ABSTRACT

An ultrastructural study was made of Peltigera canina, P. rufescens and P. spuria collected in different seasons. Cellular and subcellular changes were observed in the Nostoc symbionts when cultured. In comparison with the lichenized state, cultured Nostoc cells showed an increase in the thickness of their gelatinous sheath. The sheath contained gelatinous fibers, bacterial cells and vesicles similar to those found in free-living forms. Cultured Nostoc cells were rounded when they occured as single cells but broader than long when the cells were joined in a chain. There was a remarkable decrease from the lichenized state in the size of Nostoc cells in culture. Nostoc of the three Peltigera species, when cultured in Bold's Basal medium with 1N nitrogen concentration, showed a decrease in heterocyst frequency from the lichenized forms.

At the subcellular level, the most apparent differences between lichenized and cultured Nostoc cells of the three Peltigera species was the arrangement and amount of thylakoid membranes. In lichenized Nostoc cells of P. canina and P. rufescens, many thylakoid membranes were observed and were distributed irregularly throughout the cell producing many areas of nucleoplasm. In contrast, in the cultured forms the thylakoids were fewer and arranged parallel to the cell wall forming distinct areas of chromatoplasm and nucleoplasm. In lichenized Nostoc of P. spuria, only a few thylakoid membranes were observed parallel to the cell wall while in cultured cells the thylakoids were arranged in such a manner as to make many whorls with intrathylakoidal spaces. The Nostoc photobiont of P. spuria seemed to be a different species than those of the other two Peltigera species. Plastoglobuli were found in both lichenized and cultured states. A decrease in the amount of cyanophycin granules and polyhedral bodies and an increase in the amount of polyglucoside granules was observed in cultured forms of Nostoc in comparison with those in lichenized states.

Many types of photobiont-mycobiont interactions were found in the same species of Peltigera during the same season. In comparison with those of P. canina and P. spuria, the symbionts of P. rufescens were closely pressed together, a condition that could be due to the exposed habitat of that species. Intracellular haustoria were absent while intrawall haustoria and protuberances were found in all three Peltigera species. Many modifications in the fungal hyphae were observed which appeared to compensate for the absence of intracellular haustoria. Invagination of the plasmalemma and crenulation of the outer layer of the cell wall of the fungal hyphae were observed which could favor the exchange of metabolic substances between the symbionts.

The seasonal changes in the number and size of subcellular structures and storage bodies in lichenized Nostoc cells of the three Peltigera species were consistent with previous reports of seasonal differences in the capacity of nitrogen fixation and photosynthesis in the Peltigera species. One interesting finding of my study was that cyanophycin granules (which contain reserves of nitrogen) were completely absent in Nostoc cells of P. canina in the winter, present in summer and abundant in the spring and fall. This finding correlates well with the seasonal changes in nitrogen fixation which occur in that species of Peltigera, as reported by many workers. Similar correlations were found between changes in the amount of polyglucoside granules (which contain reserves of glycogen), polyhedral bodies (carboxysomes) and the seasonal activities of photosynthesis in Peltigera species.

TABLE OF CONTENTS