anomalous blue interference colour. Biotite is rare and when present exhibits dark yellow to yellowish red pleochroism. Microprobe analysis of sapphirine is SiO_2 11·28, TiO_2 0·01, Al_2O_3 66·71, FeO 3·86, MnO_3 0·03, MgO 17·48, ZnO 0·10, K_2O 0·04; Total 99·51. The analysis indicates the peraluminous nature of sapphirine. Orthopyroxene + ortho-amphibole + sapphirine + biotite association is common and has been reported from many areas. In this type of association the formation of sapphirine is attributed to silica and potash metasomatism[3,7,8]. In the present area sapphirine is closely associated with spinel and could have formed by the addition of silica to spinel. At places, sapphirine is associated with cordierite. Microprobe analysis of cordierite is SiO_2 50·07, TiO_2, 0·02, Al_2O_3 34·13, FeO 1·57, MnO 0·03, MgO 12·63, ZnO 0·01, Na_2O 0·2, K_2O 0·04, Total 98·70.

Sapphirine + cordierite assemblages in the recrystallised ultramafics must have formed during high grade metamorphism connected with subsequent migmtisation. The presence of corundum, edenitic hornblende and biotite in thin sections, and the close spatial association of this enclave with biotite-garnet rich pelites, strongly suggest a possible alkali, Al, and silica influx into the ultramafics. Orthopyroxene-ortho-amphibole-tremolite-olivine assemblages indicate a PT range of 5–6 kb and 650° C[6]. Enstatite + sapphirine association in the MgO-Al_2O_3-SiO_2 system has a large stability field[9]. But presence of cordierite along with sapphirine + orthopyroxene puts an upper limit of 6 kb.

The estimated PT condition[10] for the western block of the Sargur high grade terrain is 790° C and 12 kb. The co-existing mineral assemblages of charnockites from southern Karnataka give a PT range of 800° C and 6–8 kb[11]. PT estimates for the basic rocks from Sargur proper indicates temperatures of 800° C and pressures of 8–9 kb[12]. Thus the orthopyroxene + sapphirine + cordierite association has vast implications and suggests the region has a complex metamorphic history.

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NITROGEN FIXATION IN SOME SPECIES OF *OPUNTIA*

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NITROGEN fixation especially through associate symbiont, *Azospirillum* is receiving greater attention in recent years as this organism was found to be universally present in a number of plants[1,2,3] belonging to different families. In the present report, evidence for N_2-fixation in some species of *Opuntia*, a succulent xerophytic genus, commonly occurring in the deserts, through *Azospirillum* sp. is presented.

The roots of *Opuntia coccinellifera*, *O. microdays* and *O. vulgaris* were collected from research farm of this Institute. After removing the adhering soil particles, the roots were placed in 250 ml Erlenmeyer flasks closed with rubber corks with a serum cap at the centre. Ten per cent of the air from the flasks was then replaced with acetylene and the flasks were incubated for 24 h at 30 ± 1°C. The nitrogenase activity expressed as the amount of C_2H_4 produced was determined by employing AIMIL-NUCON gas chromatograph using poropak-T column (2m × 0·00 m) at at a flow rate of 25 ml/min of N_2 as carrier gas. The organism was isolated from the surface sterilized root bits by enrichment culture technique using N_2-free semi-solid malate medium[4]. The identity of the organism as *Azospirillum* (Fig. 1) was confirmed according to the characters described by Tarrand *et*

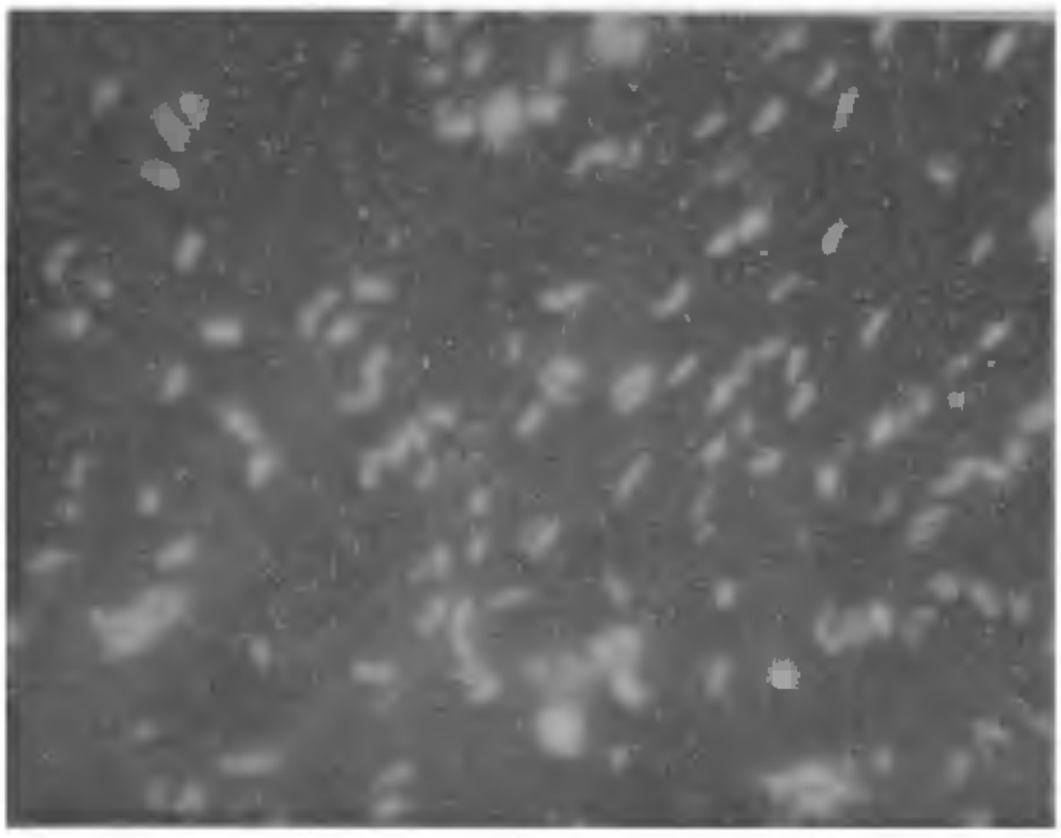

FIG. 1. Negative staining of *Azospirillum* isolated from *O. vulgaris*.

al[5]. Nitrogenase activity of these isolates was estimated after 7 days of incubation of the cultures containing 3 ml of N_2-free semi-solid malate medium inoculated with 0·1 ml of 4-day old inoculum.

The results (Table 1) indicate that the species of *Opuntia* are able to fix atmospheric nitrogen through the association of *Azospirillum* as was reported in other plants[1,2,3]. The nitrogenase activity of these species varied from 32·2 to 75·7 nmoles/g of dry roots/24 h. Microscopic observations of cross-sections of the roots revealed that the cortical cells are

TABLE I

Nitrogenase activity of roots of **Opuntia** *spp. and strains of* **Azospirillum** *isolated from the roots*

Plant species	Nitrogenase activity (n moles of C_2H_4) Roots g/24 h	Pure culture/h
Opuntia coccinellifera	75·7	72·9
O. microdays	54·5	96·2
O. vulgaris	32·2	273·6

filled with small rod-like bacteria. *Azospirillum* sp. was isolated from within the roots of all the species. These cultures were highly motile showing characteristic spiral movements and formed white subsurface pellicles in N_2-free semi-solid malate medium indicating the microaerophilic nature of these bacteria. The pure cultures exhibited nitrogenase activity varying from 72·9 to 273·6 nmoles/h, with the maximum activity with the isolate made from *O. vulgaris*. The activities of these cultures compare with those of the strains isolated from graminaceous plants[4]. These cultures generally preferred organic acids as carbon source as compared to sugars. The nitrogenase activity of the cultures was reduced by the addition of 100 ppm of ammonium sulphate indicating the repression of the enzyme. The association of *Azospirillum* with the roots of *Opuntia* spp. might be due to the accumulation, and root exudation of organic acids especially malate in these plants having crassulacean acid metabolic pathway of carbon dioxide assimilation[6].

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OBSERVATIONS ON SEEDLING ALLELOPATHY IN WEEDS

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THE term allelopathy in current literature refers to the detrimental effects of one plant on germination, growth or development of another, through the production of toxic chemical compounds that are released into the environment[1,2,3]. Investigations of allelopathic interactions thus far have been limited to mature plant parts. Since seedlings are actively growing juvenile plants with more vigorous metabolic activities, they could also produce allelopathic substances, which would be added to the environment. This fact could be ecologically very significant. Keeping this in view ten species of weed seedlings were examined for their allelopathic potential and the results are presented in this communication.

Air-dried seedlings (5 g) of 10 species (Table I) were crushed and soaked in 50 ml of distilled water for 24 h. The aqueous extracts prepared thus were filtered