S Y N O P S I S

The work embodied in this dissertation is related to the investigation of some bromo/chloro/nitro - saligenin - cyclic phosphoramidothionates with reference to their chemical, biochemical, insecticidal, fungicidal and other toxicological properties besides structure elucidations by chemical analysis and spectroscopic methods.

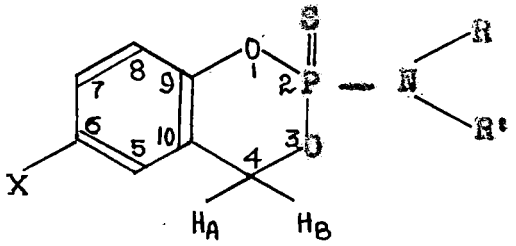
PART - I

In Part - I of this thesis, a general introduction of some organophosphorus pesticides including fungicidal activities, anticholinesterase and hydrolytic properties have been presented. Common or trade names, chemical structures and other properties of some of them have been given in Appendix - I.

PART - II

Part - II of this thesis has been devoted to a short review describing the chemical, biochemical, insecticidal, fungicidal and other toxicological properties of saligenin cyclic phosphorus compounds with special emphasis on salithion (2-methoxy-4H-1,3,2 benzodioxaphosphorin 2 - sulphide) discovered in 1963 by Prof. Eto., Prof. Oshima and their co-workers. Investigations have revealed that the biological activities of these compounds are greately influenced by the exocyclic substituents in benzene ring and/or in hetero-cyclic ring.

It was reported by Prof. Eto and his co-workers that 2-methoxy-6-nitro-4H-1,3,2 - benzodioxaphosphorin 2-sulphide (BD-8) was obtained as a paste after purification through silicic acid column chromatography and found to have about sixty times less insecticidal activity compared to salithion. However, it has been observed in this laboratory that the methoxy compound (BD-8) is a solid (m.p. 84°C), and has about 1.5 - 2 times greater oral insecticidal activity to Periplanata americana than salithion and comparable activity to grasshoppers (oxya nitiduta). Moreover, introduction of an amide group in place of an alkyl ester group often gives organophosphorus esters fungicidal, nematocidal and other biological activities. There are many examples in literature which show that some phosphoramidothionates, phosphoramides or phosphonamides in which the phosphorus atom is attached directly to the nitrogen atom of an amine or a hetero-cyclic compound such as phthalamide, imidazole or triazole, have very good fungicidal activity. These observation prompted us to undertake a systematic work on some bromo/chloro/nitro - saligenin cyclic phosphoramidothionates. The work embodied in Part-III of this dissertation is related to the investigation of some 2 - alkylamido - 6 - bromo/chloro/nitro-4H-1,3,2 - benzodioxaphosphorin 2 - sulphides having general structure (A).



A

where, X = Br or Cl or NO_2

-NRR' = pyrrolidino

= piperidino

= morpholino

= dimethylamido

= diethylamido

PART -III

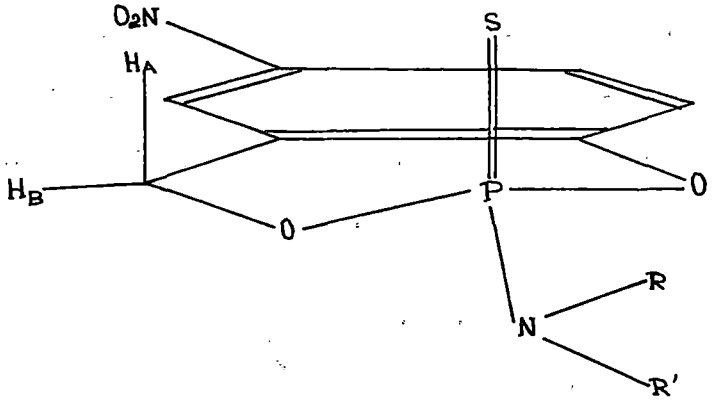
Chapter - I

Chapter - I deals with the works related to the synthesis and structure determination of the bromo/chloro saligenin - cyclic phosphoramidothionates. The structures of these compounds have been established by chemical analysis, UV, IR, Mass and ^{1}H NMR spectral data.

All compounds show common IR bands : 1000 - 1020 cm^{-1}(s) P-O-C (alkyl); 1235 - 1260 cm^{-1}(s) and 880 - 910 cm^{-1} (s), P-O-C (aryl); 800 - 830 cm^{-1}, P = S (I); 630 - 670 cm^{-1} (s), P = S (II). In mass spectra all the compounds show molecular ion peaks (M^+) and $(M+2)^+$ ion peaks. The ^{1}H NMR spectra of the 6 - bromo/chloro - saligenin cyclic phosphoramidothionates have signals at δ=4.75 - 5.75 ppm for the $-CH_2-$ protons in the dioxaphosphorin ring.

From the study of the ^{1}H NMR spectral data of some 2 - alkoxy/phenoxy/alkylamido - 6 - nitro - 4H - 1,3,2 - benzo-

dioxaphosphorin 2 - sulphides it is fairly evident that the chemical shift difference of the protons H_A and H_B increases in going from 2 - alkoxy to 2 - alkylamido compounds, and that the 2 - substituent at the same time increases in bulk, and probably spends more time in the conformation with the least steric interactions. The structure II appears to explain, to a reasonable extent, the reversal of the expected proton chemical shift order for the quasi axial and quasi equatorial protons, due to the position of the magnetically anisotropic P = S bond relative to the $-CH_2-$ group in the dioxaphosphorin ring.



II

^{13}C - and ^{31}P - NMR spectral data of some 2 - alkoxy/phenoxy/alkylamido - 6 - nitro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphides, the temperature dependant ^{1}H NMR spectra of 2 - methoxy - 6 - nitro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphide (BD-8) have been presented. It has been

observed that as the temperature is varied, the rates of interconversions of the conformers are also varied. This suggests that the methylene protons (H_{4A} and H_{4B}) are not equivalent to each other, and the dioxaphosphorin ring is conformationally mobile in solution.

Chapter - II

Chapter - II deals with the works related to the biological activities and hydrolytic properties of some 2 - alkyl - amido - 6 - bromo/chloro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphides, the results have been compared with that of the analogous 2 - alkyl ⊜ amido - 6 - nitro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphides synthesized in this laboratory.

All the compounds have less oral insecticidal activity than salithion against P. americana. They are less toxic to male rats than salithion, and are not phytotoxic. All the 6-bromo/chloro saligenin cyclic phosphoramidothionates show very poor anticholinesterase activity in blow-fly head homogenate and goat-blood plasma. The 6 - bromo/chloro-saligenin cyclic phosphoramidothionates show very good inhibitory effect on the growth of Helminthosporium oryzae and Pyricularia oryzae; even compared to Hinosan they have greater inhibitory effect.

Of all the compounds 2 - N,N - Dimethylamido - 6 - chloro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphide (CL-4) and 2 - N, N - Diethylamido - 6 - chloro - 4H - 1,3,2 - benzodioxaphosphorin 2 - sulphide (CL-5) are most effective against H. oryzae; 2 - N, N- Diemethyl amido - 6 - bromo - 4H - 1,3,2 -benzodioxaphosphorin 2 - sulphide (BR-4) is most effective against P. oryzae. From/ the

chemical hydrolysis studies it has been observed that the 6 - chloro saligenin cyclic phosphoramidothionates are most stable and the 6 - nitro - saligenin cyclic phosphoramidothionates are least stable to alkaline hydrolysis at pH 11.85.

The biological activities and other data justify further examination of these phosphoramidothionates as potential pesticides.