*J. Phytol. Res.* 7 (2): 165-167, 1994

# BIOCHEMICAL CHANGES IN *HYPTIS SUAVEOLENS* (L.) POIT AND *HELIANTHUS ANNUUS* L. IN RESPONSE TO CHROMIUM TREATMENT

**S.VASANTHA PILLAY**

Plant Physiology Laboratory, Department of Botany, Osmania University, Hyderabad-500 007, India.

The effect of soil chromium treatment on different metabolites and certain enzymes of *Hyptis suaveolens* (L.) Poit. and *Helianthus annuus* L. was investigated. Treated plants showed a reduction in soluble and protein nitrogen content and an increase in reducing sugars. Decrease in catalase activity and increase in peroxidase and polyphenol oxidase activity was observed for both the plants; however the changes in the enzymes activity was more in sunflower. Acid phosphatase and ATPase activity increased at higher levels of treatment.

**Keywords** : Chromium toxicity; *Helianthus annuus*; *Hyptis suaveolens;* Metabolism.

Soil chromium treatment to *Hyptis suaveolens* (L.) Poit and *Helianthus annuus* L. (sunflower) caused a reduction in growth and pigment composition. Interactions and changes in the levels of macro and micro-nutrients were also observed[1]. Comparing the toxic effects of Cr on sunflower and *Hyptis,* the latter was found more tolerant[1]. The present study was conducted to find out the changes in different metabolites and activity of certain enzymes as influenced by different levels of chromium treatment.

Experimental materials used and the methods followed are described in the earlier communication[1]. The different metabolites were estimated from an ethanol homogenate of the leaves. Nucleic acids were extracted as per the modified method of Ogur and Rosen[2]. RNA and DNA in the extract were estimated by adapting the procedures of Schneider[3] and Burton[4]. The soluble nitrogen was determined as per the modified method of Moore and Stein[5]. Protein nitrogen was also estimated similarly after subjecting the material to acid hydrolysis to yield free amino acids. Reducing sugars were estimated by Nelson's modification of the micro-somogyi Method[6]. Starch was also analysed similarly after extraction by perchloric acid digestion. The activity of catalase, peroxidase and polyphenol oxidase was assayed after the method of Chance and Machly[7] as modified by Kar and Mishra[8]. The method given by Parida and Mistra[9] was followed for the estimation of acid phosphatase and ATPase activity.

Table 1 shows the effect of chromium treatment on the nucleic acid; nitrogen and carbohydrate fractions of *Hyptis* and sunflower. Chromium treated *Hyptis* plants showed a decrease in RNA, soluble nitrogen and protein contents. Reducing sugars and starch increased at higher levels of treatments.In case of sunflower plants, chromium treatment brought down the level of soluble nitrogen and protein and increased the level of reducing sugars.

In both *Hyptis* and sunflower plants the catalase acitivty decreased following treatment with chromium (Table 2). Sunflower plants which were more affected by chromium treatment than *Hyptis*[1] showed

**Table 1.** Effect of chromium on the nucleic acid, nitrogen and carbohydrate fraction of *Hyptis suaveolens* and sunflower (*Helianthus annuus* ). (Results mean of three replicates)

| Treatments | Nucleic acid Fractions | | Nitrogen Fraction | | Carbohydrate Fraction | |
|---|---|---|---|---|---|---|
| | mg/g. f.wt. | | µg/g. f.wt. | | mg/g. f.wt. | |
| | DNA | RNA | Soluble nitrogen | Protein nitrogen | Reducing sugar | Starch |
| *H.suaveolens* | | | | | | |
| Control | 1.47 | 12.11 | 62 | 2597 | 0.88 | 25.0 |
| Cr,250 ppm | 1.57 | 8.75 | 43 | 2242 | 1.40 | 33.0 |
| Cr,500 ppm | 1.57 | 5.50 | 46 | 1658 | 1.80 | 35.0 |
| Cr,750 ppm | 1.29 | 5.60 | 50 | 1658 | 2.00 | 37.0 |
| *H.annuus* | | | | | | |
| Control | 1.76 | 5.92 | 54 | 3160 | 2.00 | 35.5 |
| Cr,250 ppm | 1.29 | 5.25 | 38 | 1954 | 1.20 | 24.9 |
| Cr,500 ppm | 1.30 | 5.20 | 38 | 2077 | 2.40 | 33.0 |
| Cr,750 ppm | 1.21 | 5.12 | 37 | 2324 | 3.00 | 25.0 |

**Table 2.** Effect of chromium on the activity of Catalase, Peroxidase, Polyphenol oxidase, Acid phosphatase and ATPase in leaves of *Hyptis suaveolens* and sunflower (*Helianthus annuus*). (Reuslts mean of three replicates)

| Treatments | Catalase mg.$H_2O_2$/ destroyed/ min | Peroxidase mg./purpuro gallin/ g.f.wt. | Polyphenol oxidase mg./purpuro gallin/ g.f.wt. | Acid phosphatase enzyme units/ g.f.wt.. | ATPase enzyme units/ g.f.wt. |
|---|---|---|---|---|---|
| *H.suaveolens* | | | | | |
| Control | 22.61 | 17.6 | 9.9 | 1.0 | 0.6 |
| Cr,250 ppm | 19.78 | 25.3 | 22.0 | 1.4 | 1.4 |
| Cr,500 ppm | 11.32 | 52.8 | 24.2 | 1.7 | 1.4 |
| Cr,750 ppm | 6.76 | 70.4 | 35.2 | 2.0 | 1.6 |
| *H. annuus* | | | | | |
| Control | 26.35 | 19.8 | 2.2 | 2.6 | 0.8 |
| Cr,250 ppm | 11.45 | 41.8 | 17.6 | 2.6 | 1.1 |
| Cr, 500 ppm | 6.86 | 55.0 | 24.2 | 2.7 | 1.2 |
| Cr,750 ppm | 3.40 | 155.3 | 41.8 | 3.8 | 1.8 |

a greater decrease in catalase activity. At the highest level of 750 ppm chromium treatment the decrease in activity was nearly 8 fold in sunflower as compared to 3 fold decrease in *Hyptis*. Peroxidase and polyphenol oxidase activity increased with increase in chromium treatment (Table 2). At 750 ppm, the increase in peroxidase acfivity was 8 fold for sunflower and only four fold for *Hyptis*. Polyphenol oxidase activity also increased 20 fold in sunflower as against a 3 fold increase in *Hyptis* at the same level of treatment. Decrease in catalase activity and increase in peroxidase activity by excess supply of nickel has been reported[10,11]. The disturbed metabolism as reflected by changes in the activity of these enzymes is an effort by the injured plant to survive under metal stress. Changes in the activity of the enzymes were more pronounced in sunflower than Hyp*tis* indicating the tolerance of the latter. Activity of acid phosphatase and polyphenol oxidase increased both in *Hyptis* and sunflower (Table 2) at higher levels of chromium treatment probably to increase the rate of Pi liberation for maintenance of higher cellular activity.

The author is thankful to the Council of Scientific and Industrial Research (CSIR), New Delhi for the award of a fellowship.

## References

1. Pillay S V, Rao V S and Rao K V N 1991, *In:Botanical Researches in India* (ed.) N C Aery and B L Chaudhary pp.239-245.
2. Ogur M and Rosen G 1950, *Arch. Biochem. Biophys.* **25** 262
3. Schneider W C 1957, *In:Methods in Enzymology* Vol.*3* pp. 680-684.
4. Burton K 1968, *Methods in Enzymology* Vol. *12 B* (Eds) L. Grossman and K Moldave Academic Press, New York, pp. 163-166.
5 Moore S and Stein W 1954, *J. Biol.Chem.* **211** 907
6. Nelson N 1944, *J.Biol. Chem.* **153** 375
7. Chance B and Machly A C 1955, *Methods in Enzymology* **2** 764-775
8. Kar M and Mishra D 1976, *Plant Physiol* . **41** 1152
9. Parida R K and Mishra D 1980, *Photosynthetica* **14** 431
10. De Kock P C, Commissong K, Farmer V G and Inkson R H E 1960, *Plant Physiol* . **35** 599
11. Agarwala S C and Kumar A 1962, *J. Indian Bot. Soc.* **41** 77