committee since the organization of the club and has worked closely with Jack Welsh in the building of the course. E. H. Mulock has been chairman of the house committee for 10 years. Now in his third term as president of the club and chairman of the board of directors is the popular Paul Beer, while M. S. Denman is serving as vice-president.

Mute evidence of the business-like manner in which the club's affairs have been conducted is the operating statement for 1938, which reveals a net profit of $7,654.32. Total income, including dues, locker rental and profit on cigars, beverages, etc., amounted to $63,905.42. The total expense amounted to $49,845.21. This figure included expense for the house, cafe, golf, swimming, entertainment, taxes, insurance and interest. With a net operating profit of $14,060.21, the depreciation was figured at $6,405.89 to bring the net profit down to $7,654.32.

All in all, Wakonda can easily be cited as a good, solid, smart example of a well operated club in a midwestern metropolis. Its members have ample reason to be proud of it.

WHAT PLANT TISSUE TESTS TELL

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SINCE we must use raw materials, like phosphorus, nitrogen, potash and calcium, along with water, carbon dioxide, and so on, to make vegetables or grass, we are always confronted with the problem of getting adequate and proper amounts and balances of these materials for a growing plant to perform satisfactorily. As far as the soil and the problem as related to the soil is concerned, you get into difficulties in the supplying of nitrogen, phosphorus, and potash. Primarily, they will give you the greatest amount of concern in the growing of grasses.

The agronomists have become quite interested in soil tests, and I want to discuss soil testing with you. One limitation in soil testing is that you take a soil sample, dissolve out the phosphorus and potash, and then you measure with the devices that come with the various soil test kits, thereby finding high or low phosphorus or potash, as the case may be; but the thing you still do not know for sure is whether the amount of phosphorus or potash you get by the soil test method is the amount the 'plant can get hold of.' That is the problem you run into.

Test for Nutrient Deficiencies

On the other hand, if we go into the consideration of the possibilities which lie in the field of testing the plant tissue to find the nutrient deficiencies, as far as nitrogen, phosphorus, and potash are concerned, we find the plant tissue test method may help us a great deal.

In the plant tissue test you take a sample of the clipped grass, put it in a small vial, put the reagent to it, develop a certain color, and these colors tell whether you have or don't have the phosphorus or potash; and in the case of nitrogen we actually macerate a little of the grass tissue on a little porcelain plate and add the proper reagents. You may or may not get a color, depending on whether nitrogen is in the plant.

Test Technique Is Simple

The technique of the plant tissue test is simple. The directions with the kit are all written and the test technique is merely "cook book" procedure. The difficulty comes, however, in making your interpretation.

For an example of how we might interpret the results we are getting with the plant tissue tests, let's take a soil in which the available nitrogen content is low and the phosphate content and potash content are about medium. Taking a soil which has that condition, let's see what we could expect the plant tissue test to show.

But first, in order to get over this idea of what the plant tissue test would show, let's take along an analogy to explain the thing. The plant is somewhat like a factory, and the nitrogen, phosphates and potash we can liken to materials which are coming in on conveyors. One brings in nitrogen, one phosphates, and another

* G.S.A. Convention Address.

potash, and for that factory to function, for the machinery in the plant factory to function, all must be coming in at once, because if the nitrogen is not there the machinery is not functioning, the factory is not putting out, new grass is not being made, and the potash and the phosphates would be piling up under the conveyor.

So, in our example, we have a soil in which it seems the nitrogen is very low; this is an ideal situation taken from considerable experience we have had — we would analyze the plant tissues, grind them as I described, and make the test, but find no nitrogen. We would find in the plant tissue a very high phosphorus, for example, and a quite high amount of potash.

Analyze for All Factors

So many times different people have tried the plant tissue test and have said, "It doesn't need phosphorus or potash, and it does need nitrogen," or "turn around and analyze for one or the other." You can't do that and be safe. You must analyze for all of them, because we want to find out which conveyor is running empty.

So, in this case we would find the plant does not have any nitrogen and so long as the plant does not have nitrogen piling up in there, it cannot grow; it is standing absolutely still because that is the first limiting factor. You can spike or treat for disease, add phosphorus and potash and plenty of water, but if nitrogen is the factor the plant stands still until that is supplied.

Suppose we supply some nitrogen here. We put in nitrogen and the machinery starts up, the plant starts to grow, and the performance picks up. But bear in mind when we looked back at the storage bins we found that while nitrogen in the bin was very low in our warehouse (if you want to look at it like that), the potash was somewhat low and the phosphorus none too good. But we have added nitrogen, and the plant has started to function again—for a time.

Now let's take this situation. We find in the plant tissue a high nitrogen, phosphorus not quite so high, and potash low. It means this: the machinery started work, the plant started to make more grass, but it did not take long before in that speeded up situation it began to run short on potash because it didn't have much to start out with. Again we find the nitrogen piling up in front of the machinery, the phosphorus not so high and the performance is limited by the potash. So then we supply potash. Then the situation changes—for the better. Potash was the first limiting factor, and then when we supply potash and nitrogen the plant speeded up to the extent the phosphorus we originally had in the soil would permit it to go. So our limiting factor now becomes phosphorus.

Suppose now we supply the phosphorus. Then so far as nitrogen, phosphorus, and and potash are concerned everything should be all right. Then you might go out and test the plant and find that nitrogen, phosphorus, and potash, all three, are high.

What would it mean when all three of those factors are high and yet the plant is not performing satisfactorily? It means you can eliminate those three factors as being your trouble, and look for something else. It might be disease, over-watering, bad drainage, salt concentration, starvation for some minor elements, etc.

Performance Indicates Condition

You can go out and test your plants and if they don't show anything at all—look at your performance. If the performance is fine it means the machinery is using the materials as fast as they come in. Everything must be in good balance. There is no piling up in front of the machinery. There, you are not to be concerned, because everything is satisfactory. On the other hand if the plant was not performing right and you had low nitrogen, phosphorus, and potash, it is possible that all three are limiting. Those are the things you have to consider in interpreting these tests. I feel that these tests will be used a great deal in the future.

I am quite familiar with soil tests. We all know we can go out and add treatment to soil to see what will happen but you greenkeepers cannot afford to do that because you cannot afford to make mistakes. You can't afford to be experimenting on your greens. You can have experimental plots but what might be good here, might not be good there. We can test

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The most complete golf schedule issued for any section of the country is Michigan's which includes tournaments of the Detroit DGA, Michigan PGA, Metropolitan GA, Michigan Seniors GA, Junior District GA, Women's District GA and Women's Metropolitan GA. It also includes schedules of national and international events, association rosters and directory of officials and department heads of Michigan clubs.

Bob Howell, Detroit District GA tournament chairman, puts out the booklet. Bob's ad and two others help defray cost of the fine job.

the soil for phosphorus and potash and that works quite well in agronomic factors on farm fields; but that doesn't work so well on golf greens, because you have used arsenic and that interferes. The potash is interfered with by ammonia. You use a great deal af ammonium sulphate and you might get interference from that. These are some of the limitations in the soil tests.

With the agronomic crops we have had much more experience this last year by using the tissue test than we have with turfs. For instance, consider a case like this. We had an experiment out on one of our pasture areas. This experiment was designed to test whether phosphate could be topdressed on the soil, whether it should be put down in rows, or disced into the ground.

We went out on the experimental layout with the tissue test. We tested the plants for nitrogen, phosphorus, and potash, and we found in the grasses in every plot that nitrogen was the limiting factor. Here we had an experiment to study what phosphorus was doing, and what was the use of measuring what the phosphorus was doing when the grass was not doing more than nitrogen was permitting it to do. The experiment was worthless.

In the case of clover, it would make its own nitrogen. When we tested the clover where phosphorus had not been added, there was no phosphorus in the plant. In the grasses where phosphorus had not been added, there was much phosphorus in the plants, but again there was a piling up in the machinery of the plant because the plant needed nitrogen to go along.

Potash Deficiency Colors Leaf

I want to say one word on potash, and it is related to something which came out of our tissue testing. When a grass starves for potash we find that the margin of the leaf tends to brown. If you take some of these turf grasses and look at them under a little magnifying or hand glass, in the case of potash starvation you can see quite easily that the edges are brown—green in the mid-leaf but brown at the edges.

One greenkeeper brought in a core of soil from one of his greens. With the turf just as it was taken out of the green, it was examined and found that it suggested potash starvation. This was in the latter part of July. We tested the soil. I did not have a great deal of confidence in the soil test because there was a possibility the test might show high potash that could be due to the ammonia which had recently been added; but we tested the grass and found there was no potash in it. When potash was supplied, it snapped out of it.

Old Tissues Don't Recover

Old tissues that have been injured and are brown on the sides will not recover, but new ones will recover. It leads me to wonder if many times we are not running into, especially in the more humid regions, a considerable potash storage toward the middle of July and August; that may be the cause of the browning. To support this belief I feel we have more potash starvation in that period of summer than any other time.

I want to say that if we want to clean the soil of potash, all we need to do is to leech that soil with any kind of salt, the kind doesn't matter. Ammonium sulphate is a salt, of course, and we can completely clean the potash out of that soil. If you are using a lot of ammonium sulphate, that is perfectly all right, but watch out, for you may be leeching the potash out.

I wish you who are watering a great deal and using ammonium sulphate in your water would watch the potash during the latter part of July and August. You can go to grass during the winter and test it for phosphorus and potash and even on soil quite deficient in phosphorus and potash, you will find the grass high in phosphorus and potash. Yet look at your grass performance. It is not doing anything; it is frozen and dead and there is only a little green down near the crown. The factory is shut down for cold weather; the material is piling up.

Always, in making the test, watch the performance. If it is satisfactory, you have nothing to worry about; if it is not satisfactory it may be one of these three things we have been talking about.

I want you to understand that in making these remarks regarding soil tests or plant tissue tests, we are still in a rather youthful period and we need more information. We at Purdue have a kit that will make the tests and there are commercial concerns that handle them. Undoubtedly, before very long, we will use this technique with considerable advantage.

I just caution you—the technique of making the test is merely "cook book" procedure. The value to you will depend upon the interpretation you make of it. You have to think of this as a moving thing, something changing every day.