exhibited strong antibiosis, equivalent to that of Gv_1, which was highly mycoparasitic, unlike Gv_2. It is pertinent to mention here that antibiotic production by *G. virens* was ascribed a more important role than mycoparasitism[17]. The ability of the two antagonists to utilize various components of fungal cell walls as carbon source, as well as the annulling of their mycoparasitic potential by cycloheximide, stress the importance of wall-lytic enzymes in mycoparasitism[13]. In fact, both *T. longibrachiatum* and *G. virens* produce wall-lytic enzymes at low level constitutively and production could be induced further (unpublished).

Thus, with *G. virens*, mycoparasitism does not seem to be the major mechanism in contrast to *T. longibrachiatum*. In view of the strain variation observed in the mycoparasitic and antibiotic potentials of these antagonists, it appears that antagonists possessing both these phenomena would be able to effectively combat plant pathogens such as *R. solani*, *Pythium aphanidermatum* and *Sclerotium rolfsii*.

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EFFECT OF COPPER SULPHATE ALGICIDE ON GROWTH OF AND NITROGEN FIXATION IN *AZOLLA PINNATA* R.BR.

K. RAJARATHINAM*, M. JAYABALAN* and M. A. PADHYA
Department of Botany, Faculty of Science, M. S. University of Baroda, Baroda 390 002, India.
**Present address: Department of Botany, VHNSN College, Virudhunagar 626 001, India.*

THE most common method for the chemical control of free-living algae is the application of 1% copper sulphate solution[1]. Application of 10 ppm copper sulphate solution completely controlled snails, which affect the growth of *Azolla*, but the extent to which the copper sulphate affected growth of *Azolla* was not reported[2]. The present communication deals with the effect of copper sulphate on the growth, chlorophyll and nitrogen content, and acetylene reduction activity of the *Azolla–Anabaena* complex.

Azolla pinnata R. Br. plants were grown (3 g/l) on nitrogen-free liquid medium[3] with varying levels of copper (0, 2, 5, 10 and 20 ppm). Culture conditions were as described previously[4,5]. Plants were harvested after three weeks and their biomass was recorded. The chlorophyll content[6], total nitrogen content[7] and nitrogenase-catalysed acetylene reduction activity[8] were estimated as described earlier.

Increasing Cu concentration in the medium was associated with reduction in biomass, chlorophyll content, nitrogen content and acetylene reduction activity (table 1). The growth of *Azolla* in the presence of low concentration (2 ppm) of Cu was comparable to that of the control. At 5, 10 and 20 ppm Cu in the culture medium, dry matter accumulation showed 20, 32 and 63% reduction respectively. Chlorophyll and nitrogen content, and acetylene reduction activity also showed reduction at 5, 10 and 20 ppm Cu. A positive correlation exists between dry matter accumulation and nitrogen content ($r = 0.767$).

Table 1 *Effect of copper sulphate on the growth, chlorophyll and nitrogen content, and nitrogenase activity of Azolla–Anabaena complex*

Cu level (ppm)	Fresh weight (g)	Dry weight (g)	Chlorophyll (mg/g fresh wt)	Nitrogen (mg/g dry wt)	Nitrogenase activity (nmol C_2H_4 formed/g/h)
0	26.7	1.14	0.53	39	762
2	25.9	1.10	0.53	39	759
5	21.6	0.91	0.49	38	686
10	18.3	0.78	0.43	35	460
20	9.8	0.42	0.36	31	288
CD at 5%	1.3	0.07	0.08	2	79

In *A. pinnata*, the decrease in dry matter production with increasing Cu level in the culture medium is closely associated with the decrease in nitrogen content. Nitrogen content is directly related to the capability of this species to fix nitrogen. A direct correlation has been shown to exist between photosynthesis and nitrogen fixation[8]. The present results clearly indicate that Cu above 2 ppm resulted in reduction of chlorophyll content. This would ultimately affect nitrogenase activity. Higher concentration of Cu has been shown to inhibit the enzyme invertase by inactivation of the active centre because of reaction with Cu^{2+} ion[9]. Cu^{2+} was found to catalyse the oxidation of SH groups and cause the formation of SS groups, thereby inactivating the enzyme[10]. Inactivation of enzymes results in derangement in metabolism, and ultimately affects growth.

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GROWTH RESPONSE AND ROOT COLONIZATION IN CULTIVARS OF SESAME TO VAM FUNGI

T. SULOCHANA, C. MANOHARACHARY and P. RAMA RAO
Department of Botany, Osmania University, Hyderabad 500 007, India.

IN India fat and edible oil are derived from oil-seed crops such as groundnut, palm, soybean, sunflower, sesame, coconut, etc. Most of these crops are grown in nutrient- and moisture-deficient soils. Recent researches on plant nutrition and vesicular-arbuscular mycorrhizal (VAM) associations indicate that these fungi play a major role in nutrient acquisition from soils deficient in phosphorus and other elements as well as better water uptake under stress[1–3]. VAM symbiosis and the effects of VAM on the growth and nutrient uptake in inoculated groundnut have been worked out earlier[2,4–6]. In soybean VAM association and uptake of nutrients have been investigated[1,7,8]. However very little information is available on VAM association either in sunflower[2] or in sesame (*Sesamum indicum* L.).

The sesame varieties Gowri, JE X Phule Til, E-8 and T-4 have been chosen for the present study. The rhizosphere soil samples and root pieces were collected and studied for VAM association[9,10]. VAM fungal spores of individual species were collected from the field soil[9]. These were surface-sterilized and multiplied in sterilized soil and sand (1 : 1) mixture with *Cenchrus ciliaris*. This constituted the soil inocula used for evaluating the cultivar response in pot trials using an alfisol. Such inocula were raised for seven VAM species. Pot trials were conducted in the glass house. The soil inoculum (50 g) for each VAM species, containing 10 spores/g was placed below the sesame seed bed to ensure that all the growing roots passed through the inoculum layer. Of the cultivars tested, Gowri responded favourably. VAM root colonization pattern[11] and growth response[2] were studied using seven VAM fungi obtained and the data are presented.

Rhizosphere soil samples and root pieces collected