	47.40	....
July.........	32.36	48.0	311.4	380.0	143.0	190.0	14.85	49.00	....

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									
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	214
April........	262	...	247	247	206	230	137	208	202
May........	258	540	314	263	217	226	136	210	239
June........	260	510	389	361	221	218	127	210	345
July.........	261	480	455	396	223	215	125	217	351

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							
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
May	.895	....	....	.380	.735	14.00	.193
June	.895	....	....	.360	.720	13.45	.177
July	.895	....	....	.380	.735	14.00	.177

Index Numbers (1910-14 = 100)

	Superphosphate	Florida land, pebble	Tennessee phosphate rock	Muriate of potash	Sulphate of potash in bags	Sulphate of potash magnesia	Manure salts
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							
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
May	167	...	...	69	77	58	82
June	167	...	...	66	76	56	80
July	167	...	...	69	77	58	80

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						
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
May	2.98	1.70	8.67	11.80	6.60	6.37
June	2.98	1.56	8.72	11.29	6.37	6.23
July	2.98	1.56	9.37	10.89	6.80	6.37

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						
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
May	111	60	248	334	196	181
June	111	55	249	320	189	177
July	111	55	268	308	202	181

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								
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	228	261	254	130	92	222	167	72
April	235	261	257	130	92	219	167	72
May	242	264	257	128	85	236	167	72
June	247	264	257	126	82	231	167	70
July	244	266	257	128	82	242	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

"Annual Report of State Chemist of Florida, Fertilizers, Feeds, Foods, Drugs and Cosmetics, Pesticides and Seeds, Year Ending December 31, 1955," State Dept. of Agr., Tallahassee, Fla.

"A Method of Determining Profitable Rates of Fertilizer Use: Nitrogen on Coastal Bermuda for Hay," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 22, July 1956, W. J. Foreman and O. Steanson.

"Counties Participating in Nitrogen Soil Test Experiments," Dept. of Agron., Univ. of Ill., Urbana, Ill., AG 1675, April 1956, L. T. Kurtz.

"Nitrogen Fertilizers for Maine Farms," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Misc. Pub. 625, Feb. 1956, H. J. Murphy.

"Fertilizers and Limes—1955," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Insp. Series 61, Feb. 1956, S. B. Randle.

"Summary Inspection Report of Official Samples on Seed, Feed & Fertilizer, 1954-55 Fiscal Year," State Dept. of Agr., Oklahoma City, Okla.

"The Nitrogen, Phosphorus, Potassium and Ash Content of Castor Bean Hulls," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Tech. Bul. T-61, June 1956, W. Parkey, J. E. Webster, and D. L. Van Horn.

"Distribution of Fertilizer in Oklahoma Counties by Grades and Material for the Period July 1, 1955 to July 1, 1956," State Dept. of Agr., Oklahoma City, Okla., Ann. Rpt.

"Inspection of Fertilizers Made for the State Department of Agriculture and Conservation," Agr. Exp. Sta., Univ. of R. I., Kingston, R. I., Ann. Fert. Cir., Dec. 1955, R. W. Gilbert and J. B. Colson.

"Oat Fertilizer Tests, Blackland Experiment Station, Temple, 1953-55," Agr. Exp. Sta., Texas A. & M. College, College Station, Texas, Prog. Rpt. 1874, May 1956, E. D. Cook and W. R. Parmer.

"1954 Irrigation and Nitrogen Fertilization Experiments on Sugar Beets in the Columbia Basin," Agr. Exp. Sta., State College of Wash., Pullman, Wash., Stas. Cir. 278, Dec. 1955, J. S. Robins, C. E. Nelson, and C. E. Domingo.

"Influence of Fertilizer on Two Grass-Legume Mixtures in the Big Horn Basin," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Bul. 337, Oct. 1955, R. D. Lewis.

"Commercial Fertilizers, Consumption in the United States, 1954-55," USDA, Wash., D. C., 2070, June 1956, W. Scholl, H. M. Wallace, and E. I. Fox.

Soils

"The Uptake of Radiostrontium by Certain Type Crops from Calcareous Soils," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Tech. Bul. 130, Oct. 1955, W. H. Fuller and W. J. Flocker.

"Soil Drifting, Its Causes and Control," Exp. Farms Serv., Dept. of Agr., Ottawa, Ont., Can., Pub. 896, Rev. April 1956, K. W. Hill.

"Cation Exchange Properties of the Hawaiian Great Soil Groups," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Tech. Bul. 31, June 1956, Y. Kanehiro and A. T. Chang.

"Soil Survey, Tunica County, Mississippi," USDA, Wash., D. C., Series 1942, No. 14.

"Soils of McCone County, Soil Reconnaissance of Montana, Preliminary Report," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 514, Oct. 1955, L. F. Gieseker.

"Soils of Richland County, Soil Reconnaissance of Montana, Preliminary Report," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 515, Nov. 1955, L. F. Gieseker.

"Gypsum for Improving Alkali Soils," Agr. Exp. Sta., Univ. of Nev., Reno, Nev., Cir. 7, March 1955, C. E. Houston and J. A. McCormick.

Crops

"Field Crops for Alaska, Recommended Varieties," Agr. Exp. Sta., Univ. of Alas., Palmer, Alas., Ext. Cir. 14, March 1955, H. J. Hodgson, R. L. Taylor, R. J. Bula, and J. C. Brinsmade.

"1956 Vegetable Varieties for Alaska, Field and Garden," Agr. Ext. Serv., Univ. of Alas., College, Alas., Cir. 450, Rev. Dec. 1955.

"Rose Growing in Arizona," Agr. Exp. Sta., Univ., of Ariz., Tucson, Ariz., Bul. 276, May 1956, R. B. Streets.

"Planting and Pruning Roses," Agr. Ext. Serv., Univ., of Ariz., Tucson, Ariz., Cir. 237, Jan. 1956, H. F. Tate.

"Growing Cantaloupes in Arizona," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Bul. 275, May 1956, W. D. Pew, R. B. Marlatt, and L. Hopkins.

"Small Grain Varietal Yield Trials, 1951-55," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 54, March 1956, R. L. Thurman and H. R. Rosen.

"Miscellaneous Cotton Experiments for 1955," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Mimeo. Series 45, March 1956, B. A. Waddle, C. Hughes, and J. F. Jacks.

"Growing Cane Berries in Your Garden," Agr. Exp. Sta., Univ. of Calif., Davis, Calif., Lflt. 62, May 1956, L. C. Gibbs and H. M. Butterfield.

"Report of the Director of Science Service for the Year Ended March 31, 1955," Dept. of Agr., Ottawa, Ont., Can.

"Winter Wheat Improvement Work in Ontario," Dept. of Agr., Ottawa, Ont., Can., 13th Ann. Rpt., April 1956.

"Double-Cross Hybrid Corn, a Story of Small Plots and Big Men," Agr. Exp. Sta., New Haven, Conn., Cir. 198, June 1956, D. F. Jones and H. A. Wallace.

"Report of General Activities with Financial Statement for the Fiscal Year Ended June 30, 1955," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla.

"Ornamental Vines for Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 571, Feb. 1956, R. D. Dickey, E. West, and H. Mowry.

"Yield and Quality of Flue-Cured Tobacco as Affected by Fertilization and Irrigation," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 572, March 1956, F. Clark, J. M. Myers, H. C. Harris, and R. W. Bledsoe.

"Flowers for Florida Homes," State Dept. of Agr., Tallahassee, Fla., Bul. 59, Feb. 1956, J. V. Watkins and P. E. Parvin.

Economics

"Seasonal and Inter-Area Shifts in the Western Lettuce Industry," Agr. Exp. Sta., Univ. of Ariz., Tucson, Arizona., Rpt. 123, Oct. 1955, J. S. Hillman.

"How Arkansas Farmers Secure Their Cotton Planning Seed," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 561, Oct. 1955, C. C. Cable, Jr.,

"Acreage Estimates for California Fruit and Nut Crops, 1919-1953," State Dept. of Agr., Sacramento, Calif., Spec. Pub. 257, Nov. 1955.

"Twenty-Three Years of Citrus Costs and Returns in Florida, 1931-1954," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Econ. Series 56-1, April 1956, Z. Savage.

"Sources of Incomes on Cotton Farms in the Georgia Piedmont," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo. Series N. S. 20, May 1956, W. J. Foreman, O. Steanson, and J. C. Elrod.

"Economic Aspects of Joint Production of Wheat and Rye," Agr. Exp. Sta., Kans. State College, Manhattan, Kan., Agr. Econ. Rpt. 67, Jan. 1956, D. A. Knight.

"Resource Productivity and Income for a Sample of West Kentucky Farms," Agr. Exp. Sta., Univ. of Ky., Lexingon, Ky., Bul. 630, June 1955, H. R. Jensen and W. B. Sundquist.

"Trends in Farm Land Acreage, Use, and Value in Louisiana, 1909-1954," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., D. A. E. Cir. 190, Mar. 1956, J. P. Montgomery.

"Strengthen Farming and Homemaking in Louisiana Through More Research and Education," Agr. Exp. Sta., La. State Univ., Baton Rouge, La.

"Base Book of Mississippi Agriculture," State Dept. of Agr., Jackson, Miss., Bul. 2, Feb. 1956.

"Problems of Small Farms," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 660, Sept. 1955.

"Analysis of Forage Harvesting Patterns on New York Dairy Farms," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., Bul. 917, Oct. 1955, L. C. Cunningham and L. S. Fife.

"Possibilities for Increasing Production and Incomes on Small Commercial Farms, Southern Piedmont Area, North Carolina," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Tech. Bul. 117, Dec. 1955, J. G. Sutherland and C. E. Bishop.

Pasture Improvement by Direct Fertilization

(*From page* 22)

this nitrogen and other plant-food constituents stored in the dead tissues of the fungi and bacteria become available as they decompose and nitrify, thus bringing about a "delayed action" and a longer lasting benefit to the pasture grasses.

Fall Application of Nitrogen Not Recommended on Sandy Soils

There is some danger of losing part of the nitrogen by leaching before the root system of the crop the following spring has developed extensively enough to pick up this nitrogen. On heavy soils, there is very little danger of losing any of this nitrogen especially where applications are delayed until mid-October or later (in Wisconsin or states of comparable latitude) or when the temperature of the soil drops to 55 degrees or lower.

It's true that nitrogen applied as a broadcast treatment and plowed under with crop residues such as cornstalks, grain stubble, or weeds will hasten the rotting of this decomposable organic matter, and the nitrogen as previously pointed out will be pretty largely converted into proteinaceous tissues of the bacteria and fungi which bring about this rotting. Held in this form the nitrogen is not leachable.

There are thousands of acres of pasture land in Wisconsin where the application of 10-10-10 will be found a highly profitable investment. More abundant pastures will give us low-cost feed and in turn will make possible greater production of low-cost milk and meat, and it all fits into our program of soil conservation and grassland farming.

Ten Reasons for Topdressing Pastures with 10-10-10*

1. Ten-ten-ten applied as topdressing either in the late fall or early spring will give farmers a week to 10 days earlier grazing.

2. Applying 10-10-10 (400 to 600 lbs. per acre) or other fertilizer in the fall gets the job done when there is good firm footing for tractors, trucks, and fertilizer-distributing machinery.

3. Ten-ten-ten not only furnishes lush, early growth of pasture grasses, but extends the pasture season into late July and may stimulate the growth of the native clovers in the fall.

4. Pasture improvement by direct fertilization with 10-10-10 has proved to be economically sound. It fits a vital need on livestock farms and is a program that is simple and easy to carry out.

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* (Eight-eight-eight, 9-9-9 (solid or liquid), 12-12-12, or 13-13-13 may be substituted for 10-10-10, or 66 lbs. of anhydrous ammonia plus 250 lbs. of 0-20-20 will supply the same amounts of N, P_2O_5, and K_2O as contained in 500 lbs. of 10-10-10).

Fig. 3. On the James Polcyn farm at Montello, Wisconsin, 600 lbs. of 10-10-10 per acre applied in mid-April 1956 increased the yield from 1,590 to 8,865 lbs. dry matter. This extra forage was easily equivalent to a 16% dairy feed. The picture shows Mr. and Mrs. Polcyn and their twin sons, Jim and John. As of the middle of August the acre strip that was fertilized with 10-10-10 and which had been grazed by Mr. Polcyn's dairy cattle was literally a solid mat of white clover. On the unfertilized strip, clover plants were few and far between. The phosphate-potash balance of the 10-10-10 is no doubt accountable for the tremendous growth of clover. The yield data shown above do not include this mid-summer, lush growth of clover.

5. Pasture grass fertilized with 10-10-10 is more palatable; the feed is richer in protein and minerals, as well as vitamins.

6. By thickening the turf, water-holding capacity is increased and losses by runoff are thereby slowed down.

7. The rank, lush growth of fertilized pasture grasses will choke out many types of weeds and likewise reduce damage from infestation by grubs.

8. More feed from fertilized pastures cuts down on cash outlay for protein feed supplements, thus reducing summer feed costs and the unit cost of producing milk and meat.

9. With the Soil Bank Program taking a lot of poor pastures out of production it's a good time to make the rest of our pastures still better by fertilizing them.

10. More acres of good pasture fit into a program of soil conservation and a grassland type of farming; cut down on man hour and machinery costs by letting the cows harvest their own feed.

Nutrient Status Survey of Potatoes . . .

(From page 19)

nesium, but samples below .3% total magnesium are considered low.

Soil samples representative of the initial fertility status were obtained from each field included in the survey. The samples were analyzed for available nutrients and pH.

Survey Results

The distribution of the samples (all soils) covering range of leaf nitrogen from 5 to 7.5%, is illustrated in Fig. 2. The number in each bar of the histogram represents the number of samples falling between the indicated concentrations of leaf nitrogen. Of the 27 samples below the critical level, 18 fall within the range of 5.5 to 6% leaf nitrogen and 9 within the range of 5 to 5.5% leaf nitrogen. Additional applications of nitrogen would undoubtedly result in an increase in yield for the fields where the plant samples analyzed less than 5% leaf nitrogen, but for fields showing between 5.5 and 6% leaf nitrogen a yield response is doubtful.

The distribution of the samples (all soils) covering the entire range of leaf phosphorus from .1 to .7% is illustrated in Fig. 3. Again it is the distribution of the samples below the critical level that is of primary interest. For the 20 fields in the .35 to .4% group, which is the first group below the critical level, a response to additional applications of phosphate would be unlikely. For the 27 fields falling within .3 and .35% leaf phosphorus, a response to supplemental phosphate applications would be profitable. Those samples having less than .3% phosphorus are definitely low in this element, and an increased phosphate program is clearly needed. Particularly noteworthy in Fig. 2 is the number of samples below .35% leaf phosphorus where additional phosphate applications would probably be beneficial. This indicates a need for further investigation of the phosphate fertilization program in the area surveyed.

The distribution of the samples (all soils) covering the range of leaf potassium from 2.5 to 7.5% is illustrated in Fig. 4. Of the 27 samples below the critical level, 17 fall within the range of 4 to 4.5% leaf potassium, and the other 10 fall below 4% leaf potassium. An increase in yield from additional application of potash for those fields where the leaf level is between 4 and 4.5% would be doubtful, but a yield increase is quite probable where leaf potassium is below 4%. For several of the fields in which leaf potassium was below 4%, a definite reduction in quality was observed in the form of a stem-end discoloration of the tubers which reduced their market value. This condition could possibly have been brought about by an inadequate supply of potassium.

Nitrogen

Table I shows the percentage distribution of samples and average fertilizer applications above and below the critical levels for nitrogen, phosphorus, and potassium by soil groups. The majority of samples, 71 to 90%, for the various soil groups had leaf nitrogen concentrations above the critical level for nitrogen. When all 133 samples are grouped together, 80% fall above the critical level for nitrogen and 20% below. The average application of nitrogen for all fields was 25 pounds per acre for fields where leaf nitrogen was below the critical level and 50 pounds per acre for fields where leaf nitrogen was above the critical level. Plant nitrogen content appears to be associated with rate of nitrogen applied. The average rate of nitrogen application for fields above the critical level for each soil group varied only from 40 to 65 pounds per acre. The results of this study indicate that plot work for determining rates of nitrogen application is not needed. The recommended rate of 50 to 75 pounds of nitrogen appears to be reliable and does not warrant revising under the present fertilizer program.

Phosphorus

As illustrated in Table I, the distribution of the samples above and below the critical level for phosphorus shows the largest percentage of low samples in the upland group, closely followed by the upland-depression group. But there are a sufficient number of low samples in the lowland and organic groups to warrant concern. The low phosphorus content of the samples from the lowland and organic soils seems to be related to an insufficient application of phosphate fertilizer. The average fertilizer application of phosphate for fields having plant phosphorus values above the critical level for phosphorus was 160 pounds P_2O_5 per acre for the lowland group and 185 pounds P_2O_5 per acre for the organic group, whereas the average application for fields having plant phosphorus values below the critical level was 95 pounds P_2O_5 per acre for the lowland soils and 120 pounds for the organic soils. The low phosphorus content of the samples from the upland-depression and upland soils does not seem to be related to rate of phosphate application, since the average phosphate application for fields with samples falling below the critical level in these groups was somewhat higher than for those above. The average fertilizer application of phosphate for fields having phosphorus contents above the critical level for phosphorus was 130 pounds P_2O_5 per acre for the upland-depression group and 140 pounds P_2O_5 per acre for the upland group, whereas the average application of phosphate for fields below the critical level was 135 pounds P_2O_5 per acre for the upland-depression and 160 pounds P_2O_5 per acre for the upland group. A further note of interest is that the soil analyses for available phosphorus indicate little or no differences between fields. No logical explanation for the widely varying efficiency of the phosphate fertilizers can be given, but it is known that free iron and aluminum in these soils tend to rapidly "fix" applied phosphate. This may in part account for the variation.

The plant analyses for phosphorus indicate a definite need for experimental work with nutrient requirements of potatoes for phosphorus. A delineation of the samples into soil groups indicated that the most serious phosphate problem is on the upland soils of Whatcom County, but the need for phosphate trials on the other soils, particularly upland-depression soils, is also evident. The recommended fertilizer rate of phosphate (P_2O_5) for potatoes in the area surveyed is 100 to 200 pounds per acre. This survey indicates that a recommendation of 150 to 200 pounds would be more in order for the upland group of soils. For the upland, upland-depression, and organic groups of soils, a recommendation of 200 pounds per

TABLE I.—THE PERCENTAGE DISTRIBUTION OF SAMPLES AND AVERAGE FERTILIZER APPLICATIONS ABOVE AND BELOW THE CRITICAL LEVELS OF NITROGEN, PHOSPHORUS, AND POTASSIUM BY SOIL GROUPS.

Leaf Nitrogen		Nitrogen (N) Applied		Leaf Phosphorus		Phosphate (P_2O_5) Applied		Leaf Potassium		Potash (K_2O) Applied	
Critical Level											
Above	Below	Above	Below	Above	Below	Above	Below	Above	Below	Above	Below
%		lb/A.		%		lb/A.		%		lb/A.	
LOWLAND SOILS											
71	29	40	25	56	44	160	95	89	11	140	40
UPLAND-DEPRESSION SOILS											
84	16	55	—*	38	62	130	135	59	41	230	140
UPLAND SOILS											
90	10	65	—*	16	84	140	160	81	19	240	135
ORGANIC SOILS											
80	20	40	—*	60	40	185	120	87	13	235	160
ALL SOILS											
80	20	50	25	42	58	155	130	80	20	185	115

* Insufficient number of samples for reliable average.

acre of phosphate (P_2O_5) would be justified.

Potassium

As shown in Table I, the majority of samples for the various groups are above the critical level for potassium. For every soil group the average fertilizer application of potash (K_2O) for fields having plant potassium contents above the critical level is considerably higher than for fields having plant potassium contents below the critical level. The potassium fertilization program appears to be generally satisfactory except for the upland-depression group where 41% of the samples were below the critical level. Increased potash applications are advisable for fields in any soil group showing low leaf values for potassium. The recommended rate of potash (K_2O) for potatoes in the surveyed area is 100 to 200 pounds per acre. On the basis of these data, a revised recommendation of 150 pounds of potash (K_2O) for the lowland soils, and 200 pounds for the upland-depression, upland, and organic soils would seem to be warranted.

Calcium and Magnesium

For calcium, 92% of the samples were above the critical level; only 8% were below. The low leaf calcium values were only slightly below the critical level and a response to lime would be doubtful, at least from the standpoint of increasing the soil nutrient supply of calcium. No critical level has been determined for magnesium, but leaf samples analyzing less than .3% magnesium are considered low. A response to magnesium applications to such fields might be expected. About 20% of the samples were below .3% magnesium. A majority of these were

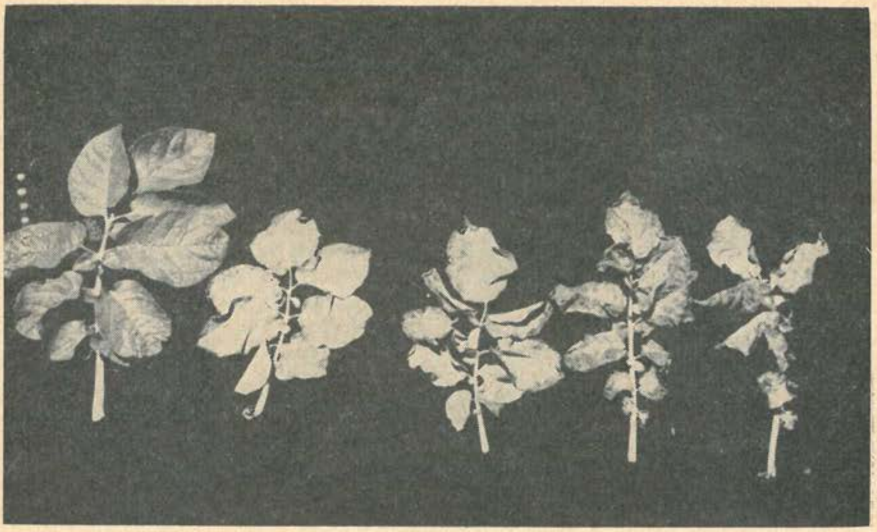

Fig. 5. Potash deficiency on potato leaves: left, a normal leaf; right, symptoms in varying degree of severity.

in the upland group of soils. A general conclusion is that a need exists for further investigation of the magnesium status of these soils. A tentative recommendation for fields where magnesium is suspected of being low is 5 to 15 pounds per acre of Mg, from a readily available source such as Epsom salts, applied as a band application with the rest of the fertilizer.

The average yield for fields having concentrations of plant nutrients above the critical levels for the various nutrients was considerably higher than where the concentrations of plant nutrients were below the critical levels. The average yield for fields having plant nitrogen concentrations above the critical level for nitrogen was 14.2 tons per acre compared with 12.9 tons per

Fig. 6. Response of potatoes to complete fertilizer—Northwestern Washington.

acre for those below the critical level. The average yield for fields having plant phosphorus levels above the critical level for phosphorus was 14.7 tons per acre compared with 13.4 for those below. The average yield for fields having plant potassium levels above the critical level for potassium was 14.3 tons per acre compared with 13.0 for those below. The average yield in tons per acre for fields included within each of the various soil groups is as follows: lowland, 14.7; upland-depression, 13.3; upland, 13.0; and organic, 14.1.

Summary

A nutrient status survey of potatoes by means of foliar analysis was conducted in northwestern Washington. The results indicate that the nitrogen fertilization program is adequate and the recommended rate of 50 to 75 pounds of nitrogen per acre is reliable. A definite need for experimental work with phosphorus exists, particularly on the upland-depression and upland groups of soils. The suggested revised fertilizer recommendation for phosphorus (P_2O_5) is 150 to 200 pounds for the lowland soils and 200 pounds for the upland-depression, upland, and organic soils. The potassium fertilization program is generally adequate, and low leaf potassium is directly related to low rates of potash application. A revised recommendation of 150 pounds of potash (K_2O) per acre for the lowland soils, and 200 pounds for the upland-depression, upland, and organic soils seems justified. A need exists for investigation of the magnesium status of the upland and organic soils. A tentative recommendation for these soils is 5 to 15 pounds Mg per acre, as a banded application, from a readily available source such as Epsom salts.

Chemical Basis for Soil Testing

(*From page* 16)

nitrogen-supplying power of the soil and the need for additions of soluble nitrogen are, therefore, among the most difficult to approach through laboratory means. Over the years soil chemists have attempted this through measurements of total nitrogen, soluble nitrates and ammonia, and determinations of the amount of total organic matter or a fraction of it. It can readily be seen that measurements of total nitrogen would be of little value in predicting nitrogen needs for a particular crop. Nitrate and ammonia nitrogen determinations are also of limited use because of the rapid movement and removal of these constituents and rapid fluctuation from time to time.

Values for total organic matter in the soil mean little in the average soil testing laboratory because of its indefinite composition.

The value obtained is useful in (1) estimating roughly the nitrogen-supplying power of the soil by assumptions as to the proportion of the nitrogen which will become available each year; (2) helping to arrive at the lime needs, especially if exchange capacity has not been determined; and (3) more fully characterizing the soil if the person making the recommendations has not seen the soil, but merely has the soil test data.

Within the past few years, advances have been made in rapid methods designed to predict the nitrogen-supplying power of the soil throughout the growing season. Iowa's soil testing laboratory now includes a procedure (4) that involves incubation of the soil sample at fixed temperature and moisture conditions. Nitrate production during this period is measured, and interpretations in terms of plant needs are based on relationship established through field experiments. A different type of test developed in Wisconsin (15) is also designed to measure the amount of nitrogen in the soil that will become available for crop growth during the season. It involves soil digestion with potassium permanganate and sodium carbonate. Ammonia is distilled off and measured. This is termed the "organic soil nitrogen that is available," and with this value, directions are given for calculating nitrogen to be added for crops.

Most soil testing laboratories do not include routine tests for trace elements, such as boron, manganese, copper, zinc, and molybdenum. From time to time methods have been outlined for these determinations, but field standardization in most areas is not available and there are few data in this country that establish correlations between value for these determinations in a wide variety of soils and needs.

Manganese determinations, when made, are based on estimates of either the exchangeable manganese or the "easily reducible" manganese oxides when the exchangeable manganese is low. Exchangeable manganese may be obtained by extracting with ammonium acetate and this value may be useful for diagnosing manganese toxicity in acid or poorly aerated soils. If the ammonium acetate contains hydroquinone as a reducing agent, the value is termed "easily reducible" manganese, and this value has been suggested for diagnosing manganese deficiency. Some rapid methods extract manganese with sodium acetate at pH 4.8 (11), and the value is an empirical one that includes manganese in various forms. Its value depends on standardization with field or greenhouse tests.

Zinc and copper occur in very small amounts in soils and determining these elements with precision is difficult in most routine laboratories. Camp (3) and Wear and Sommer (16) have presented data showing correlations between incidence of deficiency of these elements and the amounts extracted from soils by salt solutions and dilute acids. The possibilities of the zinc test, in particular, should be investigated further.

Boron in the available state in soils can be measured fairly reliably by determining the water-soluble boron. In Berger and Truog's method, soil in suspension with hot water is refluxed for five minutes. While this test appears to be quite satisfactory, very few routine laboratories make any test for boron. Recommendations for its use on crops are generally based on the nature of the crop itself and soil association rather than on soil test.

Discussion

For any chemical test to be helpful in predicting fertilizer and lime needs, one would expect the extracting solution used in the test to simulate plant roots in their ability to obtain, from the soil, the nutrients required for good plant growth. This is, of course, difficult because this ability varies among plants and even within a plant as the growing season progresses.

As has been mentioned, early chemists approached the subject from the standpoint of determining what constituted the soil solution. Some attempted to define the true solution, others to measure those cations and anions absorbed on the colloid fraction. In soils containing small amounts of soluble salts this distinction becomes difficult to make and is vague. If plant uptake of a nutrient depends on the chemical activity of that constituent, then direct measurement of the ionic activities in the soil, at optimum moisture levels, would appear to offer promise for characterizing the soil with regard to this element. Thus potassium ion activity or calcium ion activity might be determined as we determine hydrogen ion activity with the glass electrode. Development of suitable electrodes has been a problem, but Marshall and his co-workers (6) have explored this possibility and are contributing greatly to the fundamental information along this line. Recently Woodruff (17) discussed the free energy approach to the problem of cationic exchange.

Meanwhile, though empirical, the methods in use today are recognized as very useful tools for characterizing soil fertility and assist greatly in estimating needs for fertilizer and lime.

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Virginia Experiments Emphasize Economy of Fertilization

(*From page* 10)

ash were applied than when only one or the other was applied. The largest increased return on Davidson was $2.75 for 50 lbs. of K_2O fertilizer per acre. Even though the yield responses were not significant, there is some indication that responses to potash will become greater on Davidson.

The data presented have been of value as a guide in making fertilizer recommendations in Virginia. They emphasize the fact that soil testing should precede fertilizer recommendations on a particular field. That is true particularly if there have been no fertilizer yield trials on the field. In addition, these data indicate that responses to phosphate probably would have continued up to 80 or 100 lbs. of P_2O_5 per acre. In particular, they emphasize economy, the absolute necessity, of using generous amounts of fertilizer in Virginia.

TABLE V.—RELATIONS AMONG YIELDS OF RED CLOVER HAY GROWN IN ROTATION AND INCREASED RETURNS AS INFLUENCED BY FERTILIZER TREATMENTS ON TWO SOILS IN VIRGINIA.

Lbs. per A. per year of P_2O_5–K_2O	Frederick silt loam		Davidson clay loam	
	Av. annual yields hay '50–'54	Increased return value of the increased yield less the cost of the fertilizer	Av. annual yields hay '51, '52, '54	Increased return value of the increased yield less the cost of the fertilizer
	T/A.		*T/A.*	
0—(all levels)	1.32	$ 0.00	0.81	$ 0.00
20—(all levels)	1.91	21.28	1.72	33.56
40—(all levels)	2.07	26.04	2.24	52.15
60—(all levels)	2.29	33.11	2.36	55.38
(all levels)—0	1.53	0.00	1.71	0.00
(all levels)—25	1.97	15.78	1.80	2.34
(all levels)—50	2.20	23.49	1.84	2.75

Swords Into Plowshares

(*From page* 5)

programs, plans, and records. Admitting subject matter to be important, it should never be put above learners. It is just as important for the teacher to understand the learner's problems as it is for the auto mechanic to locate the trouble in a stalled car. No teacher can best supervise until he knows the needs of the learner. He can give drill-sergeant commands and yet fail as a successful supervisor."

Down in Arkansas, one of the leading states in enrollment in the past GI training program, lives a farmer who turned a brush farm of 80 acres into a profitable venture. After a four-year course of farm study and supervised operation, Neal Barton of Russellville was selected as "outstanding farmer of Arkansas" a year ago by the Junior Chamber of Commerce. At the outset Barton had a team of horses, some second-hand machinery, and a farmhouse badly in need of repairs. He had two cows but no modern cooling equipment, and his land was run-down.

His first move was to get a loan and buy 14 more tested cows. He followed up with terracing of pastures and use of some fertilizer. Then he installed a modern milkhouse with proper cooling facilities. As his productivity increased, he was able to scrap the old equipment and get some power machinery. He added a barn and stock pond, and bought himself 100 acres more land. He gave attention to his household requirements also. He put in a water system, rebuilt parts of the house, and put in some labor-saving electrical equipment.

At latest report, he has a herd of 56 cattle on a farm appraised at about $15,000 or more. His plans call for further expansion as income permits. He holds several offices in agricultural societies, takes a lead in 4-H clubs and FFA activities, and was on the board of the regional artificial livestock breeders association. He believes that his GI farm training lessons showed him the logical moves to make in revitalizing his acreage and his capital equipment.

Another equally convincing proof that trainees in the farm courses may derive sustaining experience comes from Stockton, Wisconsin. Here a disabled veteran of 35 years was named state winner in the Wisconsin Grasslands Farming contest. This honor came as he finished his last year under PL 16, the GI course for disabled veterans. He got a bad bayonet wound in Luzon. As winner of this forage-growing title, he won himself a trip to Washington and visited President Eisenhower's farm near Gettysburg. Ambrose Magel decided to go into farming or engineering while he lay in the army hospital. But as he went into service from the farm, he finally decided to return to that occupation. He used his GI loan benefit to buy a 230-acre farm. He used his data from the course to rearrange fields, remove stone piles, renovate pastures and seed them to alfalfa and ladino. He put liberal applications of fertilizers on his grasslands. He was able to grow good feed at low cost for 20 cows, and he soon built up their production to 11,000 pounds of milk per cow.

Because of his innovations and enterprise and good soil management methods, Magel's farm was made the subject of special study by his own vo-ag instructor. His teacher and others urged him to enter into the current contest, and from this he won area honors, and then went on to get top place in the finals. Naturally, Magel feels that his entrance into the contest was inspired by faith in his ability—and that, in turn, was due to proper training he had received all the way.

Activity now centers on the institutional on-farm training of the Korean GI bill. Like the rest, it is a combination of classroom work and supervised practice on the farm. The same well-qualified staffs in the vocational departments of the various states assist the Veterans Administration in staging the courses. Mistakes made in the outgoing farm courses will be carefully avoided and new and better methods used.

General farming and stock raising, or else specialized crop production, are basic. Any form of processing or marketing farm products is not included. The farmstead must be large enough to afford full-time work, when added to classroom duties. The veteran's farm must give him a satisfactory living, and not be too small to pay. He must have full management control of the farm, either by ownership, lease, or a management agreement. Each man's application for training must be approved by the appropriate supervising educational agency in his state. This is always the rule. Individual rather than mass approvals are best because his training is intended to fit his own special case, and meet his own particular requirements.

There are an outer limit and an inner limit to the periods of regular training. His outer limit is based on 1½ times his length of eligible service up to a maximum of 36 months of training. Within this so-called "outer limit" there may also be an "inner limit." This means the length of time needed for a veteran to reach his objective. This depends upon his own experience and need for instruction, the nature of his farming operations and other factors.

Veterans who want training apply at their nearest VA regional office, and hand in certain required papers. To fill these in right means he must confer with the chosen school to get necessary data. He must have an outline of his training program and a certification by the school officer that the program meets the law's standards. He also hands in a photostat or certified copy of his separation papers and evidence that he has control of the farm in question, and that the program contemplated will occupy his full time.

The course itself includes at least 200 hours per year in the classroom, with no less than eight hours in any one month. It also includes 100 hours of individual instruction per year, with at least 50 hours of that time taking place out on the farm. The instructor is supposed to visit the enrolled veteran twice a month. He helps the student turn the rules and plans of the classroom into all the numerous obligations that face the operating farmer. It is designed to bolster the self-confidence of the veteran and help him in making decisions on his own, based on lessons taught and practical problems discussed.

Financial allowances from the VA consist of first year sums of $95 per month without dependents, $110 with one dependent, and $130 where there are more than one dependent. After the first year the sums payable are reduced, at intervals of four months, as the veteran gets along in his course.

Certification is required before monthly payments are made. These papers are signed by the veteran and his school representative, showing clearly that the veteran was actually engaged in training during the period. Previous experiences in some cases of fraud make this requirement rigid and imperative.

The full-time matter also leads to difficulties. Although the law requires some full-time study, the veteran may take on up to 180 hours of outside work during any 12 months of his enrollment period. But such employment must not interfere with his training. Ordinary daily labor exchanges common to a rural area are not counted in as outside work, but this must be permitted by the school in any case. If a veteran quits regular attendance or otherwise absents himself from the course, he is warned—and if he keeps on that way, his GI allowance may be stopped. Sickness is handled in a different and a special way.

Nobody can enroll and get GI training where he has been successfully running a farm like the kind that the course is intended to cover. Neither can he enroll if he has previously attended a school that offered a course like the one he expects to get from VA. No one ever employed as a teacher of similar subject matter may enroll.

But someone who had always worked as a hired hand or done farm work under the direction of somebody else would not be barred in general. The idea is not to waste teacher time and government funds on applicants who have already demonstrated that they have the ability and skill to carry on by themselves.

Estimated expenditures are available from VA to show the amounts spent for GI training by the states. For all types of courses the national total for subsistence, tuition, equipment and supplies through June 30, 1955 was $14.4 billions. This varied from state to state in a marked degree. Relative populations had much to do with it. New York, Pennsylvania, and California had the highest expenditures.

Benefit payment costs per trainee have also been listed and distributed. Here on the individual expense basis, farm trainees led at $3,600, followed by college trainees at $2,500, below college grade at $1,500, and industrial on-the-job trainees at $1,000.

As you talk with the local men and women who have had so much to do with the success of the program and who have hunted hard for fairer and better ways to run it, you can't help feeling that our way today is better than of old. The poor apple sellers and street peddlers cast off after World War I and the frustrated lives that might have been succored by proper training rise up to haunt us. At least we know this—that for every error and fraud observed in VA's training system there have been hundreds of cases of achievement and lasting improvement. And while you're at it, the program gave valuable training to a host of teachers and supervisors besides.

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The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

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Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

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The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

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Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.

Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.

Department of Visual Instruction, Oregon State College, Corvallis, Oregon.

Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Reprints

3-1-56 Potash in Agriculture
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
SS-12-49 Fertilizing Vegetable Crops
BB-8-50 Trends in Soil Management of Peach Orchards
X-8-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
I-2-53 Sericea Is a Good Drought Crop
J-3-53 Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53 Kudzu Keeps Growing During Droughts
N-4-53 Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
P-4-53 Learning How to Make Profits from Sweet Potatoes
T-5-53 Trefoil Is Different
DD-10-53 Sampling Soils for Chemical Tests
II-11-53 The Importance of Legumes in Dairy Pastures
JJ-11-53 Boron—Important to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
K-2-54 Soil and Plant Analysis Increase Fertilizer Efficiency
R-3-54 Soil Fertility (Basis for High Crop Production)
U-4-54 Nutrient Balance Affects Corn Yield and Stalk Strength
CC-6-54 Fertility Increases Efficiency of Soil Moisture
EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
GG-8-54 Effect of Boron on Beets and Crops Which Follow
JJ-10-54 Principles Involved in Soil Testing
LL-10-54 Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco
MM-10-54 Longer Life for Ladino
SS-11-54 Foliar Application of Plant Nutrients to Vegetable Crops
YY-12-54 Physical Condition of the Soil Affects Fertilizer Utilization
A-1-55 Potash-Deficiency Symptoms
C-1-55 Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane
D-1-55 Nitrogen Use Accentuates Need for Minerals
G-2-55 Seven Steps to Good Cotton
H-2-55 Apparent Fertility Trends in Western Irrigated Soils
L-3-55 Soybean Production in the Southern States
P-3-55 N-P-K for Deciduous Fruit Trees
S-4-55 Greener Pastures Mean Better Living
U-4-55 Fertilizer Recommendations—Burley Tobacco
V-4-55 Planned Nutrition for Canning Tomatoes
W-5-55 The Production of Sugar Beets on Organic Soils
X-5-55 What Is Happening to Our Citrus Soils?
Y-5-55 Pasture Improvement Through Renovation
Z-5-55 Azalea Fertilization
EE-10-55 Fertilizing For Better Apples
HH-10-55 Fertilizers Will Cut Production Costs
LL-12-55 Potassium Deficiency of Alfalfa in California
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E-2-56 Fertilizer Statistics From the 1954 Census of Agriculture
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I-4-56 Surveying Corn Fields by Tissue Tests
J-4-56 The Relation of Potassium to Fruit Size in Oranges
K-4-56 The Value of Green Manure Crops in Farm Practice
L-5-56 Give Your Plants a Blood Test—Guide to Quick Tissue Tests
M-5-56 The Placement of Fertilizer for Peanuts
N-5-56 Fertilizer Placement for Corn in Minnesota
O-6-56 Plant Analysis As a Guide to Fertilization of Crops
P-6-56 The Use of Minor Elements for Organic Soils

THE AMERICAN POTASH INSTITUTE

1102 16th STREET, N. W. **WASHINGTON 6, D. C.**

They were out driving on a quiet country road. The car slowed to a stop.

"What's the matter?" asked the girl.

"We're out of gas," replied the boy. "We may be here quite a while."

The girl smiled shyly as she took a bottle from her bag and said softly, "We can make good use of this, then."

"Great," said the boy with a pleased grin: "is it gin or whiskey?"

"Neither," she smiled, 'it's Ethyl. I've been out riding with you college men before."

* * *

Billy: "Mother, Bobby broke a window."

Mother: "That's terrible. How did he do it?"

Billy: "I threw a rock at him and he ducked."

* * *

First Old Maid: "I hate to think of my youth!"

Second Old Maid: "Why, what happened?"

First Old Maid: "Nothing."

* * *

In a village election in rock-ribbed Republican Vermont, one Democratic vote was discovered before the tabulation had been completed. Election officials stopped to ponder this marvel, then decided to complete the count. Another Democratic vote turned up.

"That settles it," said one official, "That dad-burned fool voted twice."

A small boy, eight, eyed a small spider.

"Daddy, do spiders bite?"

"Very few of them we find around here do."

"Not at all?"

"Not at all."

"Well, do they pinch?"

"No, lad, they don't pinch."

"Don't they hurt you at all?"

"Nope, they don't hurt you at all."

"Well, anyhow they scare hell out of you!"

* * *

John: "Can you love two girls at once?"

Jimmy: "Sure; where are they?"

* * *

Usually you can tell, by looking at a girl, what kind of past she is going to have.

* * *

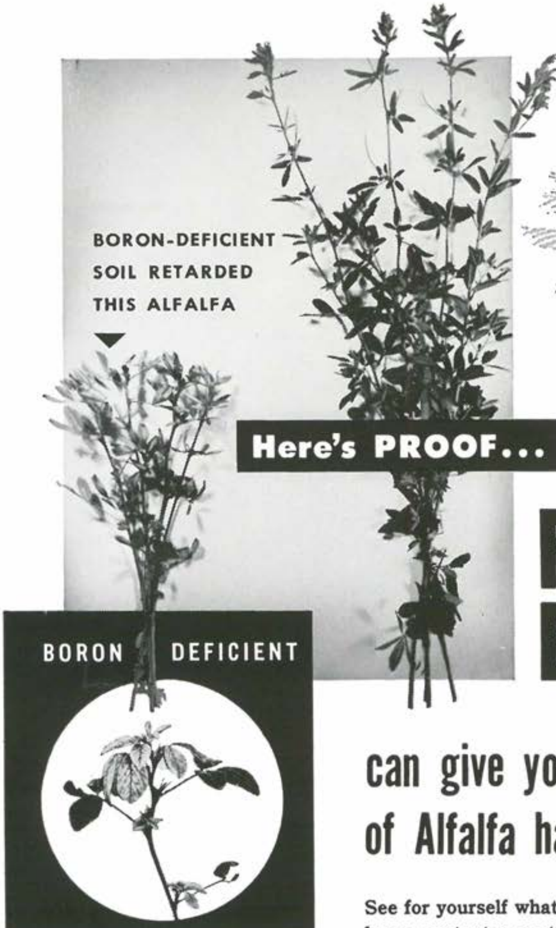
An old Negro, driving his wagon along a Tennessee road, was hailed by a white planter.

Planter: "Good mornin' uncle. How'd your crop turn out?"

Negro: "Boss, I plant my cotton, weed it, raise it, bale it—an' den de ducks et it all up."

Planter: "The ducks ate it!"

Negro: "Yes, suh. It wuz dis way. I sent dem bales to Memphis to be sold. Dey deducks sum'pin' for de railroads, dey deducks sum'pin' for handlin' it, dey deducks sum'pin' for sendin' de money back—deducks got all of it!"



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.... **Look for These Symptoms in Alfalfa:** Lack of boron causes plants to become puny and dwarfed. Look for yellow or reddened top leaves, stunted, with growing tips rosetted. See close-up photo.

See for yourself what Fertilizer Borate, with its high boron content, meant to this alfalfa field. Boron, so vital to alfalfa, is also required by other field crops such as clover, sweet corn, tobacco... and most vegetable and fruit crops. This year, invest a few extra pennies per acre in Fertilizer Borate... the low-cost fertilizer grade of borax... to grow better crops!

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