Instruction Manual

HI 99121
Soil pH
Test Kit

HANNA instruments

ISO 9000 Certified Company since 1992

http://www.hannainst.com

Dear Customer,

Thank you for choosing a Hanna Product. Please read the instruction manual carefully prior to use. It will provide you with necessary information for the correct use of the kit.

Remove the test kit from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, notify your Dealer or the nearest Hanna office immediately.

Each kit is supplied with:

- HI 991000 portable pH meter
- HI 1292D pH electrode
- HI 721319 soil drill
- HI 7051M soil preparation solution
- HI 70004 buffer solution pH 4.01 (1 pc.)
- HI 70007 buffer solution pH 7.01 (1 pc.)
- HI 721312 hard carrying case
- HI 740036 100 ml plastic beaker (1 pc.)

Note: Any damaged or defective item must be returned in its original packing materials.

Note: Read the HI 991000 instruction manual to ensure correct use of the meter.

SOIL pH

pH is the measure of the hydrogen ion concentration $[H^+]$. Soil can be acid, neutral or alkaline, according to its pH value.

Fig. 1 shows the relationship between the scale of pH and types of soil. Most plants prefer a pH range from 5.5 to 7.5; but some species prefer more acid or alkaline soils. Nevertheless, every plant requires a particular range of pH, for optimum growth.

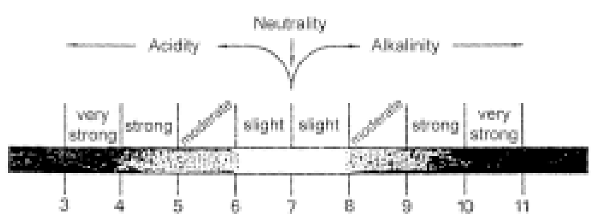

Fig. 1. Types of soil according to the pH value

pH strongly influences the availability of nutrients and the presence of micro-organisms and plants in the soil.

For example, fungi prefer acidic conditions whereas most bacteria, especially those supplying nutrients to the plants, have a preference for moderately acidic or slightly alkaline soils. In fact, in strongly acidic conditions, nitrogen fixing and the mineralization of vegetable residual is reduced.

Plants absorb the nutrients dissolved in the soil water and the nutrient solubility depends largely on the pH value. Hence, the availability of elements is different at different pH levels (Fig. 2).

Each plant needs elements in different quantities and this is the reason why each plant requires a particular range of pH to optimize its growth.

For example, iron, copper and manganese are not soluble in an alkaline environment. This means that plants needing these elements should theoretically be in an acidic type of soil. Nitrogen, phosphorus, potassium and sulfur, on the other hand, are readily available in a pH range close to neutrality.

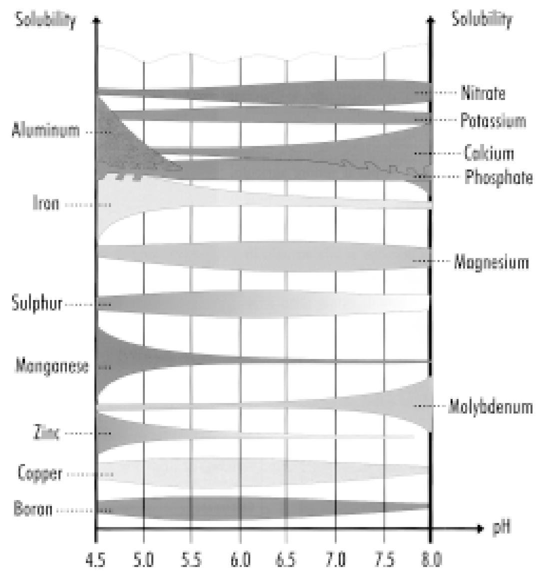

Fig. 2. Solubility of the elements according to varying pH values

Furthermore, abnormal pH values, increase the concentration of toxic elements for plants. For example, in acid conditions, there can be an excess of aluminum ions in such quantities that the plant can not tolerate.

Negative effects on chemical and physical structure are also present when pH values are too far from neutral conditions (break up of aggregates, a less permeable and more compact soil).

Management of the soil in relation to the pH value

Once the pH value is known, it is advisable to choose crops that are suitable for this range (e.g. in an acid soil, cultivate rice, potato, strawberry).

Add fertilizers that do not increase acidity (for example urea, calcium nitrate, ammonium nitrate and superphosphate) or lower alkalinity (e.g. ammonium sulfate).

It is recommended that a cost evaluation is made prior to commencement of the soil pH modification. Corrective substances can be added to modify the soil pH, however, the effects are generally slow and not persistent. For example, by

adding lime, the effects in clay soil can last for as long as 10 years, but only 2-3 years in a sandy soil.
For an acid soil, we can use substances such as lime, dolomitic, limestone and marl, according to the nature of the soil (Tab.1).

Soil Ameliorants	Clay soil	Silty soil	Sandy soil
CaO	30-50	20-30	10-20
$Ca(OH)_2$	39-66	26-39	13-26
$CaMg(CO_3)_2$	49-82	33-49	16-33
$Ca\ CO_3$	54-90	36-54	18-36

Tab.1. Quantity (q/ha) of pure compound necessary to increase 1 unit of pH

High pH levels can depend on different elements, hence, there are different methods for its correction.
- Soils rich with limestone :
Add organic matter (this is due to the fact that non-organic ameliorants such as sulfur and sulfuric acid might not make economic sense due to the large quantities needed).
- Alkaline-saline soils :
Alkalinity is due to the presence of salts (in particular a high concentration of sodium can be harmful).
Irrigation washes away salts, hence, an appropriate use of irrigation can provide positive results (drop-irrigation being the most recommended).
If alkalinity is caused by sodium, it is recommended to add substances such as gypsum (calcium sulfate), sulfur or other sulfuric compounds (Tab.2). Also in this case, a cost evaluation is necessary.

Soil ameliorants (pure compounds)	Quantity (Kg)
Calcium chloride: $CaCl_2 \cdot 2H_2O$	85
Sulfuric acid: H_2SO_4	57
Sulfur: S	19
Iron sulfate: $Fe_2(SO_4)_3 \cdot 7H_2O$	162
Aluminum sulfate: $Al_2(SO_4)_3$	129

Tab.2. Quantities provide the same result as 100 Kg of gypsum

Procedure for direct ground measurement

1) Dig, discarding 5 cm of topsoil
2) Perforate the soil (with HI 721319 soil drill) to a depth of about 20 cm or more
3) If the soil is dry, moisten it with a small amount of distilled water

4) Wash the electrode with tap water (not distilled)
5) Insert the electrode pushing it slightly into the soil to ensure proper contact
6) Observe the measurement
7) Wash the electrode with tap water (not distilled) and (using a finger) gently remove any soil remaining on the electrode (avoid using a rag or cloth)
8) Repeat the procedure in different locations in the field
9) Consider the average of the measured data

For best result, it is advisable to measure the pH of a soil solution, using a sample of soil and soil preparation solution HI 7051; it is better to use this procedure if you have to test a stony field in which you risk damaging the electrode.

Procedure for the measurement of soil solution (1:2,5)

A) Sampling

1) Extracting Soil Sample
   Take 1 sample per 1000 m^2 (0.25 acre) of homogeneous area
   Even for small areas, 2 samples are recommended (the more the samples, the better the end-results, because the result is more representative)
2) Avoid extracting samples from soil presenting obvious anomalies and consider them separately
3) Sample quantity:
   Take the same quantity of soil for each sample. For example, use bags with similar dimensions (1 bag per sample)
4) Depth of extraction:
   General: dig and discard 5 cm (2") of topsoil
   Herbaceous crops: from 20 to 40 cm of depth (8" to 16")
   Orchards: from 20 to 60 cm of depth (8" to 24'')
5) Spread the soil samples on the pages of a newspaper and let the soil dry in a shady place or put it in an oven at 40° C
6) Crumble the dried soil and mix all the samples together to obtain a homogeneous mixture, discarding stones and vegetable residues
7) From this mixture, take the soil sample for analysis

B) Soil solution preparation and measurement

1) Sift the soil at 2 mm
2) Weigh 10 gr of soil and put it in 25 ml of soil preparation solution HI 7051 (utilize the apposite beaker) or 20 gr of soil per 50 ml of soil preparation solution HI 7051
3) Mix for 30 seconds
4) Wait 5 minutes
5) Mix again and measure the pH of the solution

ORGANIC SUBSTRATE (PEAT AND MOULD)

pH measurement of organic substrates is important in greenhouses and nursery growing pots. pH should be checked at the outset to make sure that the pH of the substrate bought is that desired (pH can change if too much time elapses from the date of packaging to the moment of utilization).

A) Direct Measurement in pot

If the substrate is not wet, add a little distilled water. Insert the electrode into the soil and measure.

B) Measurement of the Organic Substrate Solution (1: 2 ratio).

Let the substrate dry;
Discard the coarse vegetable residues and pebbles;
In a beaker, prepare a solution composed of 1 part mould and 2 parts HI 7051 solution (for example: fill the beaker with the substrate up to 50 ml, press it gently, empty the content in an other container and add 100 ml of HI 7051 solution);
Mix for 30 seconds and then wait for 5 minutes;
Mix again and measure the pH of the solution.

IRRIGATION WATER

The quality of irrigation water is a very important factor to consider. If the pH value is very far from neutral (pH = 7), probably, other anomalies are present.
Ranges for evaluation of water quality:
- good from 6 to 8,5
it can be utilized without problems
- sufficient from 5 to 6 and from 8,5 to 9
sensible crops could have problems
- scarce from 4 to 5 and from 9 to 10
utilize it carefully, avoid wetting the vegetation
- very scarce with pH $<$ 4 and pH $>$ 10
There are other anomalies that have to be identified via chemical analysis.

NUTRIENT SOLUTION

A rational fertilization is needed for optimum growth of plants in greenhouses; the pH of a nutrient solution (water + fertilizer) has to meet the plants need.
If you have a fertirrigation system with automatic pH control, ensure that it is functioning properly.
Check the pH of the solution distributed to the plants as well as any recycled solutions.

ORCHARD PLANTS

	Preferred pH Range		Preferred pH Range
Apple	5-6.5	Orange	5-7
Apricot	6-7	Peach	6-7.5
Cherry	6-7.5	Pear	6-7.5
Grapefruit	6-7.5	Plum	6-7.5
Grapevine	6-7	Pomegranate	5.5-6.5
Lemon	6-7	Walnut	6-8
Nectarine	6-7.5		

VEGETABLES AND HERBACEOUS CULTIVATIONS

	Preferred pH Range		Preferred pH Range
Artichoke	6.5-7.5	Pepper	6-7
Asparagus	6-8	Early Potato	4.5-6
Barley	6-7	Late Potato	4.5-6
Bean	6-7.5	Sweet Potato	5.5-6
Brussels Sprout	6-7.5	Pumpkin	5.5-7.5
Early carrot	5.5-7	Rice	5-6.5
Late carrot	5.5-7	Soybean	5.5-6.5
Cucumber	5.5-7.5	Spinach	6-7.5
Egg Plant	5.5-7	Strawberry	5-7.5
Lettuce	6-7	String	6-7.5
Maize	6-7.5	Sugar beet	6-7
Melon	5.5-6.5	Sunflower	6-7.5
Oat	6-7	Tomato	5.5-6.5
Onion	6-7	Watermelon	5.5-6.5
Pea	6-7.5	Wheat	6-7

LAWN

	Preferred pH Range
Lawn	6-7.5

GARDEN PLANTS AND FLOWERS

	Preferred pH Range		Preferred pH Range
Acacia	6-8	Ligustrum	5-7.5
Acanthus	6-7	Magnolia	5-6
Amaranth	6-6.5	Narcissus	6-8,5
Bougainvillea	5.5-7.5	Oleander	6-7.5
Dahlia	6-7.5	Oleander	6-7.5
Erica	4.5-6	Paulownia	6-8
Euphorbia	6-7	Portulaca	5.5-7.5
Fuchsia	5.5-7.5	Primula	6-7.5
Gentian	5-7.5	Rhododendron	4.5-6
Gladiolus	6-7	Roses	5.5-7
Hellebore	6-7.5	Sedum	6-7.5
Hyacinth	6.5-7.5	Sunflower	5-7
Iris	5-6.5	Tulip	6-7
Juniper	5-6.5	Viola	5.5-6.5

HOUSEPLANTS

	Preferred pH Range		Preferred pH Range
Abutilon	5.5-6.5	Gardenia	5-6
African violet	6-7	Geranium	6-8
Anthurium	5-6	Hibiscus	6-8
Araucaria	5-6	Jasmine	5.5-7
Azalea	4.5-6	Kalanchoe	6-7.5
Begonia	5.5-7.5	Mimosa	5-7
Camellia	4.5-5.5	Orchid	4.5-5.5
Croton	5-6	Palms	6-7.5
Cyclamen	6-7	Peperomia	5-6
Dieffenbachia	5-6	Philodendron	5-6
Dracaena	5-6	Yucca	6-7.5
Freesia	6-7.5		

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