

CHAPTER VI

SUMMARY

- ❖ The present endeavour is an outcome of the analysis carried out in the plant ecology laboratory of the Department of Botany, Gauhati University to observe the systemic effect of some locally used pesticides of Assam on the growth and nitrogen fixing capacity of three autochthonous nitrogen fixing species of *Westiellopsis* isolated from 20 organically cultivated rice fields of Assam.
- ❖ The species were identified as *Westiellopsis prolifica*, *W. indica* and *W. ramosa* following standard manuals of Desikachary (1959), Komarek and Anagnostidis (1989), Komarek (2013) and authenticated following Algaebase (www.algaebase.org).
- ❖ Three most commonly used pesticides viz. Malathion (5% EC) belonging to organophosphorous group, Deltamethrin (2.5% EC) belonging to pyrethroid group and Carbofuran (3.1% EC) belonging to carbamate group of pesticides were considered for the present study.
- ❖ The different doses of Malathion, Deltamethrin and Carbofuran for the study were specified based on the respective LC₅₀ values, which were calculated based on chlorophyll-a contents of each of the test organisms.
- ❖ All the three species of *Westiellopsis* responded differentially to the three different groups of pesticides at different time and concentrations of the applied pesticides.

- ❖ The biomass contents of the *W. prolifica* decreased from lower to higher concentrations up to 16th day from the day of inoculation over the control, but on the 4th day, at 30ppm of Malathion concentration there was a little but insignificant increase in the biomass content as compared to the control.
- ❖ The chlorophyll-a production was found to be slightly higher than the control at 30ppm on the 4th day ($p<0.05$) and on 8th day ($p<0.05$) from the day of inoculation under Malathion stress.
- ❖ A significant reduction in carotenoid, protein and carbohydrate contents ($p<0.001$) of *W. prolifica* was observed up to 16th day from the day of inoculation in comparison to the control sets with Malathion application.
- ❖ The nitrogen fixing capacity of *W. prolifica* was found to be significantly reduced ($p<0.001$) under Malathion stress on 8th and 16th day.
- ❖ The biomass, chlorophyll-a and carotenoid content of *W. prolifica* decreases in a time and dose dependent manner with Deltamethrin application up to 16th day from the day of inoculation.
- ❖ A significant and gradual increase in protein content of *W. prolifica* was observed with increase in Deltamethrin concentration from 4th day to 16th day.
- ❖ An insignificant increase in carbohydrate was observed at lower dose i.e. at 25ppm over the control up to 16th day from the day of inoculation in *W. prolifica* under Deltamethrin stress.
- ❖ A significant increase in rate of nitrogen fixation was observed at 25ppm by 88% ($p<0.05$) and at 55ppm by 64% as compared to the control on 8th day in *W. prolifica* under Deltamethrin stress.

- ❖ An insignificant increase in biomass was observed in *W. prolifica* under Carbofuran stress at 20ppm on 4th and 8th day over the control.
- ❖ The chlorophyll-a and protein contents of *W. prolifica* significantly decreases with concomitant increase of Carbofuran concentration with time in comparison to the control sets.
- ❖ It was observed that with Carbofuran application, carotenoid showed insignificant enhancement at 20ppm on 4th, 8th and 12th day by 10%, 5% and 5% respectively against the control sets.
- ❖ The carbohydrate content was gradually increased in a time and dose dependent manner. The carbohydrate content was found to be increased by 48.5% (p<0.01), 56.8% (p<0.01), 57.1% (p<0.001), 30.7% (p<0.001) at 60ppm on 4th, 8th, 12th and 16th day with Carbofuran application.
- ❖ At 20ppm of Carbofuran the nitrogen fixing capacity of *W. prolifica* increases by 42% (not significant) and 60% (p<0.01) over the control on 4th and 8th day respectively.
- ❖ The biomass contents of *W. indica* decreased with the concomitant increase of the Malathion concentration with time with an insignificant increase in biomass at 30ppm over the control.
- ❖ The chlorophyll-a contents of *W. indica* was found to be significantly high over the control on 4th day at 30ppm and on 8th day at 30 and 60ppm with Malathion application.
- ❖ The carotenoid contents and the rate of nitrogen fixation of *W. indica* under Malathion stress was recorded to be significantly decreasing with higher dose of

pesticides with time but on the 4th day there was a significant increase of the carotenoid pigment at 30 and 60ppm over the control.

- ❖ The protein and carbohydrate contents of *W. indica* significantly decreased with the concomitant increase of Malathion concentration with time.
- ❖ The biomass contents of *W. indica* was found to be increasing from 4th to 16th day at initial dose of Deltamethrin (15ppm) over the control.
- ❖ The chlorophyll-a, carotenoid carbohydrate and the rate of nitrogen fixation of *W. indica* decreased gradually with the increase in Deltamethrin concentration with time.
- ❖ The protein contents of *W. indica* were found to be decreasing at the initial days of Deltamethrin treatment i.e. on 4th and 8th day but then on 8th and 16th day, the protein content were found to be significantly higher than that of control.
- ❖ The biomass, chlorophyll-a, carotenoid and nitrogen fixing capacity of *W. indica* gradually decreased with increase in Carbofuran concentration with time.
- ❖ A significant increase in protein and an insignificant increase in carbohydrate content was observed with 22ppm of Carbofuran application at the initial days of treatment.
- ❖ The biomass contents of *W. ramosa* showed a significant increase of 28% ($p < 0.001$) and 34% ($p < 0.001$) under 56 and 86ppm of Malathion stress on 4th day as compared to that of the control sets.
- ❖ A little but insignificant increase in chlorophyll-a and an insignificant increase in carotenoid and rate of nitrogen fixation were observed at 26ppm of Malathion in *W. ramosa*.

- ❖ At the highest treated concentration i.e. with 86ppm of Malathion, the protein content in *W. ramosa* was observed to be decreased by 28% ($p<0.001$) on 4th day, 41% ($p<0.001$) on 8th day, 57% ($p<0.001$) on 12th day and 65% ($p<0.001$) on 16th day respectively over the control sets.
- ❖ A progressive and significant reduction in carbohydrate was observed at 86ppm of Malathion by 26% ($p<0.001$) on 4th day, by 27% ($p<0.01$) on 8th day, by 34% ($p<0.001$) on 12th day and by 56% ($p<0.001$) on 16th day respectively.
- ❖ The biomass, chlorophyll-a and carotenoid contents in *W. ramosa* was observed to be gradually decreasing with the increase in Deltamethrin concentrations with time.
- ❖ A little but significant increase in protein content was observed in *W. ramosa* at 20ppm of Deltamethrin on 4th and 8th day by 18% and 5.3% over the control sets.
- ❖ At 60ppm of Deltamethrin, the carbohydrate contents in *W. ramosa* were reduced by 5.4%, 5.1%, 15% and 8.7% on 4th, 8th, 12th and 16th day respectively.
- ❖ At 60ppm of Deltamethrin, the rate of nitrogen fixation in *W. ramosa* was reduced by 45% ($p<0.001$) on 4th day, by 47% ($p<0.001$) on 8th day, by 58% ($p<0.001$) on 12th day and by 73% ($p<0.001$) on 16th day respectively.
- ❖ A gradual reduction of biomass and carotenoid contents in *W. ramosa* was observed with Carbofuran application.
- ❖ The chlorophyll-a content in *W. ramosa* except was found to be increased by 34% on 4th and by 48% on 8th day over the control at 10ppm of Carbofuran.
- ❖ The protein content gradually decreased on 4th and 8th day and then was observed to be increasing over the control on 12th and 16th day with Carbofuran application.

- ❖ A significant and gradual increase of Carbohydrate in *W. ramosa* was observed with increase in Carbofuran concentration with time.
- ❖ The rate of nitrogen fixation in *W. ramosa* with Carbofuran application was observed to be gradually decreased with an exception on 4th day where an insignificant increase in nitrogen fixation over the control was observed.
- ❖ It was evident from the study that the exposure to higher dose of pesticides retarded the growth and rate of nitrogen fixation in all the three test organisms with varied magnitudes.
- ❖ Carbofuran caused maximum and significant inhibition in comparison to Malathion and Deltamethrin. Hence, use of carbofuran is to be totally reduced as far as possible in the rice fields of Assam.
- ❖ As *W. prolifica* could synthesize more of its metabolites under stress conditions in comparison to *W. indica* and *W. ramosa* hence, it could be promoted as a suitable autochthonous candidate for rice field bio fertilization program in the region.