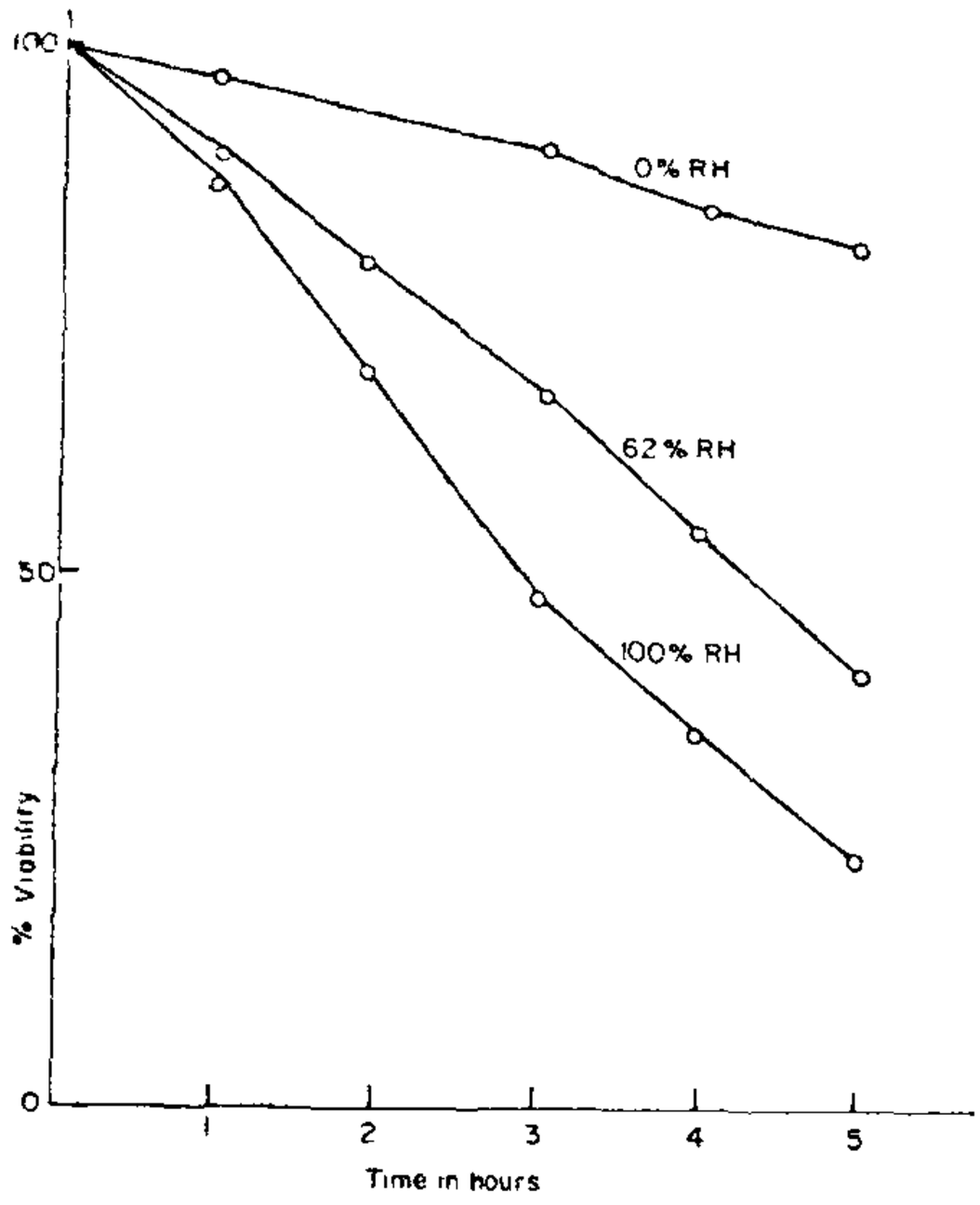

Figure 1. Survival of suspended *Typha* pollen in stirred chamber under controlled humidity.

Implications of this effect are difficult to assess in in-field conditions as humidity fluctuations are difficult to assess.

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THE NEED FOR *RHIZOBIUM PHASEOLI* INOCULATION TO ESTABLISH AMERICAN BEANS IN INDIA

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ALMOST all the species of *Phaseolus*, indigenous to India, have been included in the genus *Vigna*[1]. This classification has been supported by studies in this laboratory concerning the host-group specificity in legume-*Rhizobium* symbiosis[2]. These studies show that all the species of *Vigna*, placed earlier in the genus *Phaseolus*, are indeed nodulated by rhizobia of the cowpea miscellany group (*Rhizobium* sp.), whereas the true species of *Phaseolus* are nodulated only by rhizobia of the bean group (*R. phaseoli* Dangeard). These species of *Phaseolus* are commonly known as the 'American beans' or 'temperate beans', some of which have been introduced in India and are unsuccessfully cultivated during the cooler part of the year in plains and in the warmer part of the year in the hills.

The foregoing presentation relates to studies carried out to show that rhizobia specific to the introduced temperate beans of the *Phaseolus* group are virtually absent from Indian soils, and inoculation with specific strains of *Rhizobium phaseoli* is necessary to overcome one of the limitations in the establishment of American beans in India.

Thirteen types of soil collected from various locations in India, having diverse agroclimates were amended with superphosphate (100 kg P_2O_5/ha), and used for nodulation tests in pots. The pots were seeded with the following beans: *Phaseolus coccineus* Linn. var. scarlet runner, *P. lathyroides*, Linn. var. phasmy bean, *P. lunatus*, var. limabean and *P. vulgaris*, vars., black prince, french bean, giant springles, kentucky wonder, plentiful and tender green.

The results showed that nodulation was virtually absent in plants grown in all the soils except for stray occurrence of ineffective tiny nodules on roots due to the promiscuous nature of indigenous strains of rhizobia. Such ineffective symbiosis has been reported by several workers[2, 3].

A second set of pot trials was done by planting seeds of *P. vulgaris* var. french bean, inoculated with three different strains of bean-rhizobia (*R. phaseoli*) using the slurry inoculation method. The local strain VPKAS, was supplied by Vivekananda Laboratory for Hill Agriculture, Almora (U.P.) and strains CIAT 166 and 255 were obtained from Centro Internacional de

Agricultura Tropical, Cali-Columbia. Observations for nodulation and plant growth, recorded after eight weeks of growth, revealed effective nodulation and symbiosis with the two outside strains only (table 1).

Table 1 *Effect of Rhizobium phaseoli inoculation of Phaseolus var. French bean on the root nodulation and dry wt of shoot at the 8 week stage (mean of 10 pots, each containing 2 plants)*

Treatment	Number of nodules	Dry wt. of shoot (g)
Control-uninoculated	0.6	3.6
Rhizobium-VPKAS-Inoculated	0.7	4.1
Rhizobium CIAT 166-Inoculated	43.4	8.3
Rhizobium CIAT 255-Inoculated	12.0	5.0

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COPPER GRANULES IN THE HEPATOPANCREAS OF THE SNAIL, *CRYPTOZONA LIGULATA*

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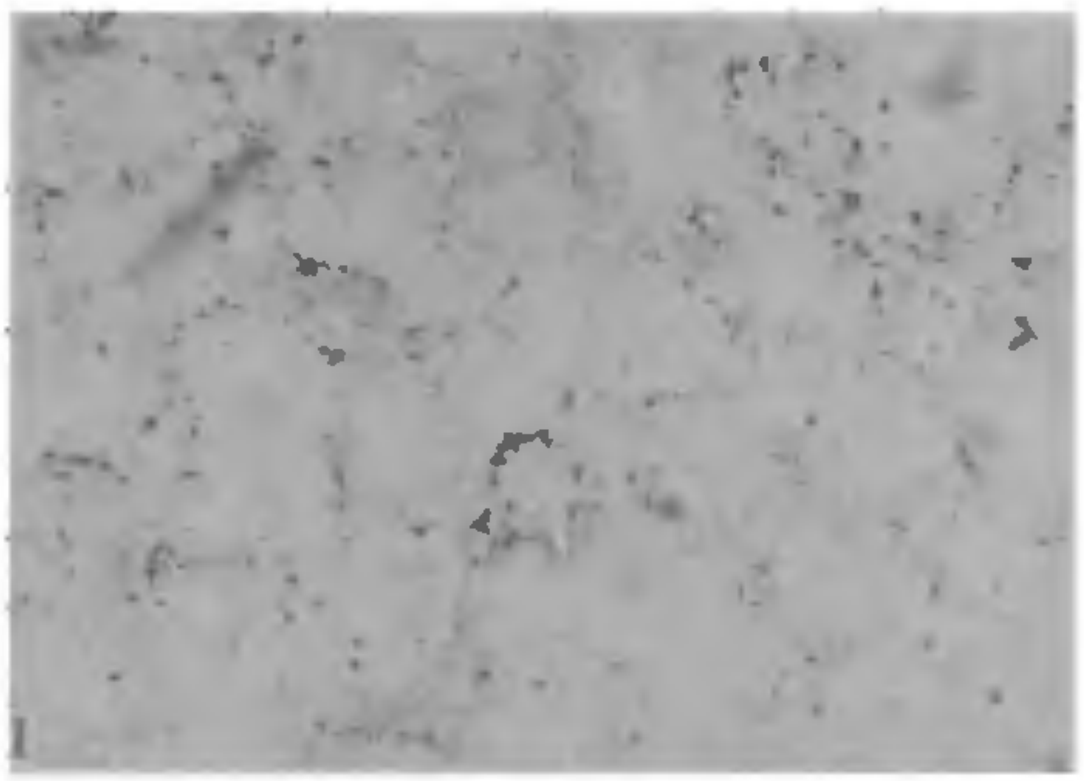
THE body fluids of molluscs consist of a copper containing respiratory protein called the haemocyanin[1,3]. The variation in the haemocyanin content in the blood during molt cycle and season has been reported in a number of Crustaceans[4,5]. The levels of copper in the blood of *C. ligulata* are reported earlier[1] and the present note relates to the influence of aestivation on the fate and the location of the granules of copper in the hepatopancreas of the snails.

The method employed for the quantitative estimation of copper in the hepatopancreas of active and four months aestivated snails was that of Barnes and Rothschild[6]. The histochemical localisation of copper in the hepatopancreas was followed by the method of Uzmann[7].

The copper content of the blood reflects the concentration of haemocyanin and it constitutes about 70% of the total blood proteins[1]. The copper levels in the hepatopancreas of active and aestivated snails are 310 $\pm$ 36 and 176 $\pm$ 30 μg/g dry wt of the tissue respectively and there is a significant decrease in the hepatopancreatic copper upon aestivation. The higher values of copper in the hepatopancreas as compared with the



Figures 1 & 2. Density of copper granules in the hepatopancreas of active (**1**) and aestivated (**2**) snails stained with rubeanic acid (× 60)