Use of Soil Test kits in Assessing Soil Fertility in Oilseed Growing Areas.

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Introduction

Ever increasing demand for increasing the productivity per unit area and the narrowing down cost-benefit ratio has made the growers more sensitive to the soil fertility status and thereby fertilizer management and soil health. Farmer-friendly portable soil test kits provide an easy and quick means of testing soil and plant tissues for precise nutrient management. Several soil test kits have been developed but did not become popular due to several reasons. A few among them being the complexity of procedures involved in soil testing at farmer level, interpretation of obtained results, non-availability of back-up technical advice and the cost involved.

Basis

This line of combination soil analysis outfits (soil test kits) offers the finest visual colour matching system available to today's agronomist. Technically advanced reagent systems and unique extraction procedures based on the Mehlich-I extraction provide fast, simple and extremely accurate soil testing. Since the original introduction of the kits, based on Morgan soil test methods, reagent systems have been updated constantly with new advancements in modern chemistry. A series of rapid, accurate chemical tests use standardized reagents to produce colour reactions measured against laminated colour charts.

All outfits are furnished in lightweight carrying cases with components securely mounted in removable foam trays. This format provides flexibility for the in-house specialist who also wants to make quick problem determinations in the field.

Colorimetric test methods are used for most test parameters. Tests for calcium, sulfate and chlorides are based on turbidity measurements. Potassium analysis also employs a turbidity measurement. A single extraction procedure, using Morgan Universal Extraction Solution, provides the liquid soil extract for all the nutrient tests with the exception of chloride, which is extracted with deionized water. The Humus Screening Test, performed on a soil sample-deionized water suspension, employs five colour standards for rapid measurement of humus content of the soil. Each kit includes complete instructions, a soil management handbook.

Test Methods

Colour chart methods are used for all tests except for Potassium. The reaction is performed in a tube or on a spot plate and the resulting colour is compared to a laminated colour chart. The Potassium test measures the amount of turbidity in a sample relative to the potassium content.

Tests for Available Nutrients

All tests measure the portion of the nutrient in the soil that would be “available” for the plant to use. Since extraction is not complete, the amount that is measured is relative, dependent on the extraction procedure.

Soil Sampling & Preparation

Follow the standard procedure for collection of soil samples from fields, orchards and greenhouse prior to irrigation. Remove any mulch covering the soil, and then use a soil sampling tube or scoop to take a sample from the entire plant rooting space, top to bottom. A composite sample insures representative test results. Thoroughly mix 8 to 10 individual samples, and then spread the composite sample on a sheet of paper or plastic to dry. Allow the sample to air dry overnight. Do not oven dry the sample.

Test Procedures

pH: pH is a measure of acidity or basicity. Soils can have a pH from 3.5 to 11.0, but plants grow well in the range of 5.0 to 8.5. In soils with a low pH (acidic), some nutrients can reach toxic levels and the activity of soil microbes is greatly reduced. Soils with a high pH (alkaline) generally have a lower micro-nutrient availability and some levels may be deficient.

Procedure

1. Fill a test tube approximately one-third full of soil. Use the deionized water to the tube, until it is filled to one-half inch from the top. Cap and shake until the soil is well dispersed.
2. Add 5 drops of Soil Flocculating Reagent. Cap and shake to mix. Allow contents to settle before proceeding to Step 3.
3. Use a 1 mL pipet to transfer 1 mL of the clear solution above the soil to one of the large depressions on a spot plate. Transfer a second 1 mL sample to the other large depression on the spot plate.
4. To the first sample on the spot plate, add two drops of Indicator. Compare the resulting colour reaction against the Colour Chart.
5. The wide range pH test result indicates which narrow range indicator and colour chart should be selected to perform a more precise pH test. Choose the narrow range indicator and appropriate chart with a mid-point that is as close as possible to the value obtained in the wide range test.

Indicator	pH Range
Bromcresol Green	3.8-5.4
Chlorphenol Red	5.2-6.8
Bromthymol Blue	6.0-7.6
Phenol Red	6.8-8.4
Thymol Blue	8.0-9.6

Example: If the wide range test result is pH 6.0, choose the Chlorphenol Red Indicator & the Chlorphenol Red Colour Chart for Step 5.

6. Add two drops of the chosen narrow range indicator to the second sample on the spot plate. Compare the resulting colour reaction against the appropriate colour chart to obtain a precise soil pH reading.

Interpretation of pH Reading

If the pH is	then the soil is
Below 5.5	Strongly Acid
5.5-6.0	Moderately Acid
6.1-7.0	Slightly Acid
Above 7.0	Alkaline

Extraction for soil analysis

The following extraction procedure uses Universal Extracting Solution to produce a single soil extract which is used in each of the following tests: nitrate nitrogen, ammonia nitrogen, nitrite nitrogen, phosphorus, potassium, calcium, magnesium, sulfate, aluminium, iron, and manganese.

Procedure

1. Fill an Extraction Tube to the line as described it manual with Universal Extracting Solution.

2. Add required quantity of soil sample. Cap and shake for one minute.

Note: When adding samples with high concentrations of carbonates to the *Universal Extracting Solution, swirl tube to mix for 30 seconds before capping to allow gases to escape.

3. Use a piece of filter paper and a plastic funnel to filter the soil suspension into a second extraction tube. (Fold the filter paper in half and then in half again to form a cone which is fitted into the funnel.) The filtrate in the second extraction tube is the general soil extract for use in the all individual test procedures listed above.

Procedure for Nitrate Nitrogen

1. Use a 1 mL pipette to transfer 1 mL of the general soil extract to one of the larger depressions on a spot plate.

2. Add 10 drops of Nitrate Reagent.

3. Use a 0.5 g spoon to add one level measure of Nitrate Reagent- 2 Powder.

4. Stir thoroughly with a clean stirring rod. Allow to stand five minutes for full colour development.

5. Match sample colour with the Nitrate Nitrogen Colour Chart. Record as pounds per acre nitrate nitrogen.

Procedure for Potassium (Potash)

1. Use a transfer pipette to fill a Potash “A” Tube to the lower line with the general soil extract.

2. Add one Potassium Reagent-B Tablet. Cap and shake until dissolved.3. Add Potassium Reagent-C until the Potash “A” Tube is filled to the upper line slowly down the side of the tube. Swirl the tube to mix. A precipitate will form if potassium is present.

4. Stand the empty Potash “B” Tube on the Potassium Reading Plate, a rectangular piece of white plexiglass with a solid black line down the middle. Place the tube directly over the black line.

5. Fill a transfer pipette with the test sample from the Potash “A” Tube.

6. The precipitate is measured against black back ground with standard charts.

Procedure for Phosphorus

1. Use a transfer pipet to fill a “Phosphorus B” Tube to the line with the general soil extract.

2. Add 6 drops of Phosphorus Reagent-2. Cap and shake to mix.

3. Add one Phosphorus Test Tablet. Cap and shake until dissolved.

4. Immediately compare the colour that develops in the test tube against the Phosphorus Colour Chart. Hold the tube about one inch in front of the white surface in the center of the colour chart. View the chart and sample under natural light for optimum colour comparison. The test result is read in pounds per acre Available Phosphorus.

Humus

Humus consists of the complex remains of fresh plant and animal residue after extensive chemical and biological breakdown. Humus accounts for 60% to 70% of the total organic carbon in soils. It can modify the physical properties of a soil, strongly affecting its chemical and biological properties.

Procedure

1. Add 2.0 g of soil to a soil extraction tube.
2. Fill the tube with 14 mL deionized water. Cap and shake to mix.
3. Use a 0.5 g spoon to add two level measures of Humus Screening Reagent Powder. Cap and shake vigorously for one minute.
4. Add 15 drops of Soil Flocculating Reagent. Cap and mix gently. Allow to settle for several minutes.
5. Use a piece of filter paper and a plastic funnel to filter the mixture into a second extraction tube. (Fold filter paper in half and then in half again to form a cone which is fitted into the funnel.)
6. Compare the clear filtrate in the second extraction tube with the Humus Colour Chart.

Interpretation

The Humus colour comparator is labelled with values of 1, 2, 3, 4, and 5. The results are interpreted as follows:

Humus or Organic Matter in Soil

Humus Reading	1	2	3	4	5
Agricultural Soils	Low	Medium	High		
Garden Greenhouse Soils		Low	Medium	High	
Organic Soils			Low	Medium	High

Sulphate: Sulphur is essential to the formation of protein and affects various aspects of plant metabolism. Sulfphur-deficient plants are pale green in colour with thin, reedy stems. Negatively charged sulfate ions are easily leached. The major sources of soil sulfate are fertilizer containing sulfate compounds and atmospheric sulfur dioxide carried into the soil by precipitation.

Procedure

1. Use a transfer pipette to transfer five drops of the general soil extract to a flat-bottomed turbidity vial.
2. Add one drop of Sulphate Test Solution. Swirl gently to mix.

3. Compare the turbidity of the sample to the turbidity standards of the Sulphate Chart. Lay the chart flat under natural light and hold the turbidity vial one-half inch above the black strip in the middle of the chart. View the black strip down through the turbid sample and compare the resulting shade of gray with the six standard shades. The test result is read in parts per million sulfate.

Green Plant Tissue Tests

Testing an extract prepared from fresh plant tissue provides a means of verifying suspected nutrient deficiencies during plant growth. The necessary information for testing nitrate nitrogen, phosphorus, and potassium in green plant tissues is given below. These tests are meant to be used in a comparative manner. It is important to test tissue from healthy plants as well as those from problem plants. Interpretations should be based on comparison of test results from plants of the same species and same age, grown in the same general environment. Since test reactions may vary from species to species, at different stages of growth, or under different growing conditions, it is not possible to accurately quantify test results. The colour charts should be used in a comparative manner. Relative values from very deficient to abundant have been assigned to the range of possible test reactions under each parameter below.

Preparation of Tissue Extract

1. Select a small lot of the leaf petioles or succulent portion of the stem. When testing problem plants, collect tissue from those areas where the abnormality is most observable.
2. Use a clean, sharp knife or a blade to cut the material into fi ne bits not more than 1/8” to 1/16” in length and thickness.
3. Fill an Extraction Tube to the lower line with this material. Do not pack down.
4. Add Universal Extracting Solution to the upper line. Cap and shake vigorously for five minutes.
5. Use a piece of filter paper and a plastic funnel, filter the mixture into a second Extraction Tube. This filtrate is the tissue extract to be used in place of the general soil extract in the nitrate nitrogen, phosphorus, and potassium test procedures.

Plant Tissue Test Procedure

Follow the soil test procedures for nitrate nitrogen, phosphorus, and potassium, using the tissue extract in place of the general soil extract. Remember that the colour charts should only be used in a comparative manner, along with the relative values suggested. The most meaningful test results will be obtained from the comparison of healthy plant and problem plant test reactions.

Guidelines for Interpreting Plant Tissue Tests

Test Factor	Test Reaction	Relative Amount of Nutrient in Plant Tissue
Nitrate Nitrogen	Dark Pink Colour	Abundant
	Light Pink Colour	Adequate
	Colourless No Reserve/Probably	Deficient
Phosphorus	Deep Blue Colour	Abundant
	Light Blue Colour	Adequate
	Yellow to Colourless	Low to Deficient
Potassium	Heavy Precipitate	Adequate to Abundant
	Medium Precipitate	Low to Deficient
	Trace Precipitate	Deficient
	No Precipitate	Very Deficient

To conclude, It can be hoped that soil test kits can achieve the objective of efficient nutrient management and will take the farming community and growers a long way in overcoming the imbalanced nutrient status of soils, which not only affecting crop production, cost of cultivation but environmental cleanliness as well. The soil test kit is not always cent percent accurate and hence it can be further improved over the period of time.

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