Table 1 *Effect of Glomus fasciculatum on damping-off of tomato caused by pythium aphanidermatum.*

Treatment *	Disease index **	Plant height (cm)	Shoot dry wt (g)	Root dry wt (g)	Mycorrhizal spore count/ 50 ml soil
Control (C)	0	29.3[b]	2.7[b]	0.4[b]	50
Mycorrhiza (M)	0	27.3[b]	2.5[b]	0.6[c]	400
Pythium (P)	4	10.6[a]	0.8[a]	0.1[a]	40
M(T) + P(T)	1	23.8[b]	2.2[b]	0.3[b]	380
M(T) + P(2W)	0	28.8[b]	2.8[b]	0.7[c]	450
p(T) + M(2W)	4	10.3[a]	0.6[a]	0.1[a]	30

* (T) = Inoculated at the time of transplanting; 2W = inoculated two weeks after transplanting.
** 0 = No disease; 1 = slightly stunted growth; 4 = plants either dead or very stunted.
Values superscribed with identical letter do not differ significantly at $P = 0.05$.

Figure 1. Influence of mycorrhiza on damping-off of tomato: P = Pythium only inoculated at transplanting, M + P = Both pythium and mycorrhiza inoculated at transplanting, four pots in each treatment.

(*Panicum maximum*) which was infected with *G. fasciculatum* and grown for 4 months (spore density 460/50 ml). Pythium inoculum was prepared by aseptically growing *P. aphanidermatum* on 100 g autoclave sterilized sorghum seeds for 15 days in 500 ml glucose bottles and suspending the fungal growth in 250 ml sterile water at the end of incubation. For inoculation 10 ml of pythium or 100 g of mycorrhiza inoculum was applied per pot. The observations were recorded after 30 days of transplanting. The experiment was twice repeated.

The results presented in table 1 and figure 1 indicate a beneficial influece of mycorrhizal inoculation on control of damping-off of tomato caused by *P. aphanidermatum*. Mycorrhiza fungal inoculation either simultaneously or 2 weeks prior to pythium inoculation reduced damping-off in tomato and significantly increased plant height, shoot and root weights over pythium only inoculation as well as over plants inoculated with pythium 2 weeks prior to mycorrhizal inoculation. The results suggested that mycorrhizal fungus could colonize and protect such tomato plants from damping-off which were not already infected with pythium. Mycorrhiza alone inoculation of tomato significantly increased the root weight but not shoot weight and plant height over control plants. Understanding the exact disease control mechanism involved in the tripartite interaction of mycorrhiza, tomato and pythium is needed for greater exploitation of the beneficial effects[1].

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EFFECT OF GASEOUS POLLUTANTS ON AMMONIUM OXIDATION IN BACTERIAL CULTURES AND SULPHUR OXIDATION IN SOIL

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NITRIFICATION and sulphur oxidation in soils are mediated essentially by autotrophic bacteria and, to a minor extent, by heterotrophs. Heterotrophic nitrifiers are more tolerant than autotrophic nitrifiers to adverse

temperatures, pH fluctuations and high level of pesticides. For instance, both carbaryl and its hydrolysis product, 1-naphthol inhibited nitrification by an autotroph (*Nitrosomonas* sp.) and a heterotroph *Pseudomonas* sp.); but inhibition of heterotrophic nitrification occurred only at higher concentrations of both compounds[1]. There are reports[2, 3] that commercial formulations of HCH (Hexamar 5 G), benomyl (Benlate) and 2-chloro-6-(trichloromethyl)-pyridine (*N-serve*) markedly inhibit sulphur oxidation. The relative effects of some gaseous pollutants (acetylene, hydrogen sulphide and sulphur dioxide) on nitrification by a *Nitrosomonas* sp. and a *Pseudomonas* sp. and, oxidation of elemental sulphur in an alluvial soil were examined.

The autotrophic nitrifying organism *Nitrosomonas* sp. was isolated from carbofuran-amended soil[4]. The heterotrophic nitrifying organism *Pseudomonas* sp. was isolated from Benlate-amended soil and was capable of forming nitrite from peptone, ammonium sulphate and urea[5]. *Nitrosomonas* sp. was grown in a mineral salt medium (pH 7.8) containing $(NH_4)_2SO_4$ (1 g), K_2HPO_4 (0.5 g), NaCl (2 g), $MgSO_4 \cdot 7H_2O$ (0.2 g), $FeSO_4 \cdot 7H_2O$ (0.05 g), $CaCO_3$ (6 g) per litre of distilled water. *Pseudomonas* sp, was grown in 1% peptone broth (pH 7). To study the effect of gases C_2H_2, H_2S, and SO_2, on nitrification, 10 ml of the respective media for *Nitrosomonas* sp. and *Pseudomonas* sp. were dispensed in 100 ml volumetric flasks and sterilized at 121°C for 15 min. The media were inoculated with 0.2 ml of 10–15 day old culture of *Nitrosomonas* sp. or a loopful of peptone broth suspension of 2–3 day old *Pseudomonas* sp. The cotton plugs used for closing the flasks were replaced by separately sterilized vacutainer stoppers. Air was replaced with C_2H_2, H_2S or SO_2 through a syringe to provide concentrations ranging from 0.1 to 10 KPa. Nitrite in the culture media was estimated colorimetrically using sulphanilamide and N–1–naphthylethylenediamine dihydrochloride[6].

None of the volatile compounds (C_2H_2, H_2S, and SO_2) inhibited nitrification by *Pseudomonas* sp. at concentrations of 5 or 10 KPa while only C_2H_2 effected striking inhibition of ammonium oxidation by *Nitrosomonas* sp. even at a low concentration of 0.1 KPa (table 1). There are reports of significant inhibition of autotrophic ammonium oxidation by C_2H_2[7, 8], without being toxic to heterotrophic nitrification[9]. According to an earlier report[9], C_2H_2 even at 0.1 KPa decreased the cell viability and/or ammonium oxidase of *Nitrosomonas* sp. In our study, growth of *Pseudomonas* sp. was not inhibited by C_2H_2 at 5 KPa since turbidity measurements showed identical cell density in medium with and without C_2H_2. This would probably explain the innocuous effect of C_2H_2 on heterotrophic ammonium oxidation. H_2S and SO_2 were not inhibitory to both autotrophic and heterotrophic nitrification. The innocuous effect of SO_2 on nitrification in soil has been reported earlier[10].

Table 1 *Effect of acetylene, hydrogen sulphide and sulphur dioxide on nitrification by a Nitrosomonas sp. and a Pseudomonas sp.*

Concentration of the gas (KPa)	Nitrite formed (μmol)[b]	
	Nitrosomonas sp	*Pseudomonas* sp
C_2H_2		
0	13.7 ± 0.9	1 8 ± 0.4
0.1	0.2 ± 0.1	1.3 ± 0
5	*n.d.*	*1.7 ± 0 1*
H_2S		
0	27.5 ± 1.9	1.6 ± 0.1
1	24.9 ± 0.3	2.0 ± 0.1
10	24.5 ± 1.2	1.2 ± 0.1
SO_2		
0	14.3 ± 0.4	0 6 ± 0
1	12.4 ± 0.6	0 8 ± 0 1
10	17.3 ± 1.2	0.7 ± 0

[a] Experiments on C_2H_2, H_2S and SO_2 were conducted independently with the respective controls.
[b] Results are the mean of duplicate samples + the deviation. n.d. – not determined.

To study the effect of C_2H_2 on sulphur oxidation, 10 g portions of alluvial soil (pH 6.3; organic matter, 0.65%; total S 356 μg/g; SO_4^{2-} – S, 8.5 μg/g) were mixed with elemental sulphur (1 mg/g) in sterile 100 ml volumetric flasks closed with vacutainer stoppers. The required volume of C_2H_2 was then introduced. Soil samples without C_2H_2 served as controls. Soil samples were incubated at 28 ± 2°C and 60% moisture holding capacity. After 20 days, SO_4^{2-} was extracted from soil with ammonium acetate (0.5 N)-acetic acid (0.25 N) solution and estimated turbidimetrically at 440 nm[11].

Sulphur oxidation in soil was not affected by C_2H_2 at 10 KPa while only a slight inhibition was noticed at 100 KPa (table 2). N-serve at 250 μg/g of soil inhibited sulphur oxidation[4] and autotrophic nitrification at 0.05–2.0 μg/g[12]. Likewise, it was found that C_2H_2 only at high concentration (100 KPa) inhibited sulphur oxidation. In a more complex soil system, the gaseous pollutants and other toxic substances may immediately be sorbed into the soils making them innocuous to microorganisms and their activities.

Table 2 *Effect of acetylene on oxidation of elemental sulphur in an alluvial soil*

C_2H_2 KPa	SO_4^{2-}–S formed μg/g soil[a]
0	45.5 ± 0.5
10	42.0 ± 1.0
100	26.0 ± 0.5

[a] Values are the mean of duplicate samples ± the deviation.

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ON THE OCCURRENCE OF *DAPHNIA PROJECTA* HEBERT, 1977 (CLADOCERA, DAPHNIDAE) AND DESCRIPTION OF MALE FROM SOUTHERN TAMILNADU.

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WHILE studying the Cladocera of temporary ponds of southern Tamilnadu, we found abundant material of *Daphnia projecta* Hebert. This species was first described from Australia[1] based upon females only. However, in the present study, males were collected and are described for the first time.

Daphnia is very well represented in temperate regions (10 to 12 species) and has only a few in tropicals (2 species)[2,3]. Several explanations are given for this relative paucity of species in the tropical regions[2–5]. In southern Tamilnadu, located in tropical India, as many as five species of *Daphnia* namely, *D. similis*, *D. cephalata*, *D. longicephala*, *D. projecta* and *D. lumholtzi*[6], all of them probably temperate in origin, occur.

This paper reports the presence of *D. projecta* in the southern Tamilnadu ponds for the first time and gives a full description of male, thus completing the description of the species.

Female with dorsoanterior helmet; rostrum slightly recurved and pointed. Eye small, ocellus inconspicuous. Strong carapace spines; tail long, equal to the length of carapace (figure 1). Postabdomen with 8 to

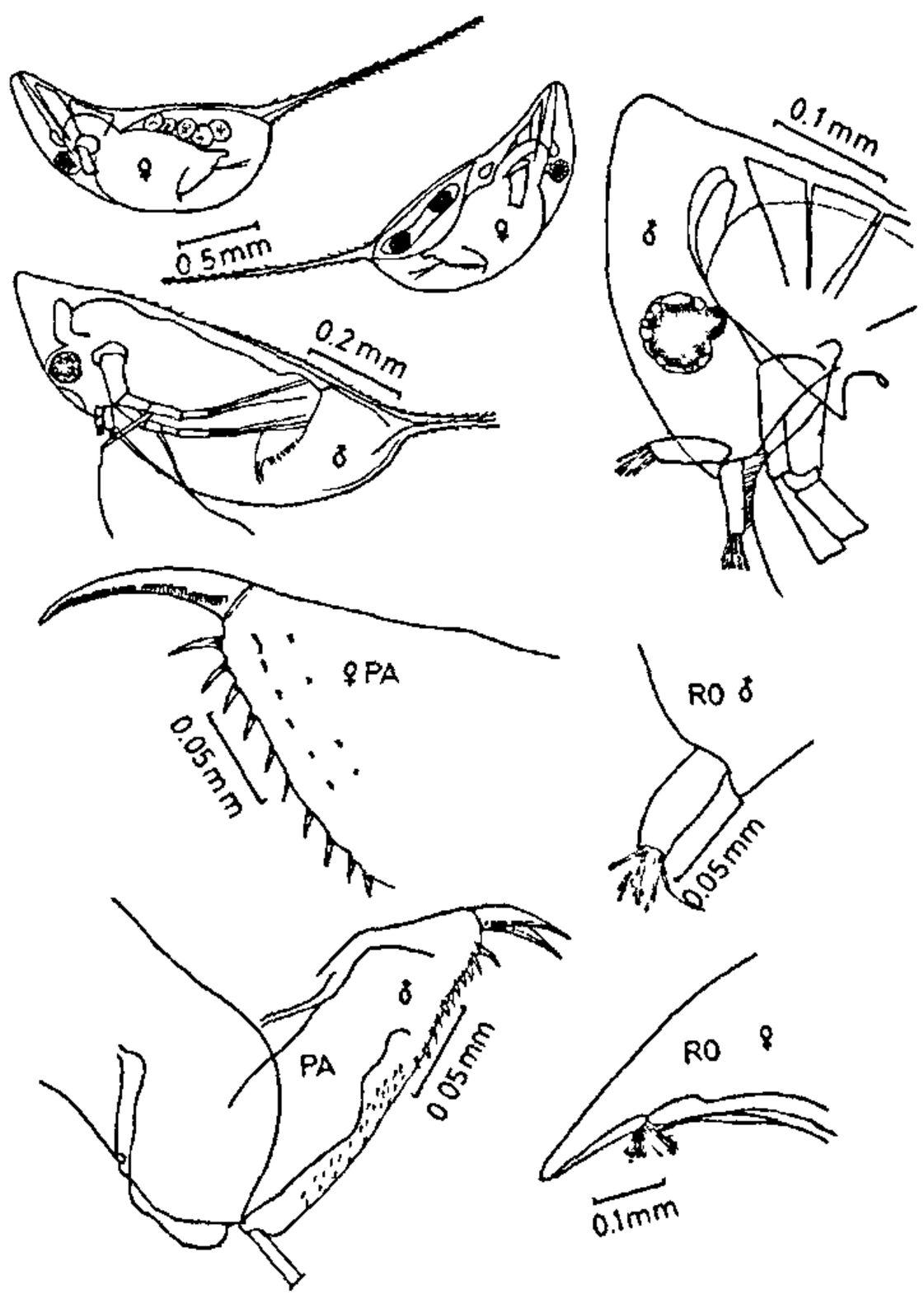

Figure 1. Daphnia projecta female and male: PA – postabdomen; RO – rostrum.