EFFECT OF CARBOFURAN APPLICATION ON THE GROWTH AND NITROGEN FIXATION OF *AZOLLA* DURING ITS CULTIVATION WITH RICE

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THE aquatic term *Azolla* has drawn considerable attention of the botanist and the agriculturist because of its fast growth, high nitrogen fixing ability, worldwide distribution and ease of cultivation with rice. The insect attack in *Azolla* is more prevalent during summer especially when the temperature rises above 28°C and if care is not taken *Azolla* crop can be destroyed by insects in 3–5 days[1,2]. The effective prevention and control of insect pest and diseases is a key element in successful *Azolla* cultivation. Fortunately, the insects which attack *Azolla* are different from those attacking rice, yet most *Azolla* pests are controlled by pesticides used for rice. The susceptibility of *Azolla* to insect pest may create a setback for its adoption in some regions. The present study, therefore, was conducted to assess the damage caused by insect pest of *Azolla* and the effect of carbofuran on *Azolla* and rice crop.

The field experiment in randomized block design was conducted at the research farm of this Institute, during wet (1983) and dry (1984) seasons. The field was prepared and divided into 8 small plots of 40 m^2. Two treatments, insecticide-treated and untreated, were replicated four times. To grow *Azolla* before and after transplanting of rice, the Bangkok isolate of *Azolla pinnata* was inoculated in the rice field at a rate of 3 t ha^{-1} 15 days before transplanting (DBT), 10 and 30 days after transplanting (DAT) and it was incorporated when the fresh biomass of *Azolla* in insecticide treated plot reached about 15 t ha^{-1}. Twenty-day-old seedlings of rice variety, Ratna was transplanted at 20 × 20 cm spacing at the rate of 2 seedlings per hill. The carbofuran at a rate of 1 kg a.i. ha^{-1} was mixed with the *Azolla* inoculum in the insecticide treatment. In no insecticide treatment, the insecticide was not applied. Other

Table 1 *Effect of carbofuran application on the growth and N_2-fixation of Azolla pinnata (Bangkok) cultured with rice variety Ratna*

Treatments	Wet 1983		Dry 1984	
	Azolla biomass (Fresh wt. t ha^{-1})	N_2-fixation (kg N ha^{-1})	*Azolla* biomass (Fresh wt. t ha^{-1})	N_2-fixation (kg N ha^{-1})
Basal crop				
I_0	12.2	19.8	10.8	20.7
I	15.6	28.8	15.1	30.7
	(27.9)	(45.5)	(39.8)	(46.4)
Dual I crop				
I_0	11.5	22.6	9.7	16.4
I	16.3	29.6	15.9	30.0
	(41.7)	(31.0)	(63.9)	(85.0)
Dual II crop				
I_0	7.0	12.7	10.5	18.0
I	15.0	29.3	15.0	26.5
	(114.3)	(130.7)	(42.9)	(45.6)
Total (Basal + dual I and II crop)				
I_0	30.7	55.1	31.0	55.3
I	46.9	87.7	46.0	86.8
	(52.8)	(59.2)	(48.4)	(57.0)

I_0, Without insecticide and I, with 1.0 kg a.i. carbofuran.
Figures in parentheses indicate percentage increase over control (no insecticide).
Basal crop refers to *Azolla* crop grown before transplanting and dual I and II are the *Azolla* crop grown 10 and 30 DAT, respectively.
The N_2-fixation refers to the amount of nitrogen accumulated in *Azolla* biomass.

cultural practices remained the same in both the treatments. The fresh weight of *Azolla* was determined before its incorporation in soil and 100 g of fresh *Azolla* was oven-dried for dry weight and N estimation. The plant height, panicle numbers, grain and straw yields of rice crop were recorded. The nitrogen content of *Azolla* was determined by modified micro Kjeldahl method[3].

The observations (table 1) show that mixing carbofuran with *Azolla* inoculum increased the biomass production and nitrogen fixation of *Azolla* during its cultivation. *Azolla* inoculated in rice field 15 DBT, 10 and 30 DAT with carbofuran covered the water surface 7 DBT, 22 and 45 DAT, respectively during wet season and 8 DBT, 20 and 42 DAT, respectively during dry season and no insect infestation was observed. The *Azolla* crop in the rice field without carbofuran was attacked by *Pyralids, Nymphula* and *Chironomus* sps of insects and could not cover the water surface. The total biomass produced by three crops of *Azolla* with carbofuran was 46.9 and 46.0 t ha^{-1} during wet and dry seasons, which fixed 87.8 and 86.8 kg N, respectively. These three crops of *Azolla* without application of carbofuran produced only 30.7 and 31.0 t ha^{-1} fresh *Azolla* containing 55.1 and 55.3 kg N, respectively during those seasons. Thus, application of carbofuran with *Azolla* inoculum produced 48.4 to 52.8% more biomass which fixed 57 to 59.2% more nitrogen (table 1). Singh[4] observed that *Azolla* crop was attacked by insects and application of 2.50 kg furadan effectively controlled them. Sasmal and Kulshrestha[5] reported that *Azolla* was attacked by two pyralid caterpillars, *Nymphula responsalis* and *Cryptoblabes gnidiella* (Mill) and application of 0.5 kg a.i. ha^{-1} carbofuran reduced 94.6% caterpillar population after 7 days of its application.

The application of carbofuran increases the height, panicle number, grain and straw yields of rice crop (table 2). An increase of 13.9, 20.2 and 23.5% in panicle number, grain and straw yields, respectively was observed due to insecticide application with *Azolla* during wet and 17.3, 16.4 and 26.5%, respectively, during dry seasons (table 2). This was due to greater biomass production and N_2-fixation by *Azolla* in the insecticide treated field than the untreated one. However, Lee[6] reported the promotion of growth of plant through inhibition of IAA-oxidase by carbofuran and its metabolite and suggested that plant interacts with the insecticide. Thus, it was concluded that mixing carbofuran with *Azolla* inoculum enhanced the growth and N_2-fixation of *Azolla* and also benefited the rice crop.

Table 2 *Effects of carbofuran application with Azolla inoculum on yields and yield attributing characters of rice variety Ratna*

	No insecticide	Carbofuran (1 kg a.i.ha^{-1})
Wet 1983		
Grain yield (t ha^{-1})	3.994	4.800 (20.2)
Straw yield (t ha^{-1})	4.150	5.125 (25.5)
Panicle number (m^{-2})	238	271 (13.9)
Plant height (cm)	87	93 (6.9)
Dry 1984		
Grain yield (t ha^{-1})	4.578	5.328 (16.4)
Straw yield (t ha^{-1})	4.891	6.188 (26.5)
Panicle number (m^{-2})	318	373 (17.3)
Plant height (cm)	76	81 (6.6)

Figure in parentheses indicate percentage increase over control (no insecticide).

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EFFECT OF EXPERIMENTAL *TRYPANOSOMA EVANSI* INFECTION ON LACTATE-DEHYDROGENASE ACTIVITY OF ALBINO RATS

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PARASITIC protozoa of the genus *Trypanosoma* cause tropical diseases including sleeping-sickness in man, and surra in domestic animals. A large number of non-specific stress result in the elevation of serum enzyme levels[1]. The elevation of serum enzymes is generally attributed either to pathological lesions and cellular necrosis or change in the permeability