symptoms which are outside the scope of this paper.

In presenting a general paper of this sort it is easy to multiply specific recommendations for control of the various diseases and to lose sight of the general principles of disease control which underly the recommendations. In approaching a disease problem the cheapest, most efficient solution is to find a crop variety which is immune or resistant. Our breeding program on celery is therefore the most valuable of all our celery disease projects. If no plants resistant to a disease are available the use of some organism which will permanently parasitize the pathogen is another basic and satisfactory approach. Attempts to control damping-off by antagonists are examples. A somewhat less satisfactory approach is to exclude the pathogen by artificial means. Seed treatment for Septoria and weed and aphid control for mosaic are examples.

In dealing with a disease which lives in the soil, and where resistant strains are unknown, a fourth approach, eradication, is possible. Flooding or treating with cyanamid for pink rot control, and fumigating for damping-off and nematode control come to mind.

When time is short and ideas are few we will continue to grab for the mop instead of the faucet. But protective sprays are expensive and they should always be looked upon as either a last resort or a source of emergency relief.

VALUE OF RAPID SOIL TESTS IN DETERMINING FERTILIZER NEEDS

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During the last 10 years agronomists and soil chemists have contributed much to the development of rapid chemical tests as a means of determining the fertilizer needs of the soil. These many contributions have shown that no method has yet been devised that is infallible. This has led some workers to question the chemical accuracy and the reliability of the results of such soil tests, despite the fact that many commercial organizations and several state experiment stations are making thousands of rapid soil tests each year. The chief advantages of these rapid tests over the older and more conventional chemical methods are their simplicity and the rapidity with which the individual tests can be carried out. These features make them well suited for routine soil testing.

There is a tendency on the part of some workers to expect too much of the rapid soil tests and to criticize them when they fail to come up to expectations. It is not reasonable to think that soil tests, in all cases, should correlate directly with the crop responses obtained from the use of fertilizers. There are various reasons for this lack of correlation but the principal one is the failure for the most part to adapt a set of methods suitable for the soils and crops under investigation. It should be obvious that the results of chemical soil tests provide only a part of the information necessary for an intelligent fertilizer recommendation. When properly correlated with crop responses to fertilizers on different soils, chemical soil tests can furnish valuable and otherwise unobtainable information that can serve a very useful purpose in fertilizer recommendations. This is true only when the tests can be relied upon to give consistently accurate and reliable analytical results.

Let us now consider some of the peculiarities involved in soil analysis. It is of the utmost importance that the sample of soil to be analyzed should be representative of the area sampled. If the soil type is relatively uniform, one sample consisting of borings made throughout the area is usually sufficient. If the soil type varies within the field, more samples should be taken corresponding to the soil variations. One of the greatest needs in soil testing in Florida is a practical method of obtaining a representative sample from a field that has been bedded and side-dressed. One method now in use is to make a cut 6 inches deep across the entire bed, and then scrape soil from the exposed surface. This soil is mixed thoroughly and a representative sample taken for testing. This method is laborious and often unreliable, especially if the soil is dry. We have recently made a soil sampler which takes a sample 12 inches by 1 inch to any depth desired. By taking 2 or 3 slices with such an implement the operator should be able to obtain a sample representative of the cross section of the bed. We have had this sample only a month or two but so far it has worked very satisfactorily. It is more time consuming than the ordinary sampling tube, but it does give a more representative sample.

With the soil sample now taken, where should it be tested: at a state-wide soil testing laboratory such as at the State Agricultural Experiment Station, at a district laboratory, or by the grower himself? Without doubt the best job of testing could be done at a central well-equipped laboratory but under such a system at least a week would elapse from the time the sample was taken until the grower could be notified as to the analysis. This would not be a factor in many states but in Florida, especially on the sandy soils, the situation is somewhat different. Here the grower may be interested in how much nutrient has been lost by leaching following a heavy rain and whether or not he should apply a side-dressing. Under such conditions time is of the essence and the grower ought to have the analysis within 2 or 3 days at the latest. Without doubt a district laboratory could render the service in the shortest possible time

Now as to methods of analysis. There is little doubt that a district laboratory, no matter how small, can do an adequate job of analysis, if properly organized and equipped. When such a laboratory is not available, the grower must either do his own testing or rely on trial and error.

There are several soil kits, now available on the market, for the grower who wants to test his own soils. These range in price from $10.00 to more than $65.00. These kits are so designed that they can be used by persons without scientific training and with a minimum of laboratory facilities. They also contain directions for their operation and for an interpretation of the results. At present the grower is at a loss as to which soil kit to buy. Each year numerous requests are received for an opinion regarding the reliability of soil kits for diagnosing the fertility of a soil. At the Vegetable Crops Laboratory we are now carrying out experiments on the relative accuracy, sensitivity, reliability and ease of manipulation of 6 soil kits in the estimation of soil fertility in the critical range of growth response with vegetable crop plants. It is particularly desirable to know how results obtained by the use of these various outfits compare with one another and how they are correlated with plant growth on different soils under various conditions.

All of the 6 kits now being compared employ extracting solutions in some manner. These kits have been adapted from methods worked out by various state agricultural experiment stations and applied to the soils of their respective states. In some cases the published methods have been commercialized and the composition of all reagents are known. In other cases the information furnished with commercial sets gives no clue as to the chemical composition of the various materials used for the tests. The company expects to furnish refills as a part of its business. Nearly all laboratories of course prefer a system which allows them to make up their own reagents from stock chemicals because many of the refills are quite expensive. The Hellige kit is based in part on methods used at the Wisconsin Agricultural Experiment Station. The La Motte kit is based partly on Wisconsin methods and partly on those used at the Connecticut Station. The Simplex set is manufactured according to directions published by the Michigan Station. The Urbana Laboratories in their set use the directions of the Illinois Station and the Purdue set was developed by the Purdue Station. No information could be obtained regarding the reagents used in the Sudbury kit.

As already mentioned, most of these kits have been adapted from procedures worked out by different experiment stations for use on soil types in their particular states. For this reason, they may or may not be suitable for the soil types present in Florida. It therefore stands to reason that kits adapted to flatwood soils may not be reliable on the muck of the Everglades or on the marl soils in the Homestead area. At the Vegetable Crops Laboratory we are trying to ascertain which of the above-mentioned kits can be used with confidence on the sandy flatwood soils.

We have considered the sampling and analysis phases of soil testing, but the phase dealing with interpretation of results is usually subjected to the most serious inaccuracies. These errors arise because this interpretation should be based on a consideration not only of the chemical analysis, but also of nutrient balance, crop requirement, soil type, texture, drainage, method of irrigation and seasonal rainfall and temperature. All of these factors play an important role in the nutrient uptake by the plant and must be considered before a satisfactory recommendation can be made. For example: the nitrogen level may be adequate but if potassium or any other of the essential nutrient elements is deficient, poor growth will result. Furthermore, it is well known that crops vary considerably, not only in the total amount of nutrients required but also in their requirement at different periods of growth. Every one knows that more fertilizer is required during a period of heavy rainfall than during a dry spell. In a dry soil ammonia is readily converted to nitrates but in a wet soil the reverse may take place. These few examples will serve to show the importance of these environmental and cultural factors in interpreting soil analysis data.

There are many instances when a simple pH determination will go a long way in diagnosing soil disorders and save the time and trouble involved in making a complete soil analysis. Such a pH determination can be made by most County Agents. Soil reaction in itself is not a measure of soil fertility but it does indicate whether or not the soil is in condition to allow the most efficient utilization of fertilizer. In highly acid soils leaching of potassium, ammonia nitrogen, magnesium and calcium is much more severe than in slightly acid or neutral soils. This is especially true in flatwood sands low in organic matter. Moreover, the availability of certain minor elements such as copper, boron, manganese and zinc for most crops is decreased if the soil becomes too alkaline. Physiological studies have shown that ammoniacal nitrogen can be readily assimilated by some plants if the soil pH is near the neutral point. This fact is well worth considering now that most of our commercial fertilizers contain from 75 to 90 percent of their soluable nitrogen as ammoniacal nitrogen. Recent studies indicate that incidence of blossom-end rot on tomato may be closely tied up with ammoniacal nitrogen and pH.

All too frequently soil samples are received with a request for a complete chemical analysis. Not only is such an analysis a complete waste of time but an interpretation based on such an analysis is next to impossible. If a soil analysis is desired to corroborate a field diagnosis of poor plant growth, a soil sample from around a normal plant in the same field should be submitted. From a comparison of the analysis of these 2 samples, the worker is in a better position to make a sound interpretation of the analytical data.

In most states rapid soil tests have been used as a prevention rather than as a cure. Because of our local conditions in Florida rapid soil tests may play an important role in "'trouble shooting.' For example, an experienced grower may recognize a certain growth abnormality and attribute it to be a nutrient deficiency. A rapid soil test carried out at this time may corroborate his diagnosis and permit him to take steps to correct the condition before the crop becomes a total loss.

The rapid tests have not been too satisfactory in diagnosing trace element deficiences. However, by ascertaining the pH of the soil, an experienced worker can usually diagnose minor element disorders. For example, on a recently limed sandy soil, a deficiency of manganese is apt to occur.

It is believed that soil testing and recommendations based upon sound principles are true aids to the grower. However, there are certain limitations which should be borne in mind. First, plant roots absorb elements from the soil slowly while in soil tests the solvents are in contact with the soil materials only a few minutes. Second, the roots of different plants vary in the amount of nutrient they can absorb. Soil tests are designed for general crops and must be carefully standardized for particular crops and particular kinds of soil. Moreover, plants feed out of the subsoil as well as out of the upper 6 inches; thus soil samples do not represent the entire environment. Plants absorb elements out of the whole soil complex, part of which may be alkaline (subsoil) and part acid (surface soil).

In conclusion may I repeat that there is no doubt about the value of rapid soil tests to growers where they have been extensively used by trained workers. Such states as New Jersey, Wisconsin, Virginia, North Carolina, Indiana and undoubtedly several others have used them with good results. The basis for this successful usage is that in these laboratories the tests are made and interpreted by agriculturists who have had broad experience with the group of soils being tested and the nutritional requirements of the crops normally grown. Our immediate problem here in Florida is to acquaint ourselves with the crop responses obtained by fertilizer applications on the many soil types found in the agricultural areas.