THE PROGRESSIVE FARMER

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Agriculture.

WHAT IS THE BEST METHOD OF CONDUCTING EXPERIMENTS TO DETERMINE THE FERTILIZER REQUIREMENTS OF DIFFERENT PLANTS AND SOILS!

Views of Director R. J. Redding, Georgia Experiment Station.

It is known to all intelligent farmers that ordinary agricultural plants are composed of certain organic and inorganic elements, numbering fourteen in all. It is a fact that all of these elements are found in all agricultural plants, and also in the bodies of all animals. The relative amounts of each element vary considerably in different plants, and, within narrow limits in plants of the same species, or even the same variety, when grown under different conditions of soil, climate and culture.

It is also well known that three of these elements, to-wit, phosphorus, potassium, and nitrogen, are all that we need concern ourselves about, because of their comparative scarcity in the soil as compared with the remaining eleven elements. These are often called the "valuable elements," although the term "costly," or "expensive" would be more accurately descriptive, since they are what the farmer pays his money for when he buys a fertilizer. Lime and carbon are just as necessary to the growth and development of a plant, or a crop, as are phosphorus or nitrogen. Indeed, were we to measure the importance of any one element to plant life by the relative amount that enters into the composition of plants, we would at once place a very high estimate on both lime and carbon. But the fact is that these two are found in great abundance in all ordinary soils, or, in the case of carbon, in the air above and within the soil.

The scientific agriculturist is well aware that an average soil contains a very large store of all the elements necessary to the growth of crops and the formation of plants. An acre of average soil, taken to the depth of 8 inches, contains about 3,200 pounds of nitrogen, 4,000 pounds of phosphoric acid and 18,000 pounds of potash. It is quite an easy matter for the analyst to find out its exact content of every one of the element. It is still easier to find out just what amount of each element is contained in a given plant or a given total crop of any kind. In the case of plants he cannot tell us the particular form or combination in which all these elements enter into the plant structure. Nor is this particularly desirable since the plant, during its growth and development selects such elements as it needs, and by an alchemy of its own combines them [illegible] into such forms as best meet the demands of its own life and of the life that is to subsist upon it. But even if we we knew exactly the chemical composition of a plant, or of a crop, it would be no certain indication of the amounts or proportions of the elements that should be supplied in the form of a fertilizer. Clover and cow peas each contains a large percentage of nitrogen; yet we find that it is not necessary to apply nitrogen to these crops.

But an analysis of the soil does not fully reveal the exact forms and chemical combinations of the different elements. The very information that appears most desirable is unattainable. In the case of plants the chemist may tell us some things that are of no especial value in this connection, and which we do not care particularly to know. In the other hand the very things we are very anxious to know he cannot tell us. Chemical analysis, alas, does not tell the exact percentage of the plant in a soil in a form that is immediately available to the crop. A soil may appear to be very rich according to analysis, and yet yield very unsatisfactory crops. On the other hand, analysis may indicate a relatively low percentage of plant food present in the soil, and yet it produces large crops. I am not myself an analytical chemist, and therefore do not feel in any degree responsible for the balk that our friends of the retort and crucible make at this point.

Again: We know just how many pounds of phosphorus, potassium, calcium, magnesium, nitrogen, etc., are required in the production of a crop of 40 bushels of corn, or 25 bushels of wheat, or 1,000 pounds of tobacco, or 1 bale of cotton. If we have an acre of land capable, without other aid than good tillage, of producing one-half of either of the above specified amounts, and we desired to add a fertilizer sufficient to produce the other half of the same crop, it does not seem, at first blush, a difficult problem. It appears reasonable that we should add as much of the different elements as are indicated in the analysis of the crop to be increased. If we want to to produce 20 bushels more of corn, why not add in the fertilizer as much phosphoric acid, potash and nitrogen as are known to be present in 20 bushels of corn? But the theory, although plausible and popular, is not sustained by practical experience. The following table, No. 1, is intended to show the amounts of the three elements required for the production of 25 bushels of corn, or 1,500 pounds of seed cotton, counting the entire crop in each case, plants and all; and also, the amounts actually removed from the soil to the barn in the 25 bushels of shelled corn, in the one case, and the 1,000 pounds of cotton seed and 500 pounds of lint in the other:

TABLE No. 1.

Crops Grown.	Require for their Production— Phos. A.	Require for their Production— Potash.	Require for their Production— Nitrogen.	Remove from the Soil— Phos. A.	Remove from the Soil— Potash.	Remove from the Soil— Nitrogen.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
25 bushels corn and stover	15	35.	32.	7.	5 5	25.
Ratio	1	2.33	2.	1.	0.8	3 6
500 pounds lint cotton	42	80	87.	0.2	2 5	2.7
Ratio	1	1.9	2.1	1.	12.5	13.5
1,000 pounds cotton seed	42	80.	87.	12.7	11.7	31.0
Ratio	1	1.9	2.1	1.	0.9	2.44

It appears from the above table that for every pound of phosphoric acid required to actually produce a crop of 25 bushels of corn there are also required 2.33 pounds of potash and 2 pounds of nitrogen. On the other hand, it is shown by the results of field experiments that a compounded fertilizer giving best results when appiied to corn must contain for every pound of phosphoric acid only 0.2 of a pound of potash and 0.5 of a pound of nitrogen. This, it would seem, indicates that phosphoric acid is relatively in deficient supply in the soil. It also indicates that nitrogen, as well as potash, is relatively abundant in the soil, or is drawn from the air.

Again: The table shows that in producing a yield of 1,500 pounds of seed cotton, or 500 pounds of lint and 1,000 pounds of seed, there are required by the whole plant, including the seed and lint, 1.9 pounds of potash and 2 1 pounds of nitrogen for every pound of phosphoric acid. So there is no great difference between the relative composition of 25 bushels of corn, stalks and all, and 1,500 pounds of seed cotton, stalks and all.

But our carefully conducted field fertilizer experiments show that the best compound fertilizer for a cotton crop should contain 0.3 of a pound of potash and 0 3 of a pound of nitrogen for each pound of phosphoric acid required.

Comparing the requirements in an applied fertilizer for corn and one for cotton it is apparent that while the relative amount of potash found in the crop of corn is greater than the relative amount of potash found in the cotton crop, yet a fertilizer for corn requires a less relative amount of potash than one intended for cotton. It is also true that a relatively, as well as absolutely, larger amount of nitrogen is found in the 1,500 pound cotton crop. But in the fertilizer formulas found to be best suited for these crops respectively, the relative proportion of nitrogen is nearly twice as great for corn as for cotton.

These facts indicate that there is a difference between the appropriating and assimilating powers of different plants, and it has not been made to appear that there is any relation between this difference and the composition of the respective plants. In the cases of corn and cotton it is suggested that the former is a grosser feeder, and may be able to utilize the potash found in the soil to a larger degree than can the cotton. It may also be true that the corn plant has less appropriating power over the nitrogen compounds in the soil and air than is exercised by the cotton plant. At any rate, whatever may be the true explanation, we are confronted by facts, and theories may well stand aside when determining practical methods, and await laboratory research and demonstration.

A remarkable fact, a paradox it may be called, will appear on a little further examination of Table 1: Ten years of field experimentation on the varying soils of the Georgia Experiment Station Farm have enabled me to reach what I consider a very close approximation to the relative composition of a fertilizer that gives the best results when applied to cotton in amounts varying from 400 to 800 pounds per acre. The formula may be thus stated:

Acid phosphate (14 per cent. available)..................1,000 lbs
Muriate of potash (50 per cent. K_2O)............... 75 lbs
Cotton meal............... 700 lbs

Applying about 550 pounds of the formula to an acre capable of producing 1,500 pounds of seed cotton would ordinarily cause an increased yield of 500 pounds of seed cotton.

Fifteen hundred pounds of seed cotton require, phosphoric acid 42 pounds, potash 80 pounds, nitrogen 87 pounds.

Apply 550 pounds of formula, phosphoric acid 50 pounds, potash 15 pounds, nitrogen 15 pounds.

Resulting 500 pounds increase seed cotton, phosphoric acid 14 pounds, potash 27 pounds, nitrogen 29 pounds.

You see we have applied 50 pounds of phosphoric acid and received in the increased yield only 14 pounds. What has become of the 36 pounds? We applied 15 pounds each of potash and nitrogen and recovered in the increased yield 27 and 29 pounds respectively. Where did these come from? The necessity of adding more plant food than is required by a definite increase in the crop is well recognized by agricultural writers. Prof. Ville's theory on this point is based on the following propositions: "(1) Give the earth more phosphates, more potash and lime, than the harvests have taken from it. (2) Give it 50 per cent. of the nitrogen they contain." He probably means that tbe applied fertilizer should contain more phosphates (phosphoric acid), more potash, and more lime, than the expected increased yield would require, and one-half as much nitrogen.

These facts, the result of direct experiments—point to the conclusion that the only reliable and practicable method of ascertaining the fertilizer needs of the soil with reference to the production of any particular crop is to apply to the soil different proportions of the valuable elements and note carefully the results. This method is in common use at the several experiment stations, and by a few intelligent lay experimenters throughout the country. To ask the soil what it requires is the only way to secure a reliable answer. It is practicable for any intelligent farmer to ask the question in this way. It is the natural way. It can be asked of any soil and with regard to any crop.

The objection to this method is the length of time we must wait for the answer. A one-year experiment gives significant and helpful results. Two years may confirm or modify the conclusions of the first year. Five years are still better. Indeed, the intelligent user of fertilizers should be a constant experimenter. In every field that he cultivates there should be one or more experimental plats or sets of test rows, as checks upon his general work. The soil of every field on a given farm will be found to vary more or less in the requirements. It will vary with reference to the same crop in different years. This year a soil planted in corn may utilize a greater or a smaller percentage of potash, or nitrogen, or phosphoric acid than it will probably use next year. It is only by a long course of careful experimentation whereby we may get a general average of results and indications, that we can solve the question, or rather approach the solution—for it is a question that will never be definitely and accurately solved. I would say that five years of repeated experiments with the same crop on the same soil should give fairly satisfactory results, which may serve as a guide in the formulation of fertilizers for the main crop on the same character of soil.

HARRY FARMER'S TALKS.

XVIII.

Correspondence of The Progressive Farmer.

It is said that the heaviest tax that farmers pay is the road tax. Very few realize what a bad road will cost unless they try a good road awhile. Harry Farmer sometime ago noticed the work done on a red clay hill and decided to notice it at times when it was impassable, but it did not get impassable as of old. Here is the way the new overseer "fixed that awful bad place:" boxes were made out 2x12 plank nailed together and ditches cut across the road about 15 yards apart and these boxes placed in the ditches and covered with 6 to 12 inches of dirt. I mention the idea because it is something new and a success. It is on the plan of tile draining hill sides excepting that the ditches are not cut so deep.

If you want a nice crop of Irish potatoes, be sure to stir the top soil after every rain so that no hard crust can form. It will pay well for the labor required.

Do not be in a hurry to clean out ditches. The work can be done better after the water has run off.

Now is a good time to prepare the land for sweet potatoes. Break the land and apply manure and fertilizers so that when the time comes to set the slips or plants everything will be ready. This is always a busy time, and much of the work can be done beforehand.

If you want a heavy crop of beans use manures that contain large quantities of potash. Phosphate should be avoided, as it hastens the crop too much. We want them to grow all the summer until late in the fall. With snaps for early use, phosphates can be used advantageously.

Feed cattle with dry feed when they are turned out to graze on young grass, decreasing the dry feed a little each day and they will not be injured.

Place a box of salt where cattle can get it when they want it. Rock or coarse salt is best.

The custom of "cow penning" land is dying out. The manure made under shelter and carted to the field when wanted is a much better plan.

Hogs like to have a shelter during the stormy days in early spring.

The old idea that a hen had to sit on the ground in order to keep the eggs moist and make good hatches is not correct. We have seen better hatches ten or twelve feet from the ground than on the ground.

The coop for young chickens should be high enough so in a heavy rain the water will not rise up under the biddies to soak them.

HARRY FARMER.

Columbus Co., N. C.

The Michigan Supreme Court has unanimously sustained the constitutionality of the law taxing inheritances.

THE HESSIAN FLY.

Some Facts Regarding the Life-history of the Insect and Some Suggestions for Avoiding Loss From its Attacks.

Correspondence of The Progressive Farmer.

A reader of The Progressive Farmer has written to the writer asking him to give an account of the Hessian Fly, which he reports as having destroyed about one-half of his wheat on a field sowed in the middle of October, last.

The Hessian fly, (*Cecidomyia destructor*), is a small fly of smoky brown color, somewhat like a mosquito in general appearance. It is the worst insect enemy to wheat, its nearest rival being the chinch bug, which is not nearly so destructive in this State. The Hessian fly occurs in damaging numbers from eastern South Dakota to eastern Texas in the West, and from southeastern Maine to northern Georgia in the East. The area here roughly indicated includes the western part of North Carolina, approximately that part which would be west of a line drawn from Henderson in the north through Hamlet in the south.

There are two destructive broods each year, one in the fall, and the other in the spring. The adult female fly lays her eggs on the lower leaves of the wheat, and the maggots which hatch from the eggs descend beneath the leaf sheaths and work around the stalks, where they feed on the juices of the injured tissue of the plant. This so much weakens the plant that when it starts to grow in the spring, it breaks near the ground, and is thus destroyed. The eggs deposited by the brood of flies which appears in the fall, hatch into maggots which attain full growth by the time the winter sets in. They now transform to the pupa state, in which no food is taken. At this time the insect is incased in a hard, dry skin of brown color, and in this stage it is often called the 'flax seed" on account of its size and appearance. This stage is passed through under the leaf sheaths around the joints or nodes of the stalk. This is sometimes mistaken for the egg stage of the insect. There may be several of these "flax seeds" around one stalk, and my correspondent sent some that contained as many as six or eight. It is in this state that the winter is passed, and the flies are developed and emerge in the spring.

Insects do not grow after the adult stage is reached, and with the Hessian fly, the main purpose of life, after the adult stage is attained, is to provide for the perpetuation of the species. In accomplishing this object it seems to be very successful. The maggots from the spring brood are full grown by harvest, and are in the "flax seed" stage at the time that the wheat is cut, and as this stage is passed near the ground, they are left in the stubble. Some flies may be found at almost any time through the summer but the main part of the brood does not emerge till fall, when the flies lay their eggs on the growing wheat.

Three remedies may be considered:

First, burn stubble immediately after harvest.

Second, plow the stubble under immediately after harvest.

Third, delay sowing as late as possible in the fall.

By either the first or second methods with the third, the best results will be obtained. The object of burning or plowing is to kill those insects that are in the "flax seed" stage in the stubble, and the object of late planting is to have the wheat come up after the fall brood of flies is gone, thus dodging them.

The name of Hessian fly was applied to this species after its appearance in New York in 1778, presumably for the reason that it was supposed to have been brought to this country in straw furnished to the Hessian troops, during the war of the Revolution.

The writer will be pleased to learn from the readers of The Progressive Farmer of any outbreaks of injurious insects.

FRANKLIN SHERMAN, JR.
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PUZZLING FARM PROBLEMS.

Scarcity of Labor and Other Discouraging Conditions to Face.

Correspondence of The Progressive Farmer.

The season for active farm operations is at hand. The winter has generally been favorable for farming, and for the number of laborers much has been done.

Labor is scarce. The young white men of the county have quit the farm. They are going to school, travelling as agents for nurseries, clerking, or have gone to the factories. The negroes who went North last summer returned last December, but so far as I know not one of them has offered to do a day's work for hire since their return. They all contemplate going North in April, and all the bucks who are not tied down with families, and can raise the means, intend to go with them. So labor for the farm is scarce and the prospect is that it will yet be scarcer for many years to come. For no negro who goes to town for a year or gets to teaching or preaching ever after thinks of offering himself for hire on the farm. Our only dependence for labor is the cropper with children, old men, and girls.

Our tenant system is wretched and the landlord is to be blamed; the most of them have suffered their tenants to work their own stock and to cultivate the land in whatever way they chose for so long that it is impossible to control them. If you undertake to do so, the cropper asserts his independence and leaves. Your neighbors take him in and ask no questions. Most of the negroes when they go to farming, pick up tools, chains, harness, etc., wherever they can find them; attend sales, buy an old plow for 25 cents or a shovel. Then they buy a broncho, or old worn-out mule from some of our many horse dealers (who takes a mortgage on the horse, also on the cow, hogs, household goods and whatever else is in sight). He is then fixed for farming.

If it is wheat sowing time, he often throws the corn or tobacco rows down with two furrows, then plows up the corn stalks or tobacco stubble with a third furrow. The wheat is then sown broadcast and brushed in.

The corn land is often prepared by breaking it by turning furrows fifteen inches apart or turning two furrows upon the unbroken ground; sometimes the middle is broken. This ridge is opened and the corn planted. Six weeks after planting the corn is barred off; from two to three weeks afterward two furrows are turned to the corn; sometime after, from one to three weeks, the middle is thrown out. This is the furrow working requiring for the whole crop from beginning to end only eleven furrows.

I do not say that all croppers work their crops in this way, but many do this way in our sandy lands in Alamance, Orange, Caswell and Person. They generally work their tobacco much better. Farming in our section is conducted generally in a haphazard way. I took the census in Pleasant Grove township. Nearly every farmer in reply as to the number of acres sown or planted in any given crop invariably answered "about so many," or "about so much." While I met with many hard-working thrifty farmers who are making a good living, I found very few who have improved their lands and surroundings. But little clover, pea vines, or hay from the natural grass harvested. In some of the fine tobacco lands I found the timber nearly all cleared away. Some landholders with no timber, others worth not enough to repair their barns, burn their plant beds, or cure their crops of tobacco. The township has fallen off in population nearly 300 within the last ten years. This is, I admit, a gloomy picture, but it is not overdrawn. I have not the blues to-day; what I have written is truth unvarnished.

B. F. WHITE.

Alamance Co., N. C.

If you receive more than one copy of The Progressive Farmer, hand to a neighbor and ask for his subscription.