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TEST THE SOIL FIRST

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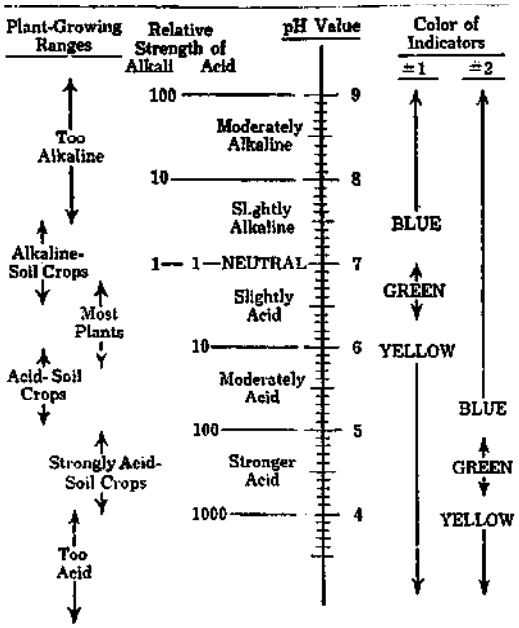
WHEN YOU ARE planning to bring your garden plot up to full production of either vegetables or blooms, a soil test is the first step. This will tell you what available plant foods the soil already contains and also determine what amounts of the primary plant-food elements—nitrogen, phosphorus and potassium—must be added for maximum plant growth and yield. Soil acidity and possible lime requirements also can be estimated closely. In small plots soil samples for testing should be taken from the positions shown in Fig. 1. Use a sharp trowel and lift a wedge of soil as indicated. Place the samples in a paper bag and allow to dry overnight. Then remove all roots, gravel and any other foreign matter. Mix the samples thoroughly.

Soil acidity is measured in what are known as pH units, which designate acid, neutral and alkaline conditions by numbers 1 to 14. Note the chart on the opposite page. Acid conditions from strong to weak generally are rated from 1 to 7. A pH of 7 usually is considered neutral. Most plants grow best in a neutral or slightly acid soil with a pH value between 5.5 and 7. However, plants do have definite pH preferences as will be noted from Table III. When testing, the pH is found by adding to the soil sample an indicator solution, Table V, which changes color, depending on the pH. Note that there are two solutions to cover the normal pH range. When checking colors it is best to place a drop of the solution on a white surface, such as a china plate, where the true color can be more accurately judged. Use only a small portion of the soil sample, about ¼ in. in a test tube, and add indicator solution No. 1 to a depth of about ½ in. Cork the tube, shake rather vigorously, and then allow the solids to settle. After an hour or so, check the color of the liquid layer. Then find the pH value in Table VI, column 1. If the liquid is yellow, indicating a pH under 6, repeat the test, using solution No. 2 and find the pH from the color as given in the last column of Table VI.

If the pH value is low (soil too acid) for the plants you want to grow, it will be necessary to lime the soil. Table VII shows how much limestone or hydrated lime to add per 1000 sq. ft. to raise the pH one unit. On the other hand if the pH is too high, add 18 lb. of sulphur per 1000 sq. ft. to lower the pH one unit.

Testing the sample for the primary plant foods—nitrogen, phosphorus and potassium—requires the preparation of a soil extract which is made by dissolving these three elements out of the soil sample with

SOIL ACIDITY CHART



Tests with indicator solutions show pH value of soil, which tells its acidity or alkalinity. pH preferences of various plants are given in Table III.

TABLE I
CONSUMPTION OF PRIMARY PLANT FOODS

(Table shows the weight of nitrogen, phosphorus and potassium consumed from an area of 1000 sq. ft. by a growing crop.)

Element	*Pounds Consumed*	*Equivalent Amount of Fertilizer*	*Effect on Plant of Lack of Element*
Nitrogen	3	30 lb. of 10% nitrogen fertilizer	Yellowish-green color. "Firing" or drying of leaves. Slow growth.
Phosphoric acid (P_2O_5)	1¼	12½ lb. of a 10% phosphorus fertilizer	Purplish leaves. Slow growth. Low yield of grain or fruit.
Potassium oxide (K_2O)	3	30 lb. of 10% potash fertilizer	Curling leaves, ragged edges. Poor roots (plants may fall down). Spotted or streaked leaves.

TABLE II
SOIL-TESTING CHEMICALS

Chemical	*Used for*	*Quantity Required*
Bromthymol blue indicator	Acidity test	1 gram
Bromcresol green indicator	Acidity test	1 gram
Sodium hydroxide (C.P. pellets)	Acidity test	¼ lb.
Sodium acetate	Extraction	¼ lb.
Acetic acid (C.P. Glacial)	Extraction	1 lb.
	Phosphorus, Potassium	

TABLE II—*Continued*
SOIL-TESTING CHEMICALS

Chemical	*Used for*	*Quantity Required*
Ammonium molybdate	Phosphorus	1 oz.
Tin wire (or foil)	Phosphorus	1 oz.
Sodium cobaltinitrite	Potassium	1 oz.
Sodium nitrite	Potassium	½ lb.
Isopropyl alcohol (99%)	Potassium	1 lb.
Diphenylamine	Nitrogen	1 oz.
Sulphuric acid	Nitrogen, Phosphorus	1 lb.

TABLE III
PREFERRED SOIL pH RANGES FOR VARIOUS PLANTS

Strongly Acid Soil
pH below 5

Cranberries	Azaleas
Blueberries	Rhodendron

Moderately Acid Soil
pH 5 to 6

Eggplant	Hydrangea (Blue)
Potatoes	Ferns
Watermelon	Pine, Firs
Parsnips	

Slightly Acid Soil
pH 5.75 to 6.75
(Most plants prefer this pH range)

Beans	Rye	Hydrangea (Pink)
Broccoli	Wheat	Iris
Brussels Sprouts	Grasses	Larkspur
Onions	Aster	Narcissus
Peas	Carnation	Pansy
Peppers	Chrysanthemum	Rose
Squash	Dahlia	Snapdragon
Tomatoes	Daisy	Tulip
Turnips	Delphinium	Zinnia
Corn	Gladiolus	

Neutral or Slightly Alkaline Soil
pH 6.5 to 7.5

Apples	Cineraria
Asparagus	Clematis
Cabbage	Geranium
Carrots	Ivy
Cauliflower	Morning Glory
Celery	Nasturtium
Lettuce	Petunia

TABLE IV
EQUIPMENT REQUIRED FOR SOIL TESTING

Test tubes—3" x ⅜" or 4" x ½"
Corks to fit test tubes
Glass filtering funnel
Filter paper to fit funnel
Graduated cylinder—10 ml. or 25 ml.
Medicine droppers

TABLE V
INDICATOR SOLUTIONS

	Indicator No. 1	*Indicator No. 2*
(A) Bromthymol blue (powder)	.01 gram	
Bromcresol green (powder)		.01 gram
Pure grain alcohol (or isopropyl alcohol)	5 ml.	5 ml.
Distilled water	95 ml.	95 ml.
(B) Sodium hydroxide (C.P. pellets)	2 pellets (⅛ gram)	2 pellets (¼ gram)
Distilled water	1 pint	1 pint

Dissolve powder in alcohol, add distilled water to complete (A); then add solution (B), drop by drop, until color is yellow-green.

TABLE VI
COLORS AND pH VALUES FOR INDICATORS

Indicator No. 1	*Color of Solution*	*Indicator No. 2*
pH over 7.5	Blue	pH over 5.25
pH 7 to 7.5	Blue-Green	pH 4.75 to 5.25
pH 6.5 to 7	Green	pH 4.25 to 4.75
pH 6 to 6.5	Yellow-Green	pH 4 to 4.25
pH under 6	Yellow	pH under 4

TABLE VII
USE OF LIMESTONE OR HYDRATED LIME TO RAISE pH OF SOIL

(Table shows number of pounds of crushed limestone or hydrated lime required per 1000 sq. ft. to raise the soil pH one pH unit.)

Type of Soil	*Crushed Limestone*	*Hydrated Lime*
Light sandy soil	35 lb.	26 lb.
Sandy loam	45 lb.	33 lb.
Loam soil	70 lb.	52 lb.
Clay loam	80 lb.	60 lb.

TABLE VIII
EXTRACTION SOLUTION

Sodium acetate	20 grams
Acetic acid (C.P. Glacial)	6 ml.
Distilled water	175 ml.

TABLE IX
STANDARD SOLUTION OF PLANT-FOOD ELEMENTS

Stock Solution

Monosodium phosphate	2 grams
Potassium nitrate	1 gram
Distilled water	1000 ml. (1 liter, or 1.056 qt.)

Standard Solution

Stock solution	10 ml.
Extraction solution	90 ml.

TABLE X
REAGENT SOLUTION FOR PHOSPHORUS

Phosphorus Reagent A

Ammonium molybdate	10 grams
Distilled water	40 ml.

Phosphorus Reagent B

Acetic acid (Glacial)	10 ml.
Distilled water	100 ml.
Sulphuric acid	5 ml.

Mixed Phosphorus Reagent

Add all of Phosphorus Reagent A to Phosphorus Reagent B and stir to mix well.

TABLE XI
PHOSPHORUS-TEST COLORS AND REQUIREMENT FACTORS

Color of Test Solution	*Amount of Phosphorus in Soil*	*Phosphorus Requirement Factor*
Faint blue or clear	Very low	900
Lighter than standard	Low	750
Like standard	Medium	600
Deeper than standard	Medium high	450
Very deep blue	High	350

TABLE XII
REAGENTS FOR POTASSIUM

Potassium Reagent No. 1

(A) Sodium cobaltinitrite	5 grams
Sodium [illegible]	30 grams
Distilled water	50 ml.
Acetic acid (Glacial)	5 ml.
Distilled water—to make a total volume of	[illegible] ml.
(B) Sodium nitrite	[illegible] grams
Water	100 ml.

1. Dissolve the chemicals in (A) in the order listed, and let stand in an unstoppered bottle for a few days.
2. Prepare solution (B).
3. Add 5 ml. of (A) to all of (B) to complete Potassium Reagent No. 1.

Potassium Reagent No. 2

Pure isopropyl alcohol

TABLE XIII
POTASSIUM-TEST COLORS AND REQUIREMENT FACTORS

Appearance Test Solution	*Amount of Potassium in Soil*	*Potassium Requirement Factor*
Trace of cloud	Very low	700
Less cloud than standard	Low	600
Like standard	Medium	400
More cloud than standard	Medium high	200
Dense cloud	High	100

TABLE XIV
REAGENT FOR NITROGEN

Diphenylamine	.05 gram*
Sulphuric acid (C.P. Concentrated)	25 ml.

* Amount the size of a small pea

TABLE XV
NITROGEN-TEST COLORS AND REQUIREMENT FACTORS

Color of Test Solution	*Amount of Nitrogen in Soil*	*Nitrogen Requirement Factor*
No blue	Very low	400
Lighter than standard	Low	300
Like standard	Medium	250
Darker than standard	Medium high	200
Very dark blue	High	100

TABLE XVI
CALCULATING FERTILIZER REQUIREMENTS
(EXAMPLE)

Food Element	*Fertilizer Material*	*Analysis No.*	*Food-Element-Requirement Factor*	*Lb. Reqd. per 1000 sq. ft.*
Nitrogen	Sodium nitrate	15	250	250÷15=17 lb.
Phosphorus	Superphosphate	20	450	450÷20=23 lb.
Potassium	Potassium chloride	52	100	100÷52= 2 lb.

an extraction solution, Table VIII. To prepare extract, fold filter paper as in Fig. 4 and place in a glass funnel. Place a level teaspoonful of soil on the filter. Place a clean test tube (or a small glass tumbler) under the funnel spout. Pour 10 ml. (milliliters) of extraction solution on the soil sample and when the liquid has passed through the filter, lift the latter and squeeze it lightly to force out the remaining extract. Portions of this extract are used in all remaining tests. Now, make a stock solution and a standard solution as in Figs. 2 and 3, also Table IX.

Tables X to XVI inclusive outline the tests for the primary plant foods and show how to calculate fertilizer requirements, Table XVI. Using as an example the test for phosphorus, Table X, pour soil extract into a test tube to a depth of about ½ in., then add an equal amount of the phosphorus reagent (solution). Stir with a pure-tin wire, or add two ¼-in. squares of tin foil and stir with a glass rod, until a full blue color results. Now, in a second test tube mix equal amounts of standard solution and phosphorus reagent and stir with a bright tin wire. Compare the colors and judge the amount of phosphorus present by referring to Table XI. The phosphorus requirement will be used later in estimating the amount of fertilizer needed. Note that two reagents are required for the potassium test, Tables XII and XIII, but that only one reagent is needed to test for nitrogen, Table XIV.

Note that in preparing the nitrogen reagent it will be necessary to handle concentrated sulphuric acid, Table XIV. This acid is extremely corrosive and must be placed in a glass-stoppered bottle, or one with a paraffined cork. Take every precaution against having any of this solution containing sulphuric acid come in contact with the skin, clothing, workbench or any metal object. Protect the eyes against spatters. Wear rubber gloves. In carrying out the test, lay a small pane of glass on a sheet of white paper, Fig. 5, and place four drops of nitrate reagent in the center. Follow with one drop of soil extract. Immediately a blue ring will form, Fig. 6, After allowing three minutes, compare the color with that of a nitrogen standard, prepared in the same way except using one drop of standard solution instead of soil extract. Refer to Table XV for the values. ★ ★ ★