Guide to Laboratory Establishment for Plant Nutrient Analysis

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Preface

This publication provides practical guidelines on establishing service laboratories for the analysis of soil, plants, water and fertilizers (mineral, organic and biofertilizers). A service laboratory needs information on a methodology that is widely acceptable, taking into consideration the ready availability of chemicals, reagents and instruments while ensuring a reasonable degree of accuracy, speed and reproducibility of results. The method needs to be easy to understand for practising technicians who are required to adopt it in a routine manner.

A manual, with simple procedural steps, is considered as providing the best help to the laboratory technicians. This publication provides various analytical methods for estimating soil constituents with the objective of assessing soil fertility and making nutrient recommendations. It describes methods for analysing plant constituents in order to determine the content of various nutrients and the need for their application. For assessing the quality of irrigation water, it presents standard methods for estimating the various parameters and constituents utilized,

e.g. electrical conductivity, sodium adsorption ratio, residual sodium carbonate, the ratio of magnesium to calcium, and boron content. In providing the methodology for fertilizer analysis, special consideration has been given to the fact that fertilizers are often statutorily controlled commodities and are traded widely among countries.

This guide also examines biofertilizers. It discusses the bacterial cultures that serve either as a source of nitrogen, such as *Rhizobium*, *Azotobacter* and *Azospirillum*, or for improving the availability of soil phosphorus, such as phosphate-

solubilizing microbes. It provides methods for their isolation, identification, multiplication and commercial production. The Reference section includes sources for further detailed information.

This guide details the equipment, chemicals and glassware required in order to establish a composite laboratory with facilities for soil, water and plant analysis. Similarly, it details the requirements for establishing a fertilizer testing laboratory and a biofertilizer testing/production laboratory. To save on the cost of some of the common equipment, facilities and supervision, the analytical facilities required for various materials can be combined. However, it is necessary to ensure that no contamination of the soil by the fertilizers or vice versa takes place. In view of this, even in a composite laboratory (which is otherwise desirable), it is necessary to keep rooms for processing and handling different types of samples separate from one another, while keeping them in close proximity in order to save on time for movement and supervision. The guide takes these considerations into account.

This publication should prove useful to administrators and planners in establishing laboratories, and to technicians through providing detailed and precise procedures for estimations.

List of acronyms, abbreviations and chemical symbols

AAS	Atomic absorption spectrophotometer
Al	Aluminium
AOAC	Association of Official Analytical Chemists, the United States of America
AR	Analytical reagent
As	Arsenic
B	Boron
BAC	Benzalkonium chloride
BGA	Blue-green algae
BOD	Biochemical oxygen demand
C	Carbon
Ca	Calcium
CEC	Cation exchange capacity
Cl	Chlorine
Co	Cobalt
COD	Chemical oxygen demand
CP	Chemically pure
CRYEMA	Congo red yeast extract mannitol agar
Cu	Copper
DAP	Di-ammonium phosphate
DDW	Double-distilled water
DTPA	Diethylenetriamine pentaacetic acid
EBT	Eriochrome Black T
EC	Electrical conductivity
EDTA	Ethylenediamine tetraacetic acid
Eq W	Equivalent weight

Fe	Iron
GLP	Good laboratory practice
H	Hydrogen
H2SO4	Sulphuric acid
HCl	Hydrochloric acid
HEPA	High-efficiency particulate air
Hg	Mercury
ICP	Inductively coupled plasma
ICP–AES	Inductively coupled plasma – atomic emission spectroscopy
INM	Integrated nutrient management
IPE	International Plant Analytical Exchange
ISE	International Soil Analytical Exchange
ISO	International Organization for Standardization
K	Potassium
LR	Laboratory reagent
M	Molar
MARSEP	International Manure and Refuse Sample Exchange Programme
mcf	Moisture correction factor
me	Milli-equivalent
mEq W	Milli-equivalent weight
Mg	Magnesium
Mn	Manganese
Mo	Molybdenum
MOP	Muriate of potash
N	Nitrogen
NaOH	Sodium hydroxide
Ni	Nickel
O	Oxygen
OM	Organic matter
P	Phosphorus
PSM	Phosphate-solubilizing micro-organism
RSC	Residual sodium carbonate
S	Sulphur

SAR	Sodium adsorption ratio
Se	Selenium
SETOC	International Sediment Exchange for Tests on Organic Contaminants
SOM	Soil organic matter
SOP	Standard operating procedure
SOP	Sulphate of potash
SSP	Single superphosphate
STPB	Sodium tetraphenyl boron
TEA	Triethanolamine
UV	Ultraviolet
WEPAL	Wageningen Evaluating Programme for Analytical Laboratories
WHC	Water holding capacity
YEMA	Yeast extract mannitol agar
Zn	Zinc