2. Laboratory Facilities, Quality Control and Data Handling

2.1. Laboratory Organization

Soil, plant, and water analyses are carried out by various institutions in the public or government sector, as well as in the private domain. Laboratories are operated by several entities, including Ministries of Agriculture, National Research and Teaching Institutes, International Organizations, and Commercial Companies.

To be much effective, analytical services should be closely linked to the extension/advisory services and should maintain a functional relationship with the universities and research stations. The kind of facility for such analyses depends on the type of institution it serves, the nature of the clientele, and the volume of samples to be analyzed. Nevertheless, all laboratories, regardless of the size, should be designed in a manner to facilitate operational efficiency, minimizes contamination, and produces reliable and repeatable results.

Various publications deal with management considerations in the design and operation of soil testing (e.g., Walsh and Beaton, 1973). While the advantages of standardized laboratory designs are self-evident, many laboratories in the WANA region have apparent deficiencies in this respect (Ryan, 2000; Ryan et al., 1999). All too often one sees soil samples stored or, worse still, ground in wet chemistry laboratories. Similarly, many laboratories are set up in a manner that inadvertently hinders efficient use of staff resources.

Soil, plant and water analysis facilities should be located in the same building and be under one unified administration. The Soil, Plant, and Water Analysis Laboratory of ICARDA was designed in the 1980 with these considerations in mind. The various components of the laboratory reflect a logical activity framework. While no two laboratories are ever the same or have the same complement of equipment, the details presented for ICARDA's laboratory will, hopefully, serve as a general guideline for laboratory arrangement and the type of equipment needed for routine service-oriented operations.

The Soil, Plant and Water Analysis Laboratory of ICARDA is represented in the following parts:

1. ***Soil Preparation Room***

Where large bulk samples, transported by truck, are received, dried and sieved. This facility is equipped with a large-capacity oven, freezers, soil grinder, containers and trays, stainless steel soil sieve sets, vacuum pumps, sample dividers, different types of soil sampling (augers, spade, and metal rings), exhaust hood, and a compressed-air machine. Soil samples (~0.5 kg) are dried and placed in clean containers and then transferee to the soil testing laboratory for requested analysis.

2. ***Soil Store Room***

Where all samples are retained for at least 2 years after analysis; bulk samples of special soil types are kept indefinitely. An inventory or catalogue of all soil samples is maintained.

3. ***Freezer Room***

In some cases it is necessary to temporarily store large numbers of samples in cold conditions, such as a freezer room, pending analysis; without such conditions, any delay in analysis would result in bacterial changes in soil samples that would invalidate the analytical results.

4. *Chemical Analysis Room*

The chemical analysis room is where the sub-sample of dried soil is received in the soil testing laboratory for requested analyses. This facility is normally has various equipment, such as N digestion/distillation, CN-elemental analyzer, flame photometer, spectrophotometer, pH meter, and conductivity meter.

The more traditional analytical processes of weighing, stirring, shaking, filtering under suction, heating, drying, incubating and centrifuging are done almost exclusively with the aid of electrical machines and devices. In addition, for the digestion and preparation of reagents, chemicals carry out in the Fume Hood.

5. *Instrument Room*

This is where soil extraction, where necessary, is carried out for analysis. This facility is normally equipped with various equipment, e.g., atomic absorption spectrophotometer, computer, refrigerator, etc.

6. *Physical Analysis Room*

This is where the dried soil sub-samples are received in the soil testing laboratory for requested analyses. This facility is equipped with various equipment, such as pF instrument for field capacity and permanent wilting point, soil dispersing stirrer (a high-speed electric stirrer with a cup receptacle) for particle size distribution, aggregate stability (for wet and dry methods) instruments, balances, permeability apparatus, and water bath.

7. Water Analysis Room

In this room the more traditional analytical processes are carried out, e.g., pH, electrical conductivity, and anions and cations.

General Equipment

Various items of equipment and associated furnishings are generally found in soil, plant and water analysis laboratories, as indicated as follows:

- Laboratory working tables
- Appropriate racks
- Weighing benches
- Cupboards
- Laboratory desks and chairs
- Fixed suction unit
- Fume hood or exhaust systems mounted above the flame photometer, atomic absorption spectrometer, muffle furnace, and Kjeldahl digestion
- Washing-sinks for cleaning glassware
- Drawing desk facilities for storing standard forms and documentation