A Survey of Nodulation Among Leguminous Plants

O. N. Allen and Ethel K. Allen

The literature concerning the symbiosis between leguminous plants and the root nodule bacteria presents today an impressive assemblage of experimental facts and significant accomplishments. In the wake of these endeavors the opinion is occasionally expressed that this field of study no longer enjoys the fertility in research possibilities that it had several decades ago. This report pertains to only two major categories of experimentation in which fruitful work remains to be done. The discussion that follows is a generalized account of developments rather than an elaboration of detailed information. Similarly, it does not present an extensive list of references, since it is assumed that the specialized group of investigators for whom this information is primarily intended is well versed in the panoramic background of research achievements.

Since it is commonly assumed that all members of the family Leguminosae bear nodules, provided that they are exposed to the proper bacteria, the first objective in this survey was to ascertain to what extent this assumption is true. Interest in nodulation studies until recent years has centered almost entirely upon cultivated leguminous plants common to temperate regions. The primary source of this information was the technical papers from centers of specialized research, botanical gardens, universities, and experiment stations throughout the world. Other data were obtained by observing personally leguminous species growing in greenhouses, natural habitats, and arboretae. Supplementary facts were contributed through personal communications from botanists and bacteriologists whose environs are rich in leguminous flora. In practically all instances where questions have arisen as to the identity of nodules on root systems, investigators have kindly sent specimens into our laboratory for a more critical examination.

The second objective was to effect a census-taking of the leguminous plants which have been used in cross-inoculation, or multiple host plant inoculation, studies. This objective was prompted by recent data evidencing promiscuity in the infective ability of the rhizobia. All information pertaining to this topic was obtained from technical reports.

Certain difficulties were encountered in this survey as a result of the frequent use by investigators of only the common names of plants employed in their studies. Recourse in such instances has been either to communicate directly with the authors, or competent botanists in the particular areas, or to review carefully the flora of the respective regions. The scientific names of all plants have been indexed in Index Kewensis, or the Gray Herbarium catalogue, in order to avoid duplication. For example, the generic names, Sesbania, and Glottidium, are synonymous with the generic name Sesbania. Similarly, the Vicia has preferred usage over the generic term. For convenience, the taxa of Engler and Prantl (3) was followed in identifying the plant species.

The data presented in this survey is divided into three periods which were determined or less by the trends in research development, although it is admitted that in any allocation of scientific data into eras, calendar limits are arbitrary. The first period, which has its beginning, is considered to terminate with the contributions of Garman and Didlake, Simon, and others whose results established a cross-inoculation concept, despite the reporting evidence in varying degrees contributed earlier. The second period, 1921-1947, is considered in this report as the "cross-inoculation era." During this period the number of inoculation groups was increased from 6 to about 16, in conjunction with considerable attention being attracted to the cowpea group because of its productive to the large numbers and the botany of species. The current period, 1930-47, is characterized by reports of irregularities in the infective capacities of rhizobia as species specificity is being questioned.

THE OCCURRENCE OF NODULES

Although the first published picture of nodules appeared in Fuchs' De Historia Stirpium Insignes in 1542, it was not until the last century that investigators fully appreciated and its role in the growth of legumes. It is not surprising therefore that between 1900 scientific workers throughout