Photosynthesis is an important biochemical event in which light energy is absorbed and converted into stable chemical potential by synthesizing the organic compounds. The process occurs in three stages. 1. The absorption of light and retention of light energy. 2. The conversion of light energy into chemical potential. 3. The stabilization of storage and chemical potential. The end product and the intermediates formed in this process are used for the synthesis of metabolic constituents, growth and dry matter production.

The economic yield of the commercial crop depends upon the amount of photosynthate that is produced and its subsequent partitioning into economic plant parts. Thus, photosynthesis is one of the major parameters though not the only parameter related to yield. The differences in yield potential could reflect on differences in varietal photosynthetic efficiency. Hence, identification and study of variation of these characters among varieties/genotypes is of practical importance.

It is well known that sugarcane is highly efficient in its dry matter production. The C$_4$ dicarboxylic acid pathway operating in this plant makes it photosynthetically efficient compared to C$_3$ plants. However it is of interest to know whether wide variation exists within the same sugarcane variety/genotypes and among different
species of *Saccharum* for exploitation in the breeding programme. The efficiency of the process is determined by the amount of photosynthate produced. This is governed by various morphological, anatomical, physiological and biochemical parameters like the efficiency of ribulose bisphosphate carboxylase, phosphoenol pyruvic carboxylase, the pigment system that captures the solar energy for production of reductant and energy, the rate at which gaseous diffusion takes place, the carbon dioxide concentration built up inside the mesophyll and bundle sheath cells and the proximity of carbon dioxide concentration to the reaction site etc. Growth analysis is one of the simple methods to assess the photosynthetic potential of a variety. Estimation of growth determinants like net assimilation rate (NAR), relative Growth Rate (RGR), crop growth rate (CGR) is useful in this regard. These factors have a bearing on yield potential and correlation of these factors with photosynthesis and ultimate yield of a variety is useful.

In view of the above interrelated phenomena the present investigation was undertaken to study the variation in photosynthesis and its related parameters in 12 varieties/genotypes of sugarcane comprising of different *Saccharum* species, IA clones and commercial hybrids choosing two from each group. The following physiological parameters were studied in these genotypes at the formative, grand growth, and maturity stages (a) Net carbon exchange (NCE), (b) Leaf diffusive resistance (c) Estimation of pigments (Chlorophyll a, b and
Carotenoids), (d) Spectral analysis of leaf segments (e) Hill reaction activity (f) Photosystem I activity (g) Phosphoenol pyruvate (PEP) carboxylase activity. Growth analysis and dry matter partitioning were also studied at the above growth stages. Leaf anatomical characters reflecting on photosynthetic efficiency were studied at the grand growth stage. Yield and quality characters were recorded at the time of harvest (12 months age). Correlation of the above characters with ultimate yield and dry matter production was also made.

The prime object of the investigation is to study the variation of photosynthesis and the physiological, biochemical and anatomical parameters associated with it and to study its contribution and relationship if any to the ultimate yield and dry matter production in the sugarcane genotypes.