International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST229675

Effect of Copper on Soil, Growth and Metabolites in Spinacia oleracea L.

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Article Info
Volume 9, Issue 6
Page Number : 531-540

Publication Issue
November-December-2022

Article History
Accepted : 05 Nov 2022
Published : 20 Dec 2022

ABSTRACT

This study explored the effects of foliar Spray of selected plant growth regulators (PGRs) on Spinacia oleracea L. and it is used as Copper sulfate at 50,100,150,200,250 ppm. Two sets of selected plants were prepared, one of them was treated with different concentration of copper and another set was kept as control. The analysis of foliar treated plants revealed the content of Total sugar (TS), Reducing Sugar (RS), Total protein (TP), Total Phenol (TPH), Total chlorophyll (TC).The physiological parameters which were measured are Height of Plants, Fresh weight of Roots, Fresh weight of leaves, Number of leaves. Soil parameters (Soil pH, Electrical conductivity, Organic carbon and Nitrogen, Boron and Sulphur, Potassium, phosphorous, Zinc, Copper and Iron) were also measured. From the result it was observed that plant growth in treated plants was better than control plants. There was a positive change in plant Growth.

Keywords : Foliar spray, Plant growth regulators, Copper sulfate, Physiological parameters, Soil parameters, Spinacia oleracea L.

I. INTRODUCTION

Copper is an effectively biocide. Cu is a micronutrient for normal growth and development. Copper (Cu) is a heavy metal which in recent studies has been attributed an increasing role in metabolic processes of plant cells. Copper is taken up by higher plants largely in the form of Cu^{+2} due to the action of still not well-known mechanisms. For its absorption from the rhizophere, in which it is almost totally bound to various ligands. Copper sulfate are commonly applied to soil to provide copper. Copper is a redox active transition metal that is involved in many physiological processes in plants because Cu can exist in multiple oxidation states in vivo. Little work has been done in this field wherein the plants have been subjected to treat with copper sulfate in different concentration and another set was control which was without copper for this one plant was selected for experiments.

II. MATERIALS AND METHODS

The selected plant was *Spinacia oleracea* L. The plant seeds were grown in the pots in Botanical garden of Botany department, Gujarat University to investigate the effect of copper on plants, two sets with three replica of each were prepared for the experiment, one set was exposed to the copper sulfate and other set of plants was kept as control i.e. without any copper treatment. Plants were treated with copper for the 30 days of duration, in which copper was applied after each an interval of 5days. After treatment plants were harvested and washed thoroughly with distilled water. Harvested plants were used for analysis of soil, plant growth and various metabolites. The experiments were carried out in completely randomized design with three replicates. Chlorophyll were extracted from the leaves and estimated by the method of Arnon (1973), Estimation of Total Sugar & Reducing sugar was done in plant extracts by the protocol given by Nelson (1944), Starch was estimated by the method of Chinoy (1939), Estimation of protein was done in plant extracts by the method of Bradford (1976), Total phenol were estimated by using the method described by Bray and Thorpe (1954). In this experiment also performing soil parameters like Soil pH, Electrical Conductivity, Organic Carbon, Nitrogen, Sulphur, Boron, Phosphorous, Potassium, Zinc, Copper & Iron by using the standard methods.

III. RESULT

Copper and Plants are significantly related to each other. When copper was applied to the plants, they showed some drastic responses and affect both morphologically and physiologically.

Effect of Copper on Plant Growth

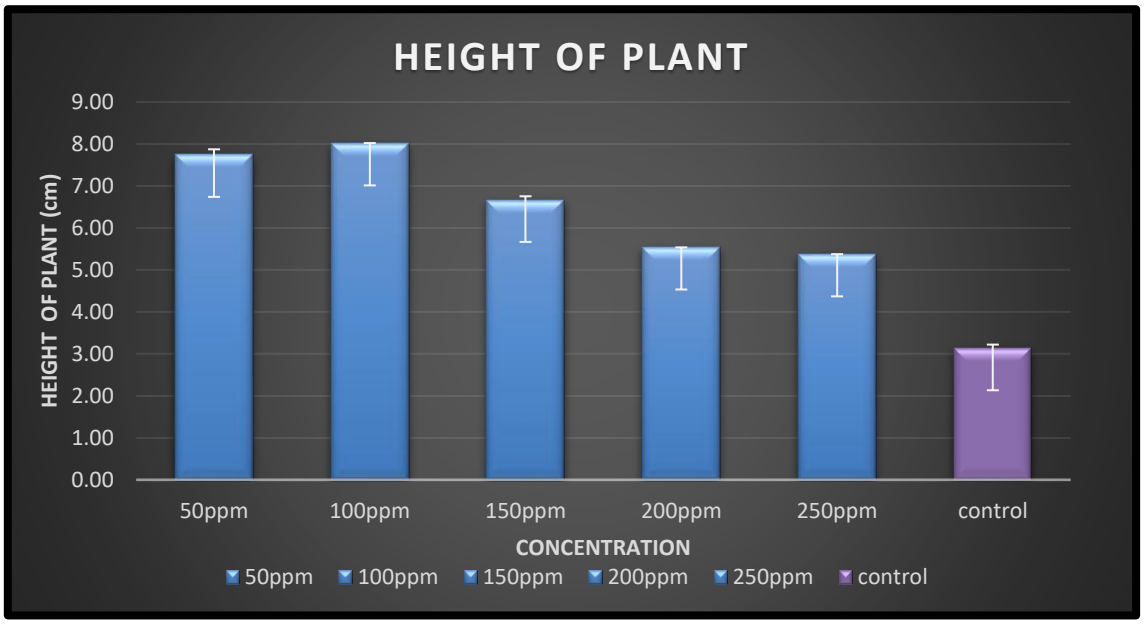

Figure 1. Effect of $CuSO_4*5H_2O$ on plant height. Values represent mean ± S.E. (n=3)

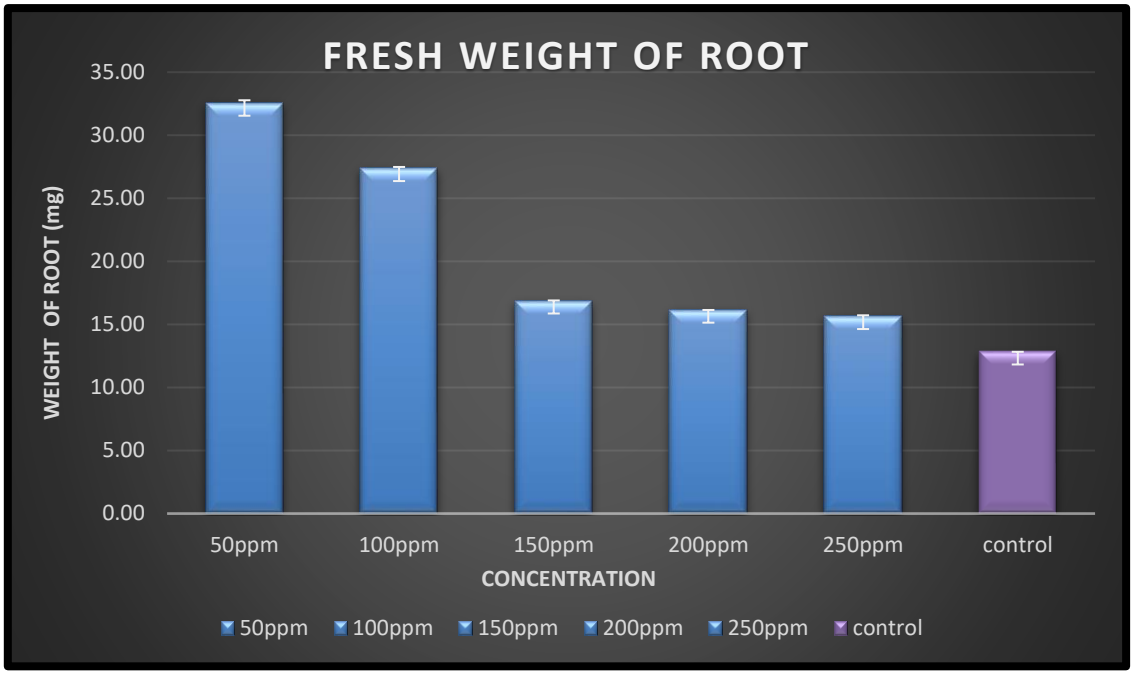

Fig 2.Effect of $CuSO_4*5H_2O$ on fresh weight of roots. Values represent mean ±S.E. (n = 3)

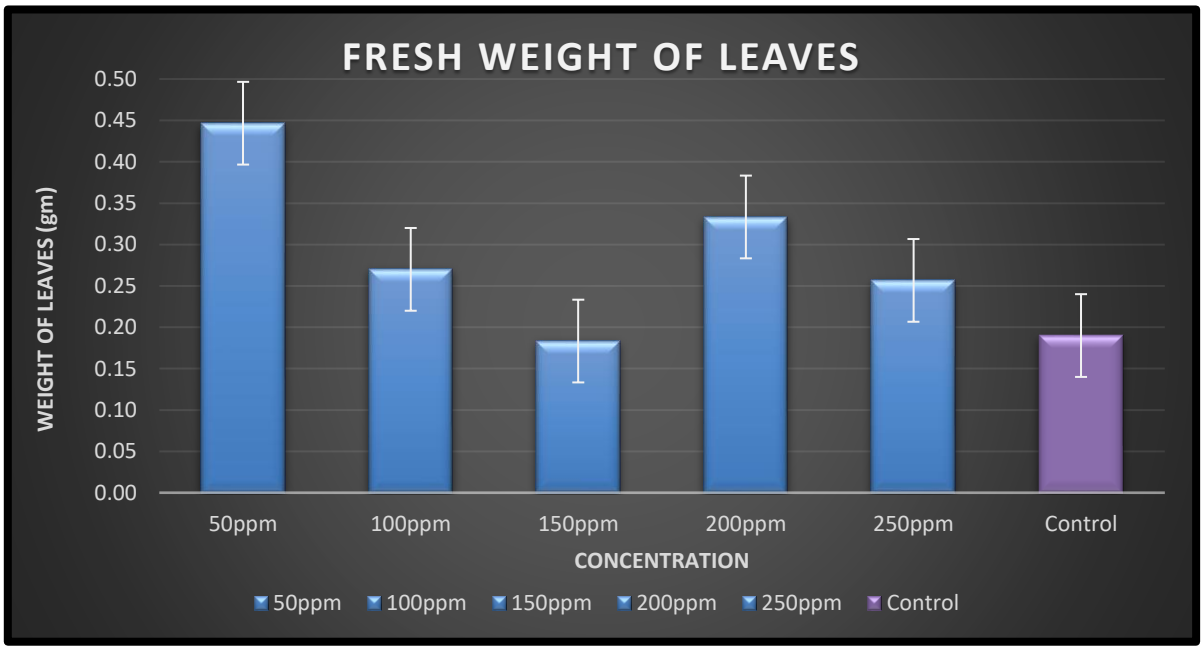

Fig 3.Effect of $CuSO_4*5H_2O$ on fresh weight leaves. Values represent mean ±S.E. (n = 3)

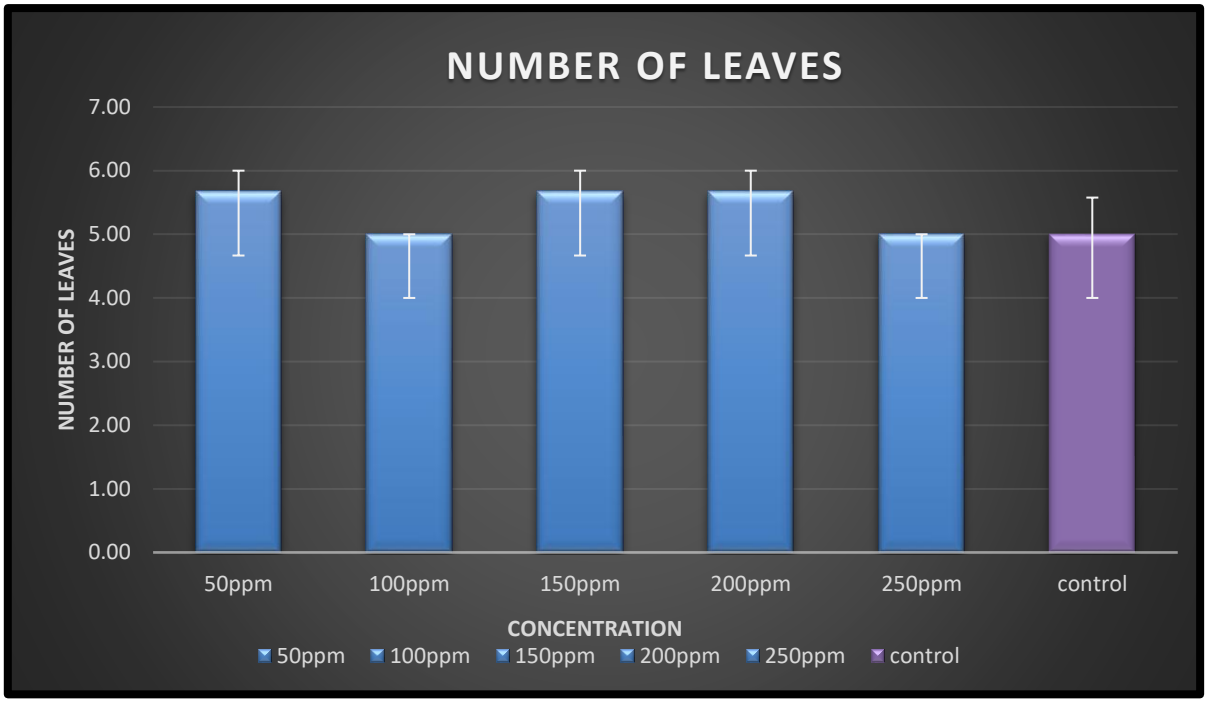

Fig 4. Effect of $CuSO_4*5H_2O$ on number of leaves. Values represent mean ±S.E. (n = 3)

When plants were exposed to the copper sulfate then it showed noticeable changes in plant growth. The height of plants in treated set is more than the control one. In 100 ppm of concentration shows the best result (Fig 1).When copper applied to the plants fresh weight of roots and leaves also affected in plant growth in 50 ppm of concentration shows more weight than the other one. (Fig 2&3). Number of leaves also increased in treated plants as compare to the control plants.in 50,150,200 ppm of concentration shows more number of leaves. (Fig 4).

Effect of Copper on plant metabolites

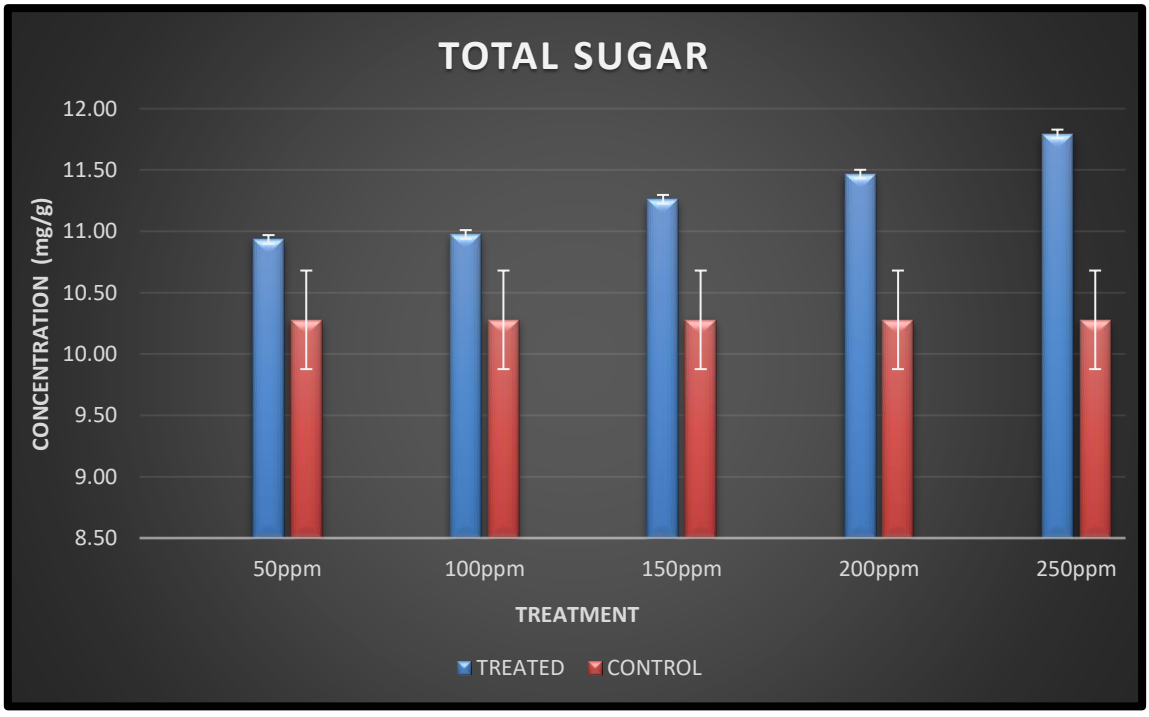

Figure 5.Concentration of Total Sugar. Values represent mean ± S.E. (n = 3)

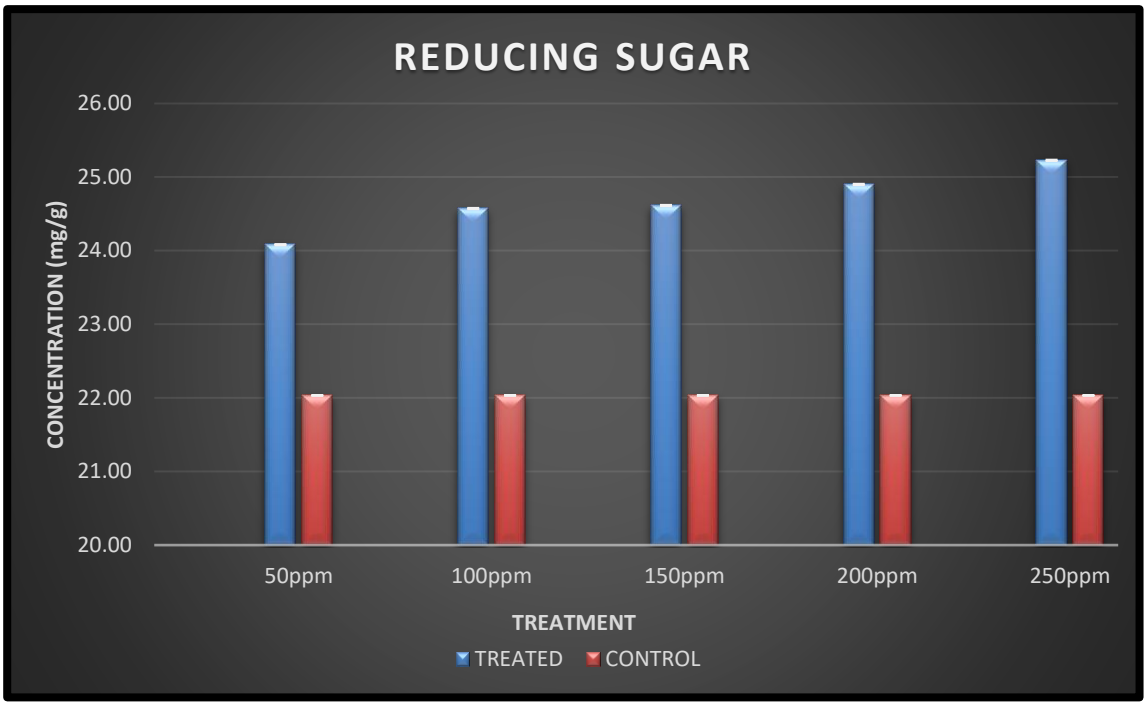

Figure 6.Concentration of Reducing Sugar. Values represent mean ± S.E. (n = 3)

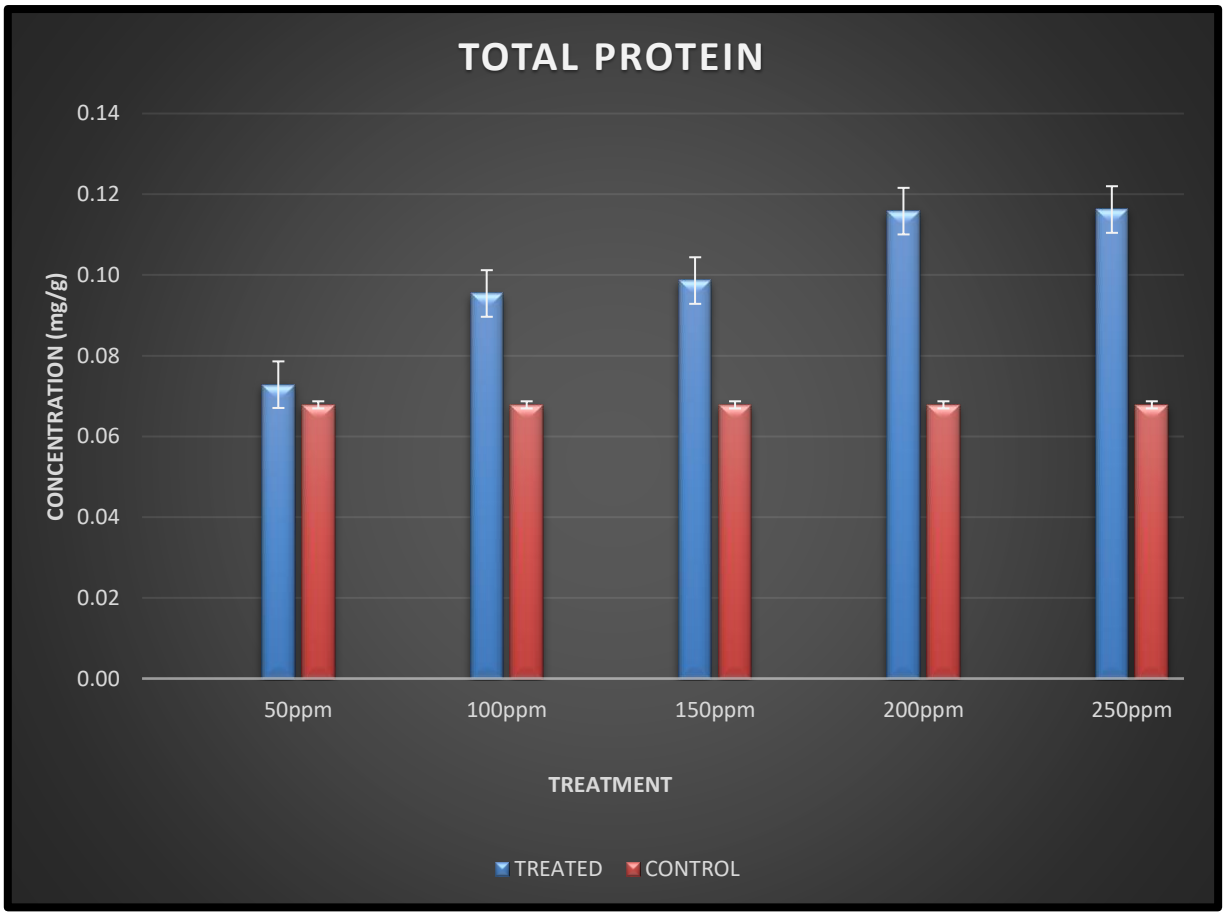

Figure 7.Concentration of Total protein. Values represent mean ± S.E. (n = 3)

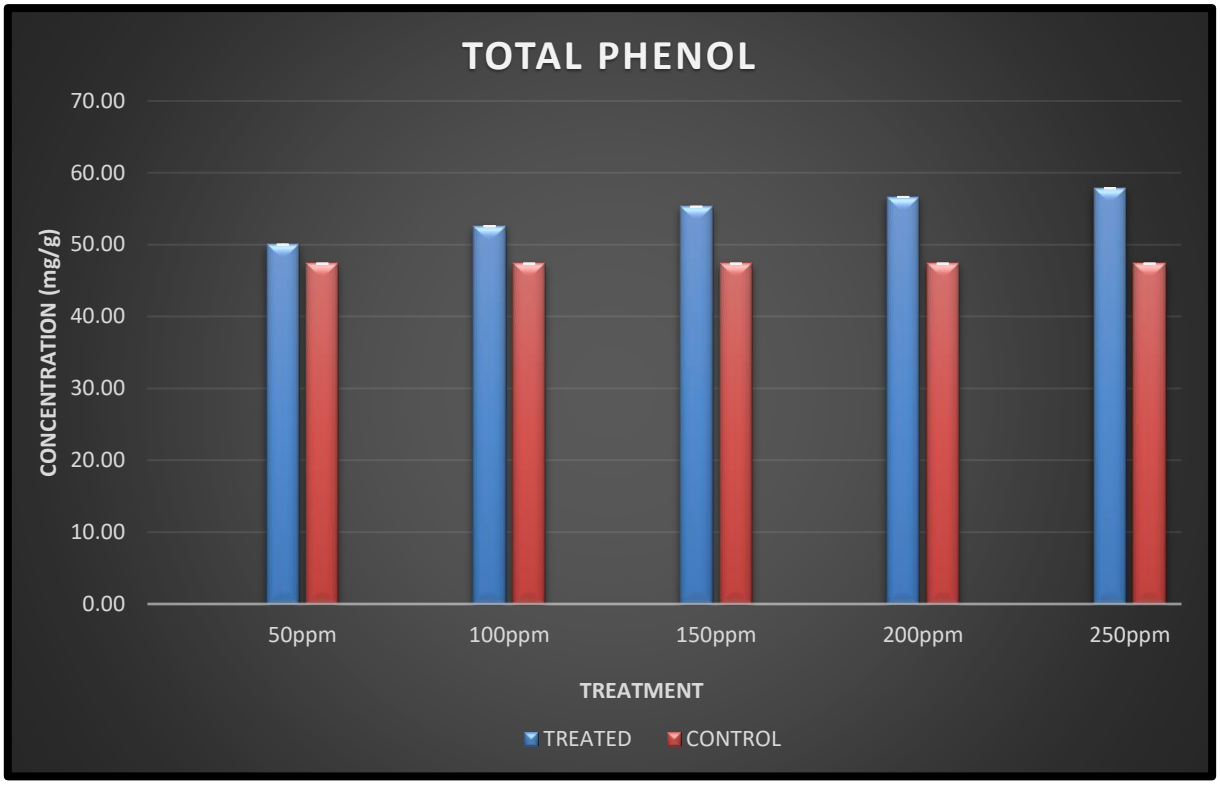

Figure 8.Concentration of Total phenol. Values represent mean ± S.E. (n = 3)

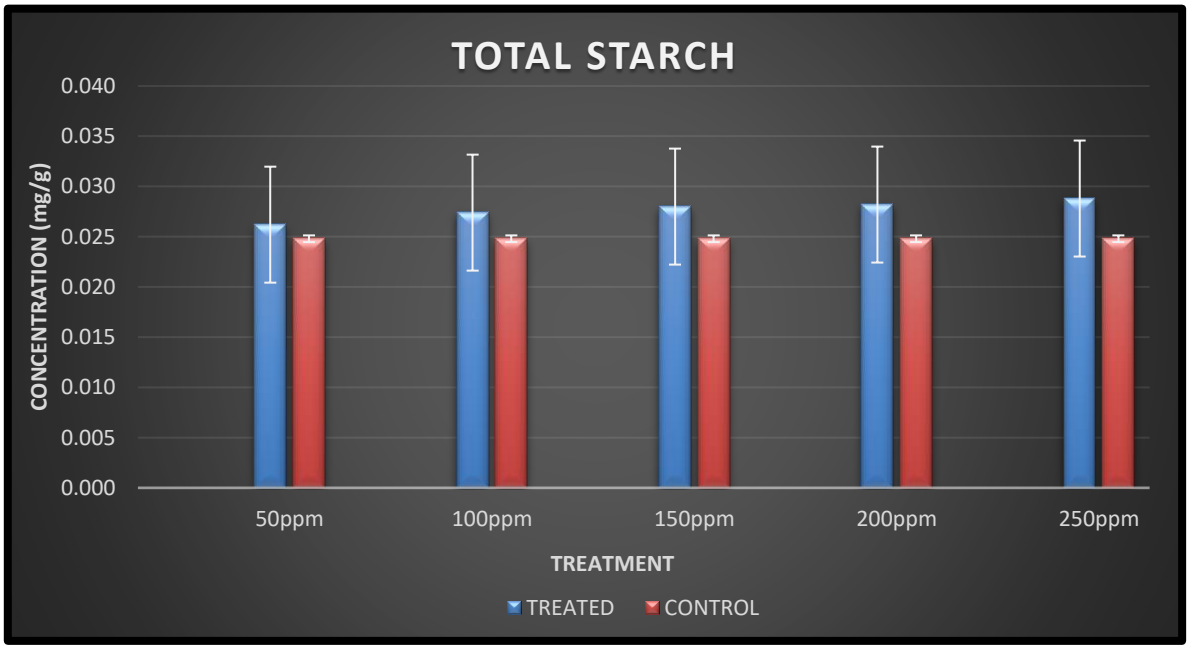

Figure 9.Concentration of Total Starch. Values represent mean ± S.E. (n = 3)

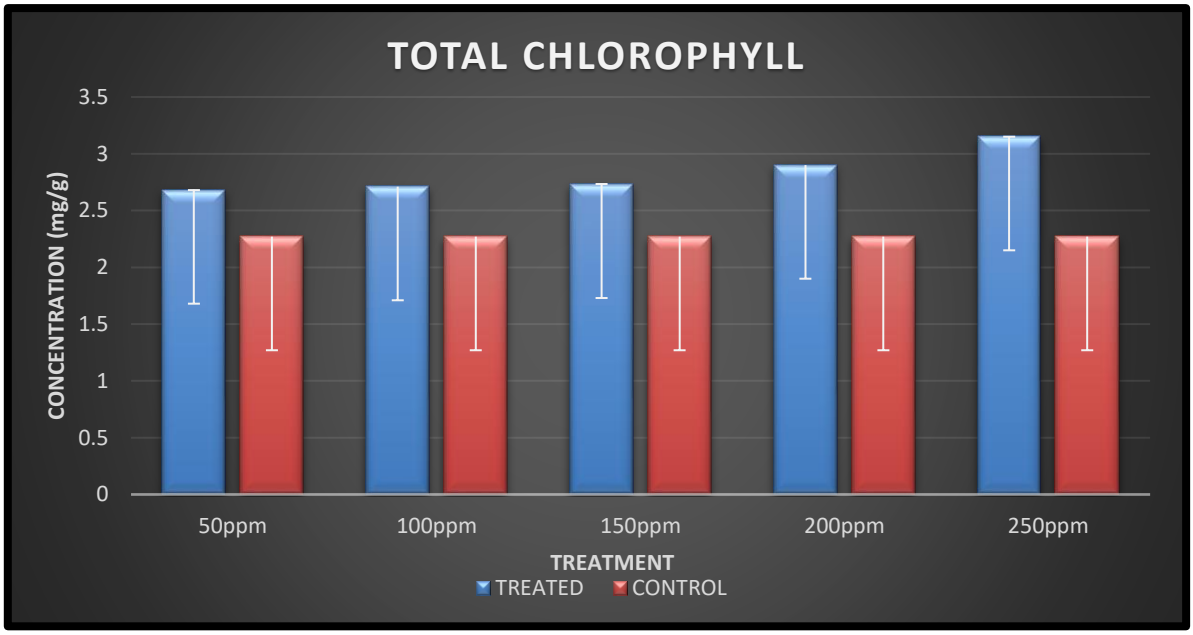

Fig 10.Concentration of Total Chlorophyll. Values represent mean ± S.E. (n =3)

Result showed that copper not only affects the plant growth, but it also affects the concentration of various metabolites. When the copper was applied to the plants then there was increase in the concentration of total sugar & reducing sugar in treated plants as compare to the control one in concentration of 250 ppm shows the best result (Fig 5&6).when plants were exposed to the copper, it affects the concentration of protein.in this experiment also 250 ppm of concentration shows the best result (Fig 7).There was also increase in the concentration of total phenol content in the treated set. The concentration of 250 ppm shows best result as compare to control plant (Fig 8).there was no change in total starch content so result showed that starch content almost an equal in treated as well as control (Fig 9). In 250 ppm of concentration had the higher amount of chlorophyll in treated set as compare to control ones (Fig 10).

Effect of copper on Soil

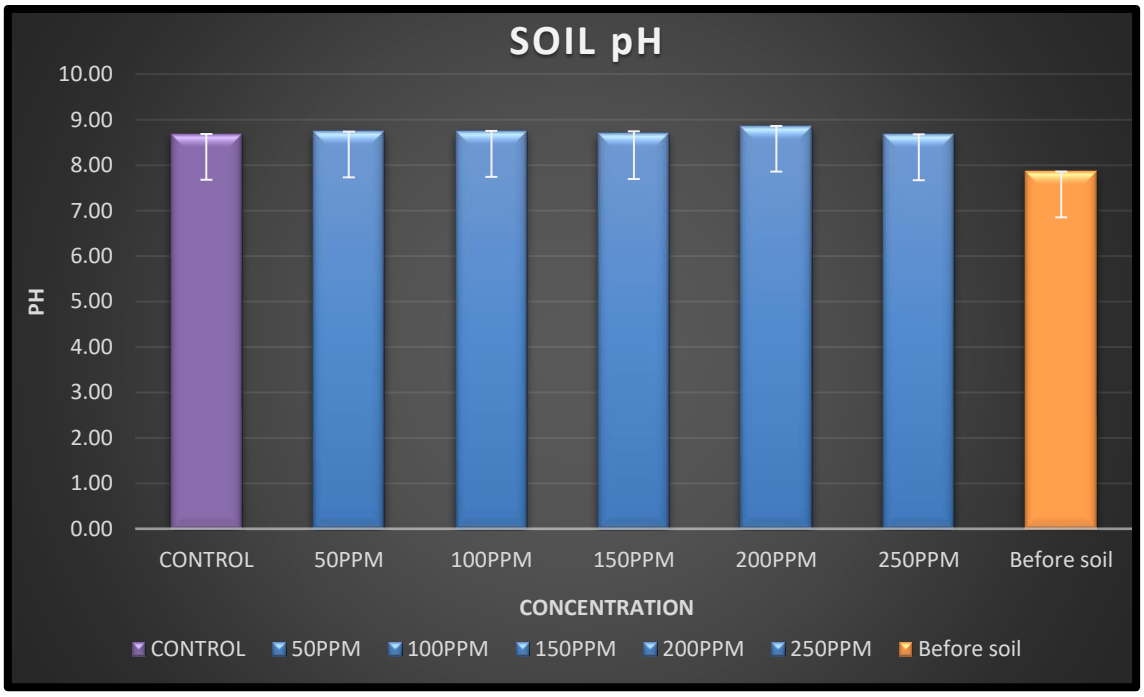

Fig 11.Soil pH.

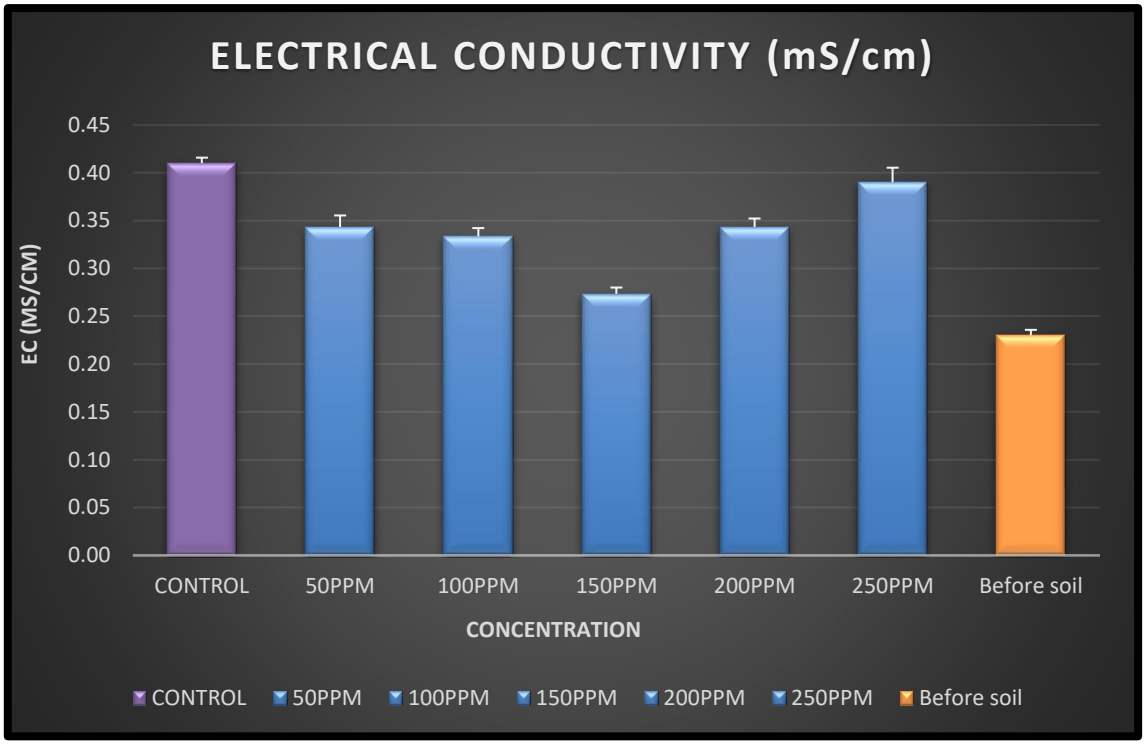

Fig 12.Elecrical conductivity.

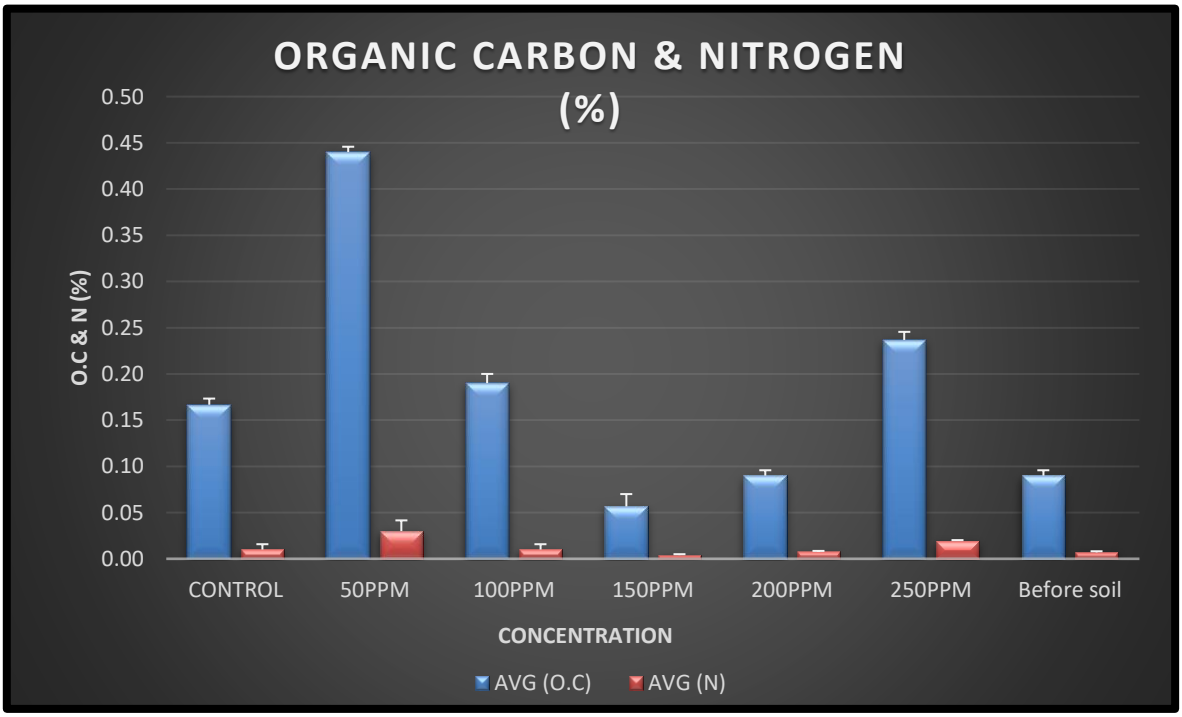

Fig 13.Organic carbon and Nitrogen

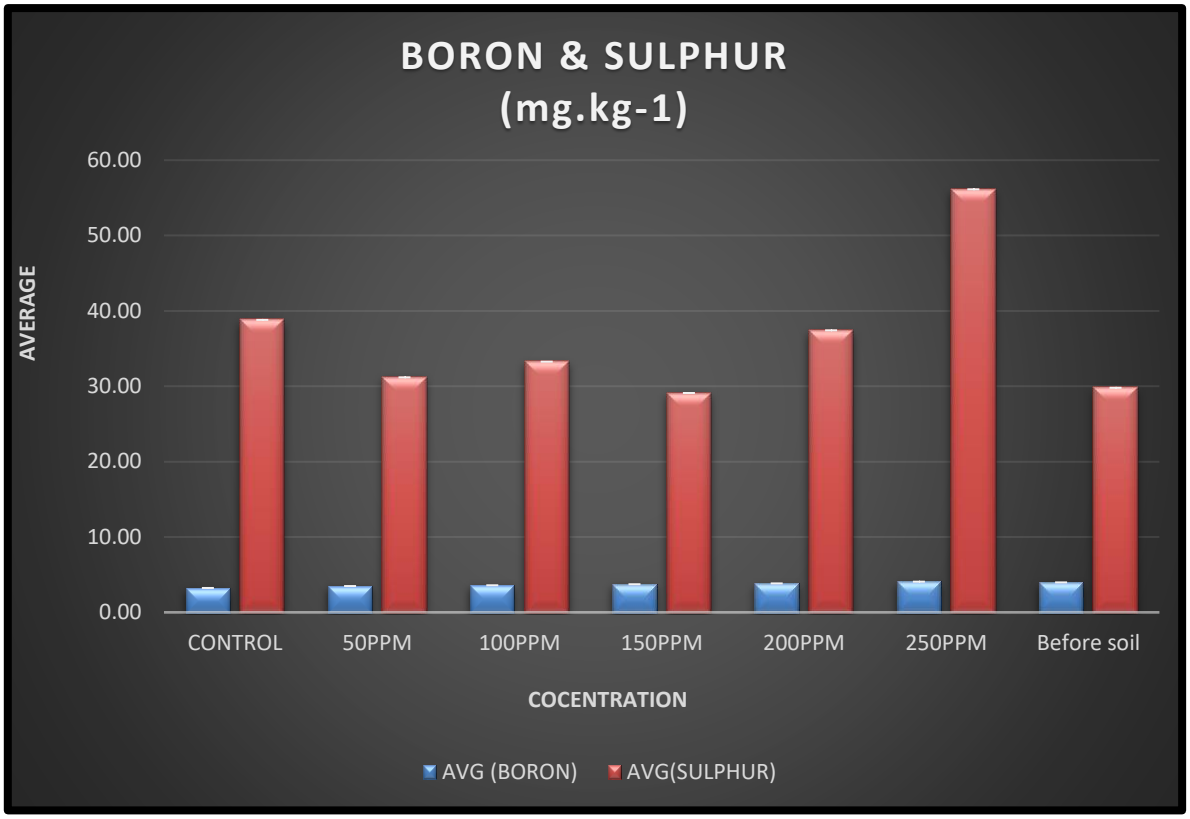

Fig 14.Boron and Sulphur

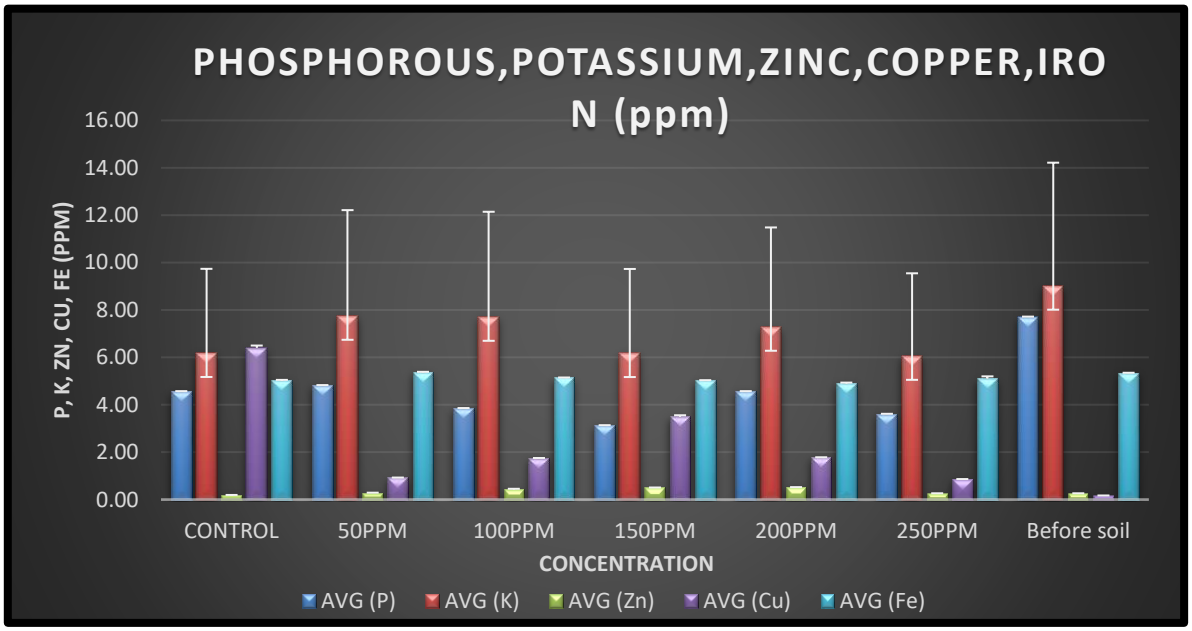

Fig 15.Phosphrous, Potassium, Zinc, Copper, Iron

Result showed that pH was decreased in before treatment of soil sample as compared to other sets (Fig 11).In electrical conductivity result showed that in before treatment of soil electrical conductivity was decreased than the other sets, while in control set was increased. So, before treatment of soil was slightly saline and in control and other concentration of soil was moderately saline (Fig 12). When plants were exposed to the copper it affects the organic carbon and nitrogen, both were increased in 50 ppm of concentration (Fig 13). Result was also showed that sulphur was high amount in soil as compare to Boron in 250 ppm of concentration high amount of boron and

sulphur were present (Fig 14). Graph showed that by copper treatment, among all the nutrients, significant nutrient was observed in potassium. Zinc was very low in this soil as compare to other elements (Fig 15).

IV. DISCUSSION

Our experiment shows that plant respond to copper treatment, it means in treated plants length of root increased and they become healthier. Copper also increases number of leaves. Copper effect actually influencing the plant growth and in a similar manner, it also affecting the plants biochemically. If plants were exposed to the copper then there was also a change in the concentration of these metabolites.in soil also affecting copper concentration.

V. CONCLUSION

When copper is applied to the plants, then plants shows positive results .There was a positive change in the plant growth. Plants grow faster when treated with copper. Copper also greatly influences the concentration of various metabolites. Hence this copper concept can be very useful in the field of Horticulture, Physiology, Ecology, Biochemistry and Soil sciences. Copper can be used in plant nurseries to speed-up seed germination and help us grow healthier plants. It concluded that plants grow faster in copper treated soil. The knowledge can be applied in agriculture to increase the yield. This idea may help to solve the problem of starvation and world hunger in the future.

VI. REFERENCES

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Cite this article as :

Vinalkumari Patel, Deepti Sharma, Suhani Parekh, Archana Mankad, "Effect Of Copper on Soil, Growth and Metabolites In Spinacia oleracea L.", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 9 Issue 6, pp. 531-540, November-December 2022. Available at doi : https://doi.org/10.32628/IJSRST229675
Journal URL : https://ijsrst.com/IJSRST229675