increased, on an average, from 4.3 to 28.6 per 50 g rhizosphere soil from 30 to 90 days of plant age.

An attempt was made to identify the endophytes basing mainly on the infection pattern within the root tissue. The extensive occurrence of internal and external vesicles or spores, which are spherical to elliptical (figure 1) with simple or funnel-shaped attachments, indicates that the VAM fungus is a species of *Glomus*. Besides this type, the predominant occurrence of arbuscules with no internal vesicles in many of the root segments (figure 2) together with the presence of intracellular coils with intermittently swollen regions (figure 3) and the occurrence of soil borne single vesicles external to the roots indicates that one of the endophytes belongs to the genus *Gigaspora*, as all these characteristics are in close agreement with those described by Abbott[7] and Hayman[8], for this fungus. The presence of comb-like hyphae with radially oriented teeth (figure 4) corresponds with the description outlined by Furlan and Fortin[9] for *Gigaspora calospora*.

The present investigation reveals that the mycorrhizal fungi occur very extensively on rice roots under upland conditions. It is therefore worthwhile to consider the impact of these endophytes on phosphorus nutrition and yield potential of rice.

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FREQUENCY DISTRIBUTION AND REGULATION OF PARASITIC POPULATIONS IN *COLISA LALIA*

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CROFTON[1,2] regarded parasitism, basically as an ecological interaction between the parasite and the host. He used frequency distribution and k (by maximum likeli-hood of Bliss & Fisher) to express quantitative relationships between the host and the parasite. When $k < 1$, the parasite species is believed to be harmless; between 1 and 3 values of k, a well defined equilibrium is said to exist, stability due to parasites killing heavily infected hosts. Boxhall[3], however, conceived of another form of regulation of parasite number, viz., worms dying in fish due to host reaction (immunological!). Niyogi *et al*[4] advocated immunological regulation of parasite populations.

The authors studied the population dynamics of *Clinostomum complanatum* (metacercariae), *Pallisentis nagpurensis* (encapsulated juvenile) and *Senga visakhapatnamensis* (encapsulated plerocercoid), which invariably occurred together in *Colisa lalia* during the annual cycle from March, '83 to February, '84. Species of worms are known generally to have a seasonal pattern of incidence and an over-dispersed distribution, the zero frequency class of hosts being highest in number and the largest number of worms restricted to a relatively small number of host specimens. In the present study of *C. lalia* susceptibility to parasitic infection is very high (almost 100%) and zero class frequency nil. Pathogenicity due to worms is low and the worms have positive co-occurrence correlationship.

Specimens of *Colisa lalia*, (311) procured from local tanks at 25 to 35 fishes each month, in one annual cycle from March '83 to February '84, were numbered, measured, weighed and then examined sexwise for parasitic infections. Worms recovered were identified, counted habitat-wise and scored separately for each fish. Data obtained were scrutinized and analysed species-wise for the several biostatistical parameters, such as incidence, intensity, density, relative density, index of infection, dominance percentage and frequency distribution in one annual cycle. Every one of the 311 *C. lalia* specimens was infected; in 70% cases harbouring *C. complanatum*, *S. visakhapatnamensis* and *P. nagpurensis* concurrently; 10 to 15% other

concurrent infections of two species occurred; single infections were, however, scarce.

C. lalia and its three species of worms provided an exceptional model of host-parasite relationships, where the zero frequency class was nil. All three species of worms had overdispersed populations, *C. complanatum* being most highly so. Frequency distribution suggested low pathogenicity and greater oscillation in number (1 to 127) in *C. complanatum*, which seemed to have achieved a higher equilibrium level.

Frequency distribution patters of *S. visakhapatnamensis* and *P. nagpurensis* in all monthly samples, from March, '83 to February, '84, was, however, different, having *k* value between 1 to 3 (exceptionally exceeding 5) Crofton[1,2] considered such host-parasite systems, with *k* value between 0.5 to 5.0, stable; stability due to ability of parasites to kill heavily infected hosts; more worms, than hosts, die in the process. Low pathogenicity in such a system would produce high infection pressure and an instability which would destroy the system[1,2]. Thus, pathogenicity of the parasite contributes to stability of population (low pathogenicity in case of *C. complanatum* and high pathogenicity in *S. visakhapatnamensis* and *P. nagpurensis*).

Encapsulated *S. visakhapatnamensis* and *P. nagpurensis*, parsasitizing the liver of *C. lalia*, become mature in the intestine of *Channa punctatus*, and are both highly overdispersed with k value less than 1. *C. punctatus*, unlike *C. lalia*, showed a seasonal pattern[5]. Infection is generally high during February to September (maturation and spawning period) and low during October to January Studies on co-occurrence correlationships and co-efficient of partial association suggested a negative interaction between adult *S. visakhapatnamensis* and *P. nagpurensis*, due possibly to non-reciprocal cross immunity[5]. Encapsulated stages of the two species in liver of *C. lalia*, on the other hand, suggested positive correlation, pointing to absence of a specific immune factor in host-parasite model of *C. lalia*.

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ICHTHYOPTHIRIUS MULTIFILIIS FOUQUET (PROTOZOA: CILIATA) INFECTION IN *CHANNA STRIATUS* (BLOCH): EXPERIMENTAL INDUCTION WITH NOTES ON TREATMENT

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ALTHOUGH the 'ich' or 'white spot' disease caused by *Ichthyopthirius* sp is considered to be of world wide in distribution affecting different species of fish[1–3], it remained almost unknown from Indian fishes, except for two reports[4,5]. Tripathi[4] recorded *Ichthyopthirius multifiliis* from *Xiphophorus halleri* and conducted some preliminary experimental reinfection studies in the Indian carps, *Labeo bata* and *Cirrhina mrigala*. *Ichthyopthirius* sp was later recorded from *Channa marulius* by Renganathan and Devaraj[5]. In this paper we report the occurrence and experimental infection of 'ich' in one of the extensively cultured murrels, *Channa Striatus* (Bloch) and its treatment using acridine orange.

Mortality of *C. striatus* was observed to be 24% during October, 1983 and 90% during March, 1984 in intensive fry rearing tanks (table 1). Infected fishes were brought to the laboratory for detailed studies. All the affected fishes were found to have white spots on the fins and body surface. Microscopic examination showed the presence of 'threonts' of *I. multifiliis*, measuring 30 to 45 μ, actively moving around beneath the fin rays. Microphotographs show that these young parasites also attach themselves to the fin rays (figures 1 and 2). The ciliation was uniform (figure 3) and the

Table 1 *Mortality of Channa striatus in intensive fry rearing tank*

Month	Actual number dead	Length in mm	Weight in mg
October 1983	24/100	39–46[a] (38.1 mm)	180–1100[a] (569 mg)
March 1984	90/100	25–43[b] (34 35 mm)	150– 750[b] 382 mg)

[a] Measurement taken from 10 fishes
[b] Measurement taken from 20 fishes