INTRODUCTION

India, a populous country, needs intensive agriculture, a sector upon which the Indian economy is largely dependent. India's food-grain production is to be achieved from 141 million hectare cultivable land to feed 1.53 billion people by 2030. About 30% of Indian crop yield potential is being lost due to insects, disease and weeds which accounts Rs. 90,000 crore annually. To minimize this loss, use of crop protective chemicals become an inevitable tool to contribute substantially to the high level of agricultural production. The agrochemicals will remain a vital component of crop protection into the foreseeable future; however, their true impact and significance must be broadly examined to ensure food safety.

West Bengal has diversified agro-climatic zones and earned reputation not only in technology-led cultivation but also in exporting agricultural commodities like tea, mango, pineapple, vegetables, etc. Tea (Camellia sinensis) is valued for its specific aroma and flavor as well as health-promoting properties. It is being exported to many countries accounting a foreign exchange of Rs. 1850 crore. It is well-known that tea plants are prone to attack by different types of pest and diseases. The tea mosquito bug and grey blight disease cause significant loss of production of tea both in terms of quality and quantity. The crop protective chemicals play a key role in minimizing such losses. Thiacloprid, belonging to neonicotinoids family encompasses high insecticidal activity with a favorable eco-biological profile and useful in modern crop protection systems. It is found to be active against tea mosquito bug. Similarly, propineb, a dithiocarbamate fungicide, has a promising control over grey blight diseases in tea. However, the application of thiacloprid and propineb may do leave residues in green tea leaves, processed tea and tea liquor. Pesticide residue in/on food commodities is a matter of concern and is regulated by national and international laws. The legal standard for pesticide residues worldwide is Maximum Residues Limit (MRL) and is established by the regulatory bodies based on supervised field studies conducted at more than one agro-
climatic zone as per Good Agricultural Practices (GAP). The literature survey revealed scanty information on systematic study of thiacloprid and propineb persistence in tea under West Bengal agro-climatic conditions. The residue data of green tea leaves, processed tea and tea liquor are the prime requirement by the registration authorities for the fixation of MRL.

Chili (Capsicum annuum L.) is widely cultivated in West Bengal throughout the year. Rising export demand coupled with higher price realization in the domestic market have motivated farmers to bring more area under chili cultivation. It occupies an important place in Indian diet as a condiment in one form or the other. The hot and humid climate favors the incidence of pests and diseases throughout the season. This could be effectively controlled by the use of crop protective chemicals. The phenylpyrazole insecticide fipronil, is novel to the agrochemical industry and its unique trifluoromethylsulfinyl sidechain may account for its toxic properties. Fipronil exhibits high specificity toward insects, acts by blocking the GABA gated chloride channel. It is highly effective against sucking pests of chili, like aphids, thrips and jassids. However, the data relating to persistence and effect of processing of this insecticide and its metabolite in chili fruits as well as fate in environmental samples (soil and water) appear to be scanty. It is also understood from literature reports that under environmental conditions fipronil is transformed to its degradates which possess insecticidal activities and little information is available on their dissipation behaviour in water at different pH. It is pertinent to mention that research recommendations on chemical control of pests are considered incomplete if data on toxic residues of the parent molecule as well as their metabolites / degradation products are not provided. Moreover, fipronil is yet to be registered for use in chili and thus supervised field trial is necessary to generate a meaningful residue data which could be effectively used for the fixation of MRL.

Application of pesticides on crops involves mixing of the pesticide formulation with water. Accidental contamination of the water sources may occur while mixing and loading sprayers, leakage of stored concentrate, spray drift under windy conditions or application too close to open water. Various treatment processes are available to reduce pesticide concentrations in water, and to minimize the potential health risks associated
with exposure to the chemicals through consumption of contaminated waters. Chemical oxidation using Fenton, or Fenton-like reactions are employed for treating water contaminated with pesticides. These processes lead to complete mineralization or transformation of the original contaminant to less toxic byproducts. Thiacloprid is moderately water soluble and resistant to degradation in water by photochemical reactions or by hydrolysis at pH values between 5 and 9. Thus, accidental spills or improper handling or disposal at mixing and loading sites could eventually endanger water resources and human health due to persistent nature of thiacloprid in water. Fenton/Fenton-like/chelate-assisted Fenton reaction was envisaged for degradation of thiacloprid in contaminated water.

Thus, in order to evaluate the persistence behaviour of thiacloprid, propineb and fipronil in different crops and soil, fipronil degradates in water and the transformation of thiacloprid by hitherto unexplored Fenton/Fenton-like/chelate-assisted Fenton reactions in water, the present investigator thought it worthwhile to undertake “Studies on the chemistry, fate and behaviour of some pesticides in crop, soil and water” with the following objectives:

OBJECTIVES OF THE STUDY:
Part - I
1. Method standardization of thiacloprid and propineb in tea and soil.
2. Persistence and dissipation behaviour of thiacloprid and propineb in tea.
Part - II
1. Method standardization of fipronil and its metabolites in chilli, soil and water.
2. Persistence and dissipation behaviour of fipronil in chilli.
3. Processing factor of fipronil in chilli powder.
4. Studies on the persistence and dissipation behaviour of fipronil and metabolites in four different soils of West Bengal (New Alluvial, Red & Lateritic, Coastal and Brown forest soil).
5. Studies on the persistence and dissipation behaviour of fipronil degradates in water at three different pHs.
Part - III

1. Transformation of thiacloprid by Fenton reaction in pure and natural water.

2. Transformation of thiacloprid by Fenton-like reaction in pure and natural water.

3. Transformation of thiacloprid by chelate-assisted Fenton reaction in pure and natural water.