

Summary

1. A review of literature relating to investigation on changes in different biochemical parameters as a result of commonly encountered environmental stresses in plants i.e. heavy metals, insecticide and fungicide application has been presented.
2. The materials and methods used in this study have been discussed in detail.
3. Tea plants, seedlings, young shoots and full grown tea bushes of different varieties i.e. TV-27, TV-23, TV-26, TV-30, TV-29, TV-28, TV-22, TV-18, HV-39 and T-78 were subjected to different types of anthropogenic stresses i.e. heavy metal, spraying with fungicide and insecticide. The two heavy metals cadmium nitrate 4-hydrate [$\text{Cd}(\text{NO}_3)_2 \cdot 4 \text{H}_2\text{O}$], Copper sulphate 5 hydrate [$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$] used in the present study were applied in the form of their respective salts at 100, 500 and 1000 $\mu\text{g}/\text{ml}$ concentration. Among the fungicide hexaconazole and insecticide acephate were selected for the study were applied at 0.1% and 1:400 concentrations respectively.
4. The result of quantification of total phenol as well as O-dihydroxy phenol content of leaves immersed at different concentration of heavy metal solutions revealed significant differences among the varieties. An increase in phenol content was evident only at lower concentration but decrease at the higher concentration of the tested metals. When seedlings were treated with the heavy metal solutions phenol content was increased after each application though reduction was noted at the highest concentration after 2nd application. An increase in phenol content was evident following 1st and 2nd spray with both fungicide and insecticide application.
5. An overall increased accumulation of proline content was noted in tea leaves subjected to heavy metal as well as fungicide / insecticide treatment.
6. An increase in protein content was evident due to heavy metal treatment, although at higher concentration accumulation was decreased. Protein content was overall reduced following the application of insecticide /fungicide to the seedlings and bushes.

7. There was a little alteration in protein band pattern revealed in SDS gel electrophoresis after treatment with heavy metal solutions or insecticide / fungicide treatment. In lower concentration of heavy metal new band was expressed, whereas, at highest concentration band disappearance was noted.
8. Chlorophyll content of the leaves showed an overall decline in all treatments. Carotenoid contents also decreased at the higher concentrations of heavy metals. Spraying with insecticide /fungicide in seedlings and in mature bushes revealed increased carotenoid content after each application.
9. Treatment with the heavy metal solutions induced accumulation of total or reducing sugar content only at lower concentration but at the higher concentration or prolonged treatment sugar content declined. In case of insecticide / fungicide treatment total sugar as well as reducing sugar content was decreased.
10. Phenyl alanine ammonia lyase enzyme activity showed general increment after heavy metal treatment both *in vitro* and *in vivo*. However, enzyme activity was declined significantly after spraying with insecticide and fungicide in relation to control.
11. Peroxidase activity increased at the lower concentration of the heavy metals , whereas activity decreased with increase in concentration. A significant increase in peroxidase activity was noticed after spraying with insecticide and fungicide application. The accumulation was much higher following 2nd spray .
12. Polyphenol oxidase showed greater activity at the lower concentration of the tested metals but activity declined at the higher concentration or prolonged application of the heavy metal solutions. There was an increase in activity of the enzyme in the leaves following spraying with both insecticide and fungicide.
13. Different peroxidase isozyme pattern was evident in most of the heavy metal treatments. The disappearance or expressions of new bands were noticed after heavy metal treatments. Significant changes of band pattern were observed in tea leaves treated with the insecticide/fungicide. Expression of new band was noted in the treated leaves.

14. The polyphenol oxidase isozyme pattern of leaves treated with heavy metals or insecticide/ fungicide revealed little alteration in band pattern.
15. HPLC analysis of catechins revealed changes in the isomer pattern after treatment with the two heavy metals. Significant variation was noted in peak heights and number in the different varieties. Chemical spraying led to a decrease in number and the height of isomers.
16. Heavy metal accumulation in tea leaves was determined after treatment with heavy metal solutions. Traces of heavy metals were observed in untreated control also. Accumulation of Cu was much higher than Cd after every application of the said metals.