

STARCH-FILLED NODULAR HYPERTROPHIES IN *TRIBULUS TERRESTRIS*

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Legume-type nodules have been reported in members of Zygophyllaceae but the information is scanty and there is a discrepancy in the literature. The endophyte has been variously classified as fungal (Issaschenko, 1913) or rhizobial (Sabet, 1946; Mostafa & Mahmoud, 1951; Athar & Mahmood, 1972) in nature. Although there have been many physiological studies of Zygophyllaceous nodules concerning fixation of nitrogen and relationship of nodulation to the interaction of soil water contents and temperature (Sabet, 1946; Mostafa & Mahmoud, 1951; Montasir & Sidrak, 1952), but there seems to be no comparative morphological, anatomical and developmental studies of lateral rootlets and nodular hypertrophies. This prompted the authors to investigate Zygophyllaceous members of Pakistan and the present short communication is a preliminary report of a survey of well grown specimens of *Tribulus alatus*, *T. terrestris*, *Zygophyllum atriplicoides*, *Z. simplex*, *Peganum harmala* and *Fagonia cretica*, all thriving as xerophytic shrubs or herbs in wastelands of Lahore, Multan, Islamabad, Karachi and Quetta areas. The root samples were collected mainly during the summer (June-August) of 1971 and 1972.

No root nodules were observed on the specimens examined, although some hypertrophies on the upper part of tap root of *T. terrestris* were present. Histologically, these hypertrophies were composed of callus cells filled with starch deposits. Smears of surface-sterilized crushed tissues and histological sections, stained with bacterial and fungal stains, evidenced no endophytic infection. Attempts to isolate any causal organism from hypertrophies of *T. terrestris* on Malt Marmite, Potato Dextrose and soil extract agar media were also unsuccessful. These observations are consistent with those of Allen & Allen (1950) who were also unable to detect or isolate any endophyte from starch-filled nodular hypertrophies of *Tribulus cistoides*. In tissue structure and origin these outgrowths bore no morphogenic or etiological similarities with *Alnus*-type, Podo-carp-type or legume-type root nodules. Relatedly, Arora (1954) and Khan (1973) reported the lack of root nodules on *T. terrestris* in India and Pakistan, respectively. In this connection Montasir & Sidrak's (1952) work is of great interest. They have shown the relationship between the nodulation in *Zygophyllum coccineum* and soil water contents and temperature. It may be that the soil factors were not favourable for nodulation in Zygophyllaceous plants examined for the present study.

The authors believe that the morphological nature and developmental anatomy of outgrowths on roots of Zygophyllaceous plants and regularity and function of such "hypertrophies" are the aspects which need further study.

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