CHAPTER - II

Scope and Object of the present investigation

The importance of the humus in soils is shown by the fact that the cation exchange capacity can be reduced by as much as 20 to 50 percent with the removal of this organic component, even though it constitutes a negligible fraction of the total soil mass. The humic and fulvic acids are the essential components of soil humus and play a predominant role in the weathering process. These substances are also involved in the migration and subsequent deposition of minerals in soils. In recent years the importance of the organo-metallic complex in leaching and podzolization of soils has been felt by different researchers. The availability of micronutrients (e.g., Cu, Zn, Ni, Co, Mn etc.) to plants and microorganisms is greatly influenced by the complexing of the metal ions with the humic materials. The vexing problem associated with the introduction of certain toxic heavy metals (Pb, Cd, Hg, etc.) in the environment has attracted many soil scientists to study the interaction of these toxic metals with humic acid fractions. As a result, any investigation on the interaction between soil-organic matter and metal ions, the micronutrients and the toxic metals in particular, is of great interest for the soil scientists and the environmental chemists as well.

By virtue of the existence of charged sites in their polymeric structure these weakly acidic substances exhibit interesting properties of the class of compounds commonly known as polyelectrolytes. Numerous attempts have been made

to reveal the physico-chemical properties of this group of natural polyelectrolytes (soil organic matter) as well as the behaviour of different inorganic and organic cations towards them.

Most of the workers in this field are of the opinion that humic and fulvic acids contain a number of functional groups responsible for acidity, various spectral and electro-chemical behaviour and complex formation with the metal ions. Much is yet to be known about the nature of the functional groups and the structure of these natural macromolecular polyelectrolytic substrates. It may be pointed out that lack of this information has made it difficult to have a clear understanding about their mode of interaction with the poly-valent cations.

It is well known that the variation of soil conditions (e.g., altitude, temperature, moisture content etc.) may have a marked effect on the physico-chemical characteristics of the humus in the soil. Little information is available on the soil humus of the eastern Himalayan region particularly in respect of their distribution in soils and their physico-chemical properties.

Keeping all these in view, the present work has been undertaken. The work has been divided in the following parts:

1. Eleven soil samples, three from the foot-hill and the remaining from the high altitude places of the Himalayas, have

been processed and characterised in respect of their distribution and the specific nature of the organic components present therein. The data have been analysed in the light of our upto date knowledge on the physical chemistry of soil organic components.

2. Humus has been isolated from two soil samples amongst the above soils studied with a wide difference in their ecological status, one from Raja-Rammohanpur situated at the foothill of the Himalayas and the other from Sandakphu, a hill station (altitude-11200 ft). Other sources include a peat humic acid sample (supplied by Fluka, AG) and a synthetic model humic acid as obtained in the laboratory. Two of the above humic acids viz., Raja-Rammohanpur soil humic acid and the peat humic acid have been methylated selectively (using dimethyl sulphate) and incorporated in the present investigation in order to have an idea about the contribution of different acidic groups of this organic soil component to the total acidity and their complexing properties with reference to some divalent heavy metal ions. With these samples following studies have been carried out.

(i) Characterisation of the humic and fulvic acids by

(a) Visible spectrophotometric investigation.

(b) Infra-red spectra.

(c) Viscosity measurements.

(d) Polarography.

(e) Potentiometric titrations of these samples both in presence and in absence of neutral salts.

(ii) Studies on the interaction of the above mentioned humic and fulvic acid samples with six divalent metal ions, four of which are known to be important micro-nutrients (Zn^{++}, Co^{++}, Ni^{++} and Cu^{++}) and the remaining two with well known toxic (Pb^{++} and Cd^{++}) properties. A simple potentiometric method has been adopted and the stability data for these metals with the humic and fulvic acids have been evaluated.