INSTRUCTION MANUAL

MT6003

NPK Soil Test Kit

SATISFACTION GUARANTEED

milwaukee

THANK YOU for choosing Milwaukee Instruments!

This instruction manual will provide you the necessary information for correct use of the test kit.

TABLE OF CONTENTS

1. GENERAL INFORMATION

1.1. CONTENT

Each **MT6003** Chemical Test Kit contains:

- **MT5015** Extraction Solution, 3 bottles (100 mL)
- **MT5009-0** Nitrogen Reagent, 25 packets
- **MT5010-0** Phosphorus Reagent, 25 packets
- **MT5002-0** Potassium Reagent, 25 packets
- three 1 mL plastic pipette
- 5 test tubes
- 1 tube-stand
- 1 spoon
- 1 brush
- 3 color cards
- 1 graduated card
- Operating manual

1.2. HEALTH & SAFETY

The chemicals contained in this test kit may be hazardous if improperly handled. Read and carefully follow Health and Safety data sheets before performing the test. Keep your kit out of reach of children. Store it indoors in a clean, dry location. Keep away from food, drink and animal feed. Always wash your hands thoroughly after making your test. Health and Safety sheets are available on request from your nearest Milwaukee Instruments Office.

2. SOIL & PLANT LIFE

Quality of plants and crops growth depend greatly on physical and chemical properties of soil, that is on soil composition: minerals and organic matter, water, gases like oxygen and carbon dioxide, and living being (primarily microorganisms such as fungi and bacteria).

Soil is not only a support system, but also a nutritive source that supplies plants with water and nutrients. Each plant needs a particular soil composition, in which it can better express its potential growth. For this reason, a correct balance in soil components is fundamental to ensure an optimal crop growth. The most important elements for plant growth are nitrogen (N), phosphorus (P) and potassium (K): for this reason they are called essential nutrient elements or macronutrients. These elements are usually added to the soil by fertilization. Other elements, the so called microelements, are generally present in sufficient quantities in the soil and the plants need them in smaller doses. Milwaukee NPK Soil Test Kit allows to measure the concentration of the three elements N, P, K in a soil sample. A table at the end of this manual shows N, P, K requirements for common crops and plants.

2.1. FEATURES & PROPERTIES OF MACRONUTRIENT ELEMENTS

A General overview of the three essential nutrient elements.

Nitrogen

Nitrogen (N) is a unique element in that it composes 80% of the earth's atmosphere. Plants, for the most part, cannot utilize atmospheric nitrogen. However the legume group of plants have the capability to convert atmospheric nitrogen into a form which can be utilized by the plant. Nitrogen fixation by legumes is conducted through a symbiotic association between the plant root and Rhizobium bacteria in the soil. The site where the nitrogen capturing process occurs is in the visible nodules formed on the plant roots. Some of the most common legumes are peanuts, soybeans, lespedeza, alfalfa, clovers, and vetches. These are noted by an * in the following table.

The most common sources of nitrogen for non-legumes are through the decomposition of organic matter and application of commercial nitrogen fertilizers.

Nitrogen is a component of the chlorophyll in plants, thus giving plants the rich green color characteristic of a healthy plant. Nitrogen promotes succulence in forage crops and leafy vegetables. When used at the recommended rates, nitrogen improves the overall quality of leaf crops and stimulates the utilization of phosphorus, potassium and other essential nutrient elements.

Given the benefits of nitrogen in crop production, it is important to note that excessive nitrogen can have an adverse effect on crops. Excess nitrogen can delay crop maturity, increase lodging due to weakened stems, produce excessive vegetative growth at the expense of fruit set, and cause potential health hazards for man and animal due to nitrate accumulation in leafy vegetable or forage crops.

Nitrogen is an indispensable nutrient element but it must be utilized properly to reap maximum benefit.

Phosphorus

Phosphorus (P) is necessary for the hardy growth of the plant and activity of the cells. It encourages root development and by hastening the maturity of the plant, it increases the ratio of grain to straw, as well as the total yield. It plays an important part in increasing the palatability of plants and stimulates the formation of fats, convertible starches and healthy seed. By stimulating rapid cell development in the plant, phosphorus naturally increases the resistance to disease. An excess of phosphorus does not cause the harmful effects of excessive nitrogen and has an important balancing effect upon the plant.

Potassium

Potassium (K) is a positively charged basic metal cation whose total content in most mineral soil, except sandy natured soils, is greater than most other major nutrient elements. It is estimated that 2.3% of the Earths surface is potassium. However most of this potassium is not available to plants because it is either bound in primary minerals or is fixed in the interlayer of clay minerals. Since clay soils develop from the decomposition of potassium rich primary minerals, it follows that soils high in clay content usually have a relatively high potassium content.

As potassium in the soil solution is diminished by plant uptake it is replenished by exchangeable potassium from soil colloids. Potassium fixed in the interlayer of clay minerals also contributes to the soil potassium supply even though it is not considered as readily available.

Depending on the type of clay mineral and its resistance to weathering actions, the potassium supply may or may not be adequate for maximum crop production. This evaluation of supply can be made with the Milwaukee NPK soil test, since exchangeable colloids and potassium in the soil solution are the forms of potassium measured by the soil test. In this light the soil test for potassium content reflects that portion of soil potassium which is readily available to plants, and depending on the soil test level may or may not be an adequate supply for good crop yields.

Soils which fix potassium serve as a bank which safeguards against leaching and ultimately, in time, returns potassium to the exchangeable form which can be withdrawn and utilized by plants. Soils which are predominantly sand with little or no clay have extremely low levels of native potassium and are subject to sever leaching. In most cases annual potassium applications are required to grow satisfactory crops.

Potassium in plant nutrition enhances disease resistance by strengthen stalks and stems. It activates various enzyme systems within plants. Potassium contributes to a thicker cuticle which guards against disease and water loss. It controls the turgor pressure within plants to prevent wilting. Potassium enhances fruit size, flavor texture and development and it is involved in the production of amino acids, chlorophyll formation, starch formation, and sugar transport form leaves to roots.

3. SOIL ANALYSIS SAMPLING

3.1. EXTRACTING SOIL SAMPLES

There are two methods by which to proceed. The first is field average sampling and the second is pinpoint sampling. The two methods are following described.

Field Average Sampling

- With a large field, take 1 or 2 samples per 1000 m2 (0.25 acre) of homogeneous areas.
- Even for smaller areas, 2 samples are recommended. The more samples you take the better the end-results, because the sample is more representative.
- Avoid extracting samples from soil presenting obvious anomalies. Fields which have knolls and low spots at intervals, or which slope evenly from high to low levels, must be sampled accordingly; that is, representative samples must be taken from the high spots and separate samples from the low spots, but in no case should these separate samples from high and low areas be mixed together.
- Take equal quantity of soil for each area sample. For example, use the same size bag or cup with the same quantity in each sample container.
- Depth of the extraction is important. Always discard the first 5 cm (2") of topsoil. For Turf grass take the sample at a depth of 5 to 15 cm (from 2" to 6"). For row crops, flowers, vegetables, shrubs samples should be taken from 15 to 40 cm of depth (6" to 16") For trees sample from 20 to 60 cm of depth (8" to 24"). A general understanding of the mature crop root depth should be used as a sample depth guideline.
- Mix the representative samples from each area together to obtain a homogeneous mixture of soil. From this mixture, take a quantity of dried soil that you need to perform the soil test being sure to discard stones and humus residue.

Pinpoint Sampling

This method assumes you have located through yield mapping or soil EC meter testing areas of poor crop performance and /or low or very high EC meter readings.

- Take 3 to 5 samples an equal distances apart within the perimeter of the targeted problem area. The more samples you take the better the end-results, because the sample is more representative.
- Take equal quantity of soil for each area sample. For example, use the same size bag or cup with the same quantity in each sample container.

- Depth of the extraction is important. Always discard the first 5 cm (2") for topsoil. For Turf grass take the sample at a depth of 5 to 15 cm (from 2" to 6"). For row crops, flowers, vegetables, shrubs samples should be taken from 15 to 40 cm of depth (6" to 16"). For trees sample from 20 to 60 cm of depth (8" to 24"). A general understanding of the mature crop root depth should be used as a sample depth guideline.
- Mix the representative samples from within each targeted area together to obtain a homogeneous mixture of soil for that target area. From this mixture, take a quantity of dried soil that you need to perform the soil test being sure to discard stones and humus residue.

4. TESTING PROCEDURE

4.1. READING THE COLOR CARD

- The **Nitrogen (NO_3)** and **Phosphorus (P_2O_5)** are ***colorimetric tests***. During the test a color is developed which corresponds with the fertility of the soil. To read the fertility, the color developed has to be compared with a color card.
- To match the color, hold the tube with the test solution approximately 2 cm (0.5") away from the side of the color card. Stand with the light source behind the card and tube and by comparison to the 4 color shades on the card read Trace, Low, Medium or High. Sunlight is best for reading the test tube color results.
- If the color of the test tube falls between two standard colors, such as between medium and high then the test results are read as Medium-High. Through this method eight different readings are possible. The reading are: Trace, Trace-Low, Low, Medium-Low, Medium, Medium-High, High, Very-High.
- The **Potassium (K_2O)** test is a ***turbidimetric test***. To read the test result, hold the tube against the reading card over the reading area. Stand with the light source behind your back. Start at trace, looking through the tube and go to low, medium or high until you just see the white line in the middle of the reading area. Report the reading only in Trace, Low, Medium, or High.

WARNING: Prolonged exposure to light may damage the colors of the comparing cards and cause them to shift or fade. Please store them out of light when not in use.

4.2. SOIL NUTRIENT EXTRACTION

The general extraction procedure in preparation for the N, P and K individual tests, is as follows:

- First, fill a reaction tube to the third graduation mark (7.5 mL) with the **MT5015** Extraction Solution. Second, using the small spoon provided in this test kit add to the reaction tube nine (9) measures of soil sample. For small garden plots add six (6) measures.
- Replace the cap on the test tube containing the extraction / soil mixture and shake gently for one minute.
- Allow the tube to stand for at least 5 minutes. The clearer the extract becomes the better the test results. However, some cloudiness will not affect the accuracy of the test.

4.3. INDIVIDUAL N-P-K TESTS

Nitrogen Test

- Use the pipette to transfer 2.5 mL of the clear general soil extract to a clean test tube. Do not transfer any soil.
- To avoid agitation of the soil, squeeze the bulb of the pipette before inserting it into the soil extract solution.
- Add the content of one packet of **MT5009-0** NITROGEN reagent being sure the entire contents of the package is used. Replace the cap on the test tube and shake vigorously for 30 seconds to dissolve the reagent.
- Allow the tube to stand for 30 seconds. Match the pink color with the N color card as described above and note the N reading.

Phosphorus Test

- Use the pipette to transfer 2.5 mL of the clear general soil extract to a clean test tube. Do not transfer any soil.
- To avoid agitation of the soil, squeeze the bulb of the pipette before inserting it into the soil extract solution.
- Add the content of one packet of **MT5010-0** PHOSPHORUS reagent being sure the entire contents of the package is used. Replace the cap on the test tube and shake vigorously for 30 seconds to dissolve the reagent.
- Allow the tube to stand for 30 seconds. Match the blue color with the P color card as described above and note the P reading.

Potassium Test

- Use the pipette to transfer 0.5 mL of the clear general soil extract to a clean test tube. Do not transfer any soil.
- To avoid agitation of the soil, squeeze the bulb of the pipette before inserting it into the soil extract solution.
- Fill the tube to the lower graduation mark (2.5 mL) with the **MT5015** Extraction Solution.
- Add the content of one packet of **MT5002-0** POTASSIUM reagent being sure that the entire contents of the package is used. Replace the cap on the test tube and shake vigorously for 30 seconds to dissolve the reagent.
- Allow the tube to stand for 30 seconds. Following test tube reading instructions as described above in the “Reading the Color Card” section and note the K reading.

5. TABLES

5.1. RELATIVE NITROGEN, PHOSPHORUS AND POTASSIUM REQUIREMENTS FOR COMMON CROPS AND PLANTS

Legend: VH = Very High H = High
M = Medium L = Low
L* = Nitrogen supplied by legume organisms

Plant/Crop	N	P	K
Alfalfa	L*	H	H
Apples	M	L	L
Asparagus	VH	H	M
Barley	M	H	M
Beans, Lima or String	L	M	M
Beets, Early	VH	VH	VH
Beets, Late	H	VH	H
Bent Grass	M	L	L
Blackberries	L	L	L
Blue Grass, Kentucky	M	M	L
Broccoli	H	H	H
Brussels Sprouts	H	H	H
Buck Wheat	M	L	L
Cabbage, Early	VH	VH	VH
Cabbage, Late	H	H	H
Carrots, Early	H	H	H
Carrots, Late	M	M	M
Cauliflower, Early	VH	VH	VH
Cauliflower, Late	H	H	VH
Celery, Early	VH	VH	VH
Celery, Late	H	VH	H

Plant/Crop	N	P	K
Clover, Alsike	L*	M	M
Clover, Ladino	L*	M	M
Clover, Red	L*	H	H
Clover, Wild White	L*	M	M
Corn, Field	M	M	M
Corn, Sweet, Early	H	H	H
Corn, Sweet, Late	M	M	M
Cotton	H	M	M
Cucumbers	H	H	H
Deciduous Plants	M	L	L
Deciduous Shrubs	M	M	L
Deciduous Trees	M	L	L
Egg Plant	H	H	H
Evergreen Plants	L	L	L
Evergreen Trees	L	L	L
Flowers, Annual	H	H	H
Flowers, Perennials & Bulbs	M	M	M
Grapes	M	M	M
Grasses, Mixed	M	L	L
Grasses, Fairways & Lawns	M	M	L
Grasses, Putting Greens	H	L	L
Lettuce, Head	VH	VH	VH
Lettuce, Leaf	H	VH	VH
Millet	M	L	M
Muskmelons	H	H	H
Oats	H	M	M
Onions	H	H	H
Orchard Grass	M	M	M

Plant/Crop	N	P	K
Parsnips	M	M	M
Peaches	M	L	M
Pears	M	L	L
Peas, Early	M	H	H
Peas, Field, Canada	L*	M	M
Potatoes, Early	VH	VH	VH
Potatoes, Late	H	VH	VH
Potatoes, Sweet	L	M	H
Pumpkins	M	M	M
Radishes	H	VH	VH
Raspberries	L	L	L
Rhubarb	H	H	H
Rutabagas	M	H	M
Rye	M	L	L
Rye Grass	M	L	L
Soybeans	L*	M	M
Spinach	VH	VH	VH
Squash, Early	H	H	H
Squash, Late	M	M	M
Strawberries	M	M	L
Timothy	M	L	M
Tobacco	VH	M	VH
Tomatoes, Early	M	H	H
Tomatoes	H	H	H
Turnips	L	M	M
Vetch, Hairy	L*	M	M
Watermelons	M	M	M

5.2. CONVERSION CHART

If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	2.54	centimeters	centimeters	0.04	inches
feet	30	centimeters	centimeters	0.4	feet
yards	0.91	meters	meters	3.3	yards
miles	1.6	kilometers	kilometers	0.62	miles
Area			**Area**		
sq. inches	6.5	sq. centimeters	sq. centimeters	0.16	sq. inches
sq. feet	0.09	sq. meters	sq. meters	11.1	sq. feet
sq. yards	0.8	sq. meters	sq. meters	1.2	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.4	hectares	hectares	2.47	acres
Mass (Weight)			**Mass (Weight)**		
ounces	28	grams	grams	0.035	ounces
pounds	0.45	kilograms	kilograms	2.2	pounds
short tons	0.9	metric tons	metric tons	1.1	short tons

If you know	Multiply by	To get
Volume		
teaspoons	5	milliliters
tablespoons	15	milliliters
fluid ounces	30	milliliters
cups	0.24	liters
pints	0.47	liters
quarts	0.95	liters
gallons	3.8	liters
cubic feet	0.03	cubic meters
cubic yards	0.76	cubic meters
Temperature		
Fahrenheit	Subtract 32, then multiply by 5/9ths	Celsius

If you know	Multiply by	To get
Volume		
milliliters	0.03	fluid ounces
liters	2.1	pints
liters	1.06	quarts
liters	0.26	gallons
cubic meters	35	cubic feet
cubic meters	1.3	cubic yards
Temperature		
Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

6. TEST REPORT MODEL

Make photocopies of this Test Report Model and use them for your periodical reports.

milwaukee	Soil and/or Well Water Test Report
Sample #, Grid #, or Location Reference of Test Sample:	
Date This Sample Taken: / /	Date This Sample Tested: / /
Past Management at this location – Last Action Taken: *(fertilization, sub-soiling, liming, irrigation, etc)*	
Well Water pH Test Results:	Soil pH Test Results:
Conductivity (EC) General Nutrients Reading Results:	
Comments / Action Taken:	

NPK Soil Test Kit Results		
Test for	**Test Results**	**Comments or Action to Be Taken**
Nitrogen (N) Phosphorus (P) Potassium (K)		
Schedule of Next Test Date: / /		
General Comments:		

Milwaukee Instruments reserves the right to make improvements in design, construction and appearance of its products without advance notice.

THANK YOU FOR CHOOSING

Sales and Technical Service Contacts:

Milwaukee Electronics Kft.
Alsó-kikötő sor 11C
H-6726 Szeged - HUNGARY
tel: +36 62 428 050
fax: +36 62 428 051
www.milwaukeeinst.com
e-mail: sales@milwaukeeinst.com

Milwaukee Instruments, Inc.
2950 Business Park Drive
Rocky Mount, NC 27804 USA
tel: +1 (252) 443-3630
fax: +1 (252) 443-1937
www.milwaukeeinstruments.com
e-mail: sales@milwaukeeinstruments.com

MANMT6003