Chapter 5

Conclusive statement,
Significant Findings of the Work
&
New Gateways/ Future Scope
5.1. SIGNIFICANT FINDINGS OF THE WORK

On the basis of current study and literature backup, we are able to conclude that Gly/Acpt/Mono/Phor can form the stable complexes with essential metal ions, and even stronger in the presence of HA. Gly/Acpt/Mono/Phor can inhibit the growth of soil microorganisms and their siderophore production ability, finally show adverse effects on essential metal ions uptake. Wheat growth experiment has proved that Gly/Acpt/Mono/Phor can inhibit the plant growth by inhibiting the uptake of essential metal ions. Current study has proved that Gly/Acpt/Mono/Phor may inhibits the plant growth by curbing essential metal ions uptake in four ways: (1) through direct interactions with metal ions, (2) through interactions with bounded metal ions of siderophores, clay and humates, (3) through the direct inhibition of PGPR strains, and (4) through the direct/indirect inhibition of plant growth. In future, detailed studies at molecular levels are required to find the exact mechanism behind the inhibition of plant growth.

There were only few studies indicated that pesticides (organophosphates) can form stable complexes with essential metal ions e.g. Gly\textsuperscript{2,23,42-45}. Unfortunately, no one have paid attention on curbing of soil fertility through metal ion complexation. Surprisingly, none of the research group highlighted effect of insecticides w.r.t. interactions with essential metal ions. Because, all these pesticides have strong coordinating sites with metal ions (like O, N (hard base) and S (soft base)), but their effect of cumulative interactions with essential metal ions is not tested during their release in market. In current study we have proved that acephate (insecticide), monocrotophos (insecticide) and phorate (nematide/ insecticide) can form stable complexes with metal ions as like glyphosate (herbicide). In our chemical/biochemical/agricultural aspect of study, it was found that pesticides under study can form stable complexes with essential metal ion and can adversely affect siderophore production, which ultimately curb the soil fertility and inhibit wheat (plant) growth.
Number of studies have been performed to decompose pesticides (chemically and biochemically), but no one pay attention how these pesticides and their metal complexes deprive the soil’s beneficial microorganisms/ siderophore and siderophore producing microorganisms. As these siderophores have direct link with crop health, play the key role for metal ions uptake from soils to plants. These siderophores convert the non-soluble metal ions into soluble form. But, once these microorganisms were deprived by pesticides, the crop productivity may ultimately deprive.

Pesticides can be adsorbed on the soil through the different mechanisms and forms stable complexes with soil’s humic substances. As we know that humic substances are “black gold” of soil and pay the vital role to maintain soil fertility and crop health. Once the stable complex forms by the pesticides with humic acid in the presence or absence of metal ions, soil’s health deprives. So, our observation of metal complex formation of HA along with Ops indicates an alarming situation for deprived health of soil/plant.

Farmers never use single pesticide in a crop session. By the use of multiple pesticides there are chances of formation of multipesticide metal complexes with different stability and toxicity. We have studied this under “cocktailed effect” or “axial bond effect”. It was found that pesticide having greater chelating ability can form complexes with essential metal ions through equitorial positions and axial positions were occupied by weak chelating pesticide.

5.2. NEW GATEWAYS/ FUTURE SCOPE
As we are the first generation worker on this topic, it’s our prime duty to introduce about the future scope of the work. There are numbers of topics/gateways open up for future work by this study;

(1) Similar studies can perform on same class (organophosphate) as well different classes of pesticides,
(2) Study of time required for siderophore producing bacteria to overcome from the effect of pesticides in the absence and presence of metal/ metal ions/ metal oxides,
(3) Search of microorganisms are required that can decompose most of the pesticides in presence/ absence of metal ions. Also, their mechanistic approach is needed to be analyzed.

(4) Method of decomposition of pesticides is needed to be studied in between pH 5-8, which is required for healthy soil. Because in past, maximum attentions were paid on pH below 3 and above 10 to just decompose the pesticides.

(5) Current study is performed under the mixture of two pesticides, and in a crop session more than two pesticides may be used by farmers.

(6) Current study is performed on wheat only; also, it is essential to determine the affects of pesticides on other crops.

(7) We studied effect of pesticide on few microorganisms only, also, it is essential to determine the affects of pesticides on farmer’s friends like earthworms, ants etc.

(8) Theoretical analysis of stability of formed complexes is required. By obtaining bond energy metal-pesticide complex, we can exactly look on to the seriousness of the problem.

5.3. SUGGESTIONS AND QUERIES

It is our humble request from all the readers/ observers to provide us, their valuable suggestions and critical reviews. If there is any query/ suggestions/ reviews regarding the thesis work please contact us or mail at the email address; nirajiitr@gmail.com (Ph.D. Supervisor) and v.kumar8491@gmail.com (Research Scholar).