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EFFECT OF WHITE ROT FUNGI- CALOCYBE INDICA & AGARICUS BISPHORUS TREATED GOLD INDUSTRY AND IRON INDUSTRY WASTEWATER ON PLANTS

Mahesha V

Department of Biochemistry, Sri Ramakrishna College of Arts and Science for women, Coimbatore -44, Tamil Nadu, India

Dr. Chitra P

Professor and Head, Department of Biochemistry, Sri Ramakrishna College of Arts and Science for women, Coimbatore -44, Tamil Nadu, India

ABSTRACT

This study discusses the various effects that iron and gold industrial waste water will affect the growth, and productivity of plants. Research in this field is topical because plant interactions are caused by a diversity of natural and man-made factors and because green chemistry now uses plants for the dedicated biotechnological synthesis. Published evidence, although incomplete and contradictory, indicates that metal can have both positive and negative effects on plants and that intracellular penetration is determined mostly by the particles' chemical nature, size, shape, surface charge, and dose. Biodegration have been confirmed with Ultra Violet–visible spectroscopy (UV- Vis), Fourier transform infrared spectrometer (FT-IR). The impact of mushroom treatments were studied by using the standard procedure on plant growth attributes (shoot and root length, dry and fresh weight of shoot and root), photosynthesis pigment (chlorophyll and total chlorophyll) and biochemical analysis (protein, carbohydrate and reducing sugar).

Keywords: Agaricus bisphorus; seed germination; plant growth; Zinc deficient soil; Iron and Gold industry.

INTRODUCTION

To fulfill the demand of growing number of people, rapid industrialization and modernization not only give useful products but also release hazardous elements to nature. The release of industrial effluents and the accumulation of toxic substances into the biosphere destroy the environment by interacting with various components of the natural ecosystem. The effluents released from textile industries, food processing industries, pharmaceutical industries, etc., containing various synthetic dyes, toxic heavy metals, and other wastes, directly or indirectly come in contact with water and soil and destroy water and soil properties by changing the pH, total organic carbon (TOC), biological oxygen demand (BOD), and chemical oxygen demand (COD). [1]

Various types of synthetic dyes are used extensively in the field of textile industries for coloring purposes. For example, in batik industries, Remazol Brilliant Blue R (RBBR) and naphthol are used as coloring agents. Remazol Brilliant Blue R is a heterocyclic compound, and its derivatives are toxic to the environment. On the other hand, naphthol is insoluble in water and is used to dye cellulosic fibers. Improper handling, carelessness, and inefficient dye waste treatments of industries are the main

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About the authors：Mahesha V

Corresponding author- Email:

reasons for the contamination of soil and water. The concentration of carcinogenic heavy metals like As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, etc. are relatively high in untreated industrial wastes. The rapid depletion of dissolved oxygen in water due to the presence of toxic heavy metals and other industrial wastes leads to "oxygen sag". Majority of the synthetic dyes are used in the field of textile industries, and the effluents are discharged as waste water. The dyes or their breakdown products are hazardous they are found to be carcinogenic.[2]

Remediation refers to the complete or partial removal of contaminants from the polluted sites to provide a sustainable environment. Various physical and chemical remediation technologies are developed to eliminate the pollutant from the soil and improve soil health. Higher costs, limited applications with limited opportunities, and the inability to enhance intrinsic soil health make them almost abandoned. Biodegradation refers to the use of biological agents such as microbes, plants, or any other living things that help to reduce contamination to a nontoxic level or untraceable level. Paul Stamets first coined the term "mycore mediation" based on the fungal detoxification of contaminated soil. He defined the term mycore mediation as a process of sequestration of contaminated soil or water by using fungi to reduce contaminants. Mushrooms are sources of protein and their enzymatic machinery have the ability to degrade pollutants for their growth and developments. [3]

Thus, mushroom cultivation got much more attention in the field of decolorization and biodegradation research. Mushrooms are mostly basidiomycetes, a class of fungi which secretes a variety of extracellular enzymes for their growth and development. These enzymes include laccase, lignin peroxidase (LiP), versatile peroxidase(VP), manganese peroxidase (MnP), phenoloxidases, etc. Singh reported that the lignin degradation ability of white-rot fungi is due to the presence of phenoloxidase [1]. Due to the potential role in bioremediation of various dyes, lignin, and cellulosic compounds, the white-rot fungi became a model organism for mycore- mediation. [4]

MATERIALS AND METHODS

Pot experiments and treatment details

A pot experiment was conducted at Bioscripts, India, during July 2019. Ten seeds had been sown in each pot (30 cm diameter and 25 cm deep) on normal ground soil. There were three replication pots for each treatment with factorial completely randomized design (FCRD).

The plant morphological parameters like shoot length, root length, dry weight and fresh weight of test crops treated with Iron and gold were carried out by using the standard procedures. Chlorophyll (chlorophyll and total chlorophyll), total carbohydrates, reducing sugars and protein were determined by standard procedure. Statistical analysis was used to analyze the significant differences among different treatments for studied parameters. [5]

RESULTS AND DISCUSSION

Confirmation of zinc level in soil

Generally, Zinc level was found to be significantly high in Iron and gold industry wastewater treated soil-soaked plant leaves when compared to control leaves, results are very similar to Prasad et al.

(2012). Brassica is known to be a metal hyper accumulator with enormous metal accumulation being reported for Zn. [6]

Lee et al. on the early growth substantially decreased on treatment with ZnO NPs at 1g/l and 2 g/l. Boonyanitipong et al. observed the determined impact of nano-ZnO on green gram plant, root and shoot . [7]

Manivasagaperumal et al. confirmed a gradual decline in the dry matter production of the plant sample at higher concentration. This result indicated that application of ZnO slightly increased dry and fresh weight at a lower concentration while an excess of ZnO reduced the biomass. [8]

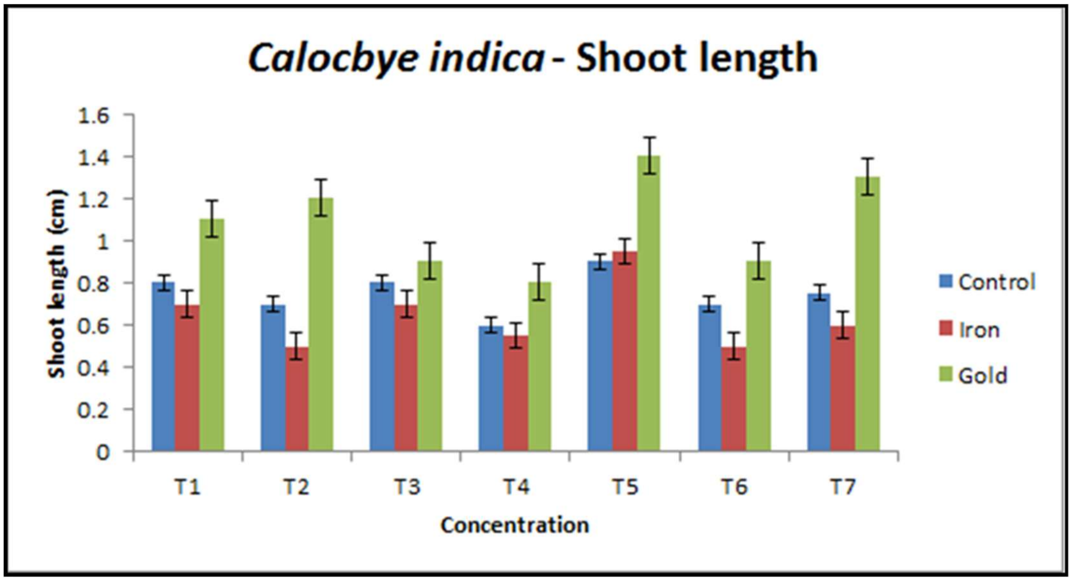

Figure 5: Calocbye indica of Shoot Length

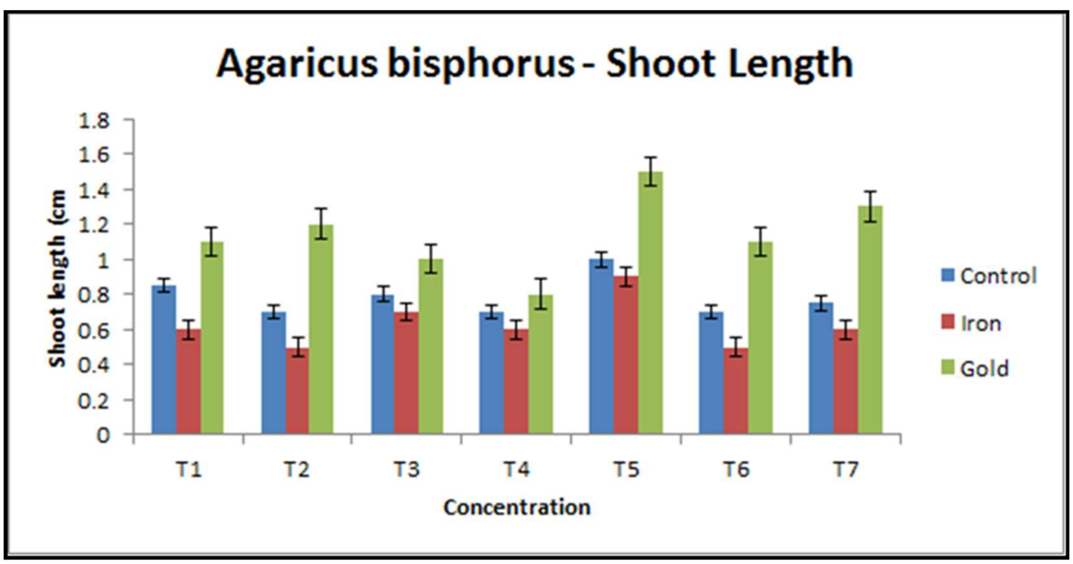

Figure 6: Agaricus bisphorus of Shoot Length

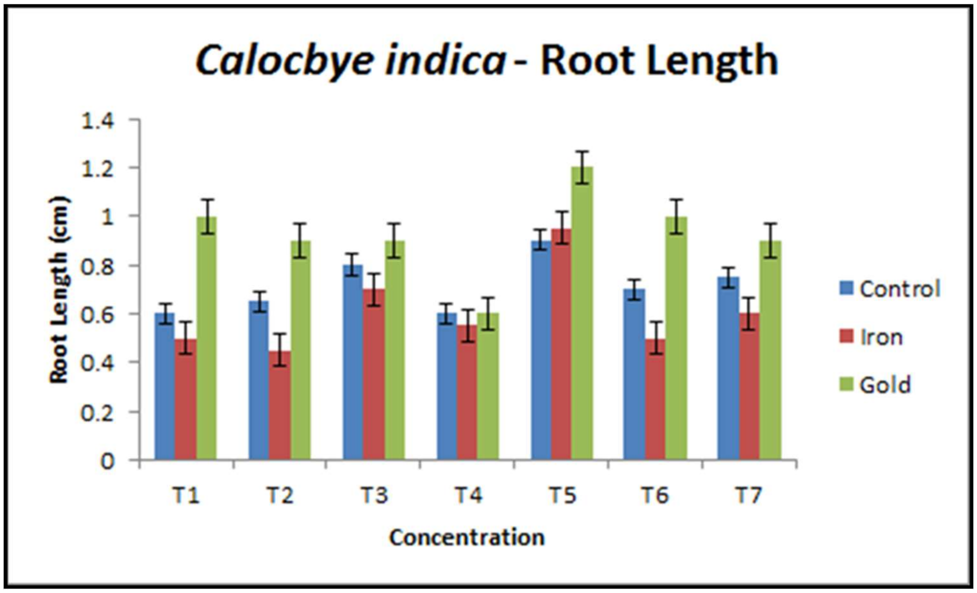

Figure 7: Calocbye indica of Root Length

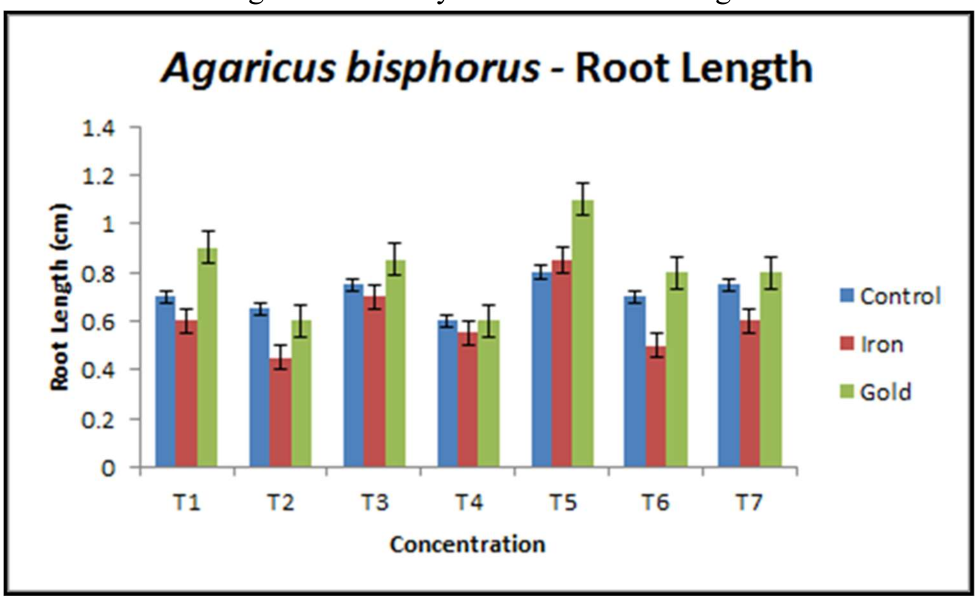

Figure 8: Agaricus bisphorus of Root Length

. The plant sample treated with control; maximum growth profile was observed at the concentration of 0.5 g/l at the end of 15 DAS. From previous study the growth profile of plant, gold confirmed less growth effect followed through iron treated plant sample while as compared to green gram grown in zinc-deficient soil by without soaked Iron and gold. [9]

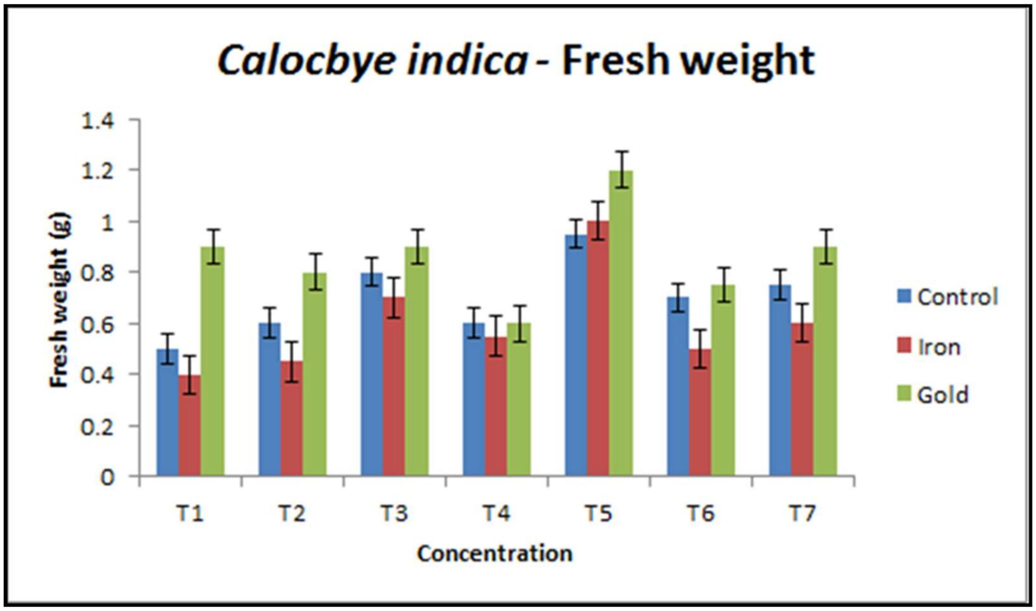

Figure 9: Calocbye indica of Fresh weight

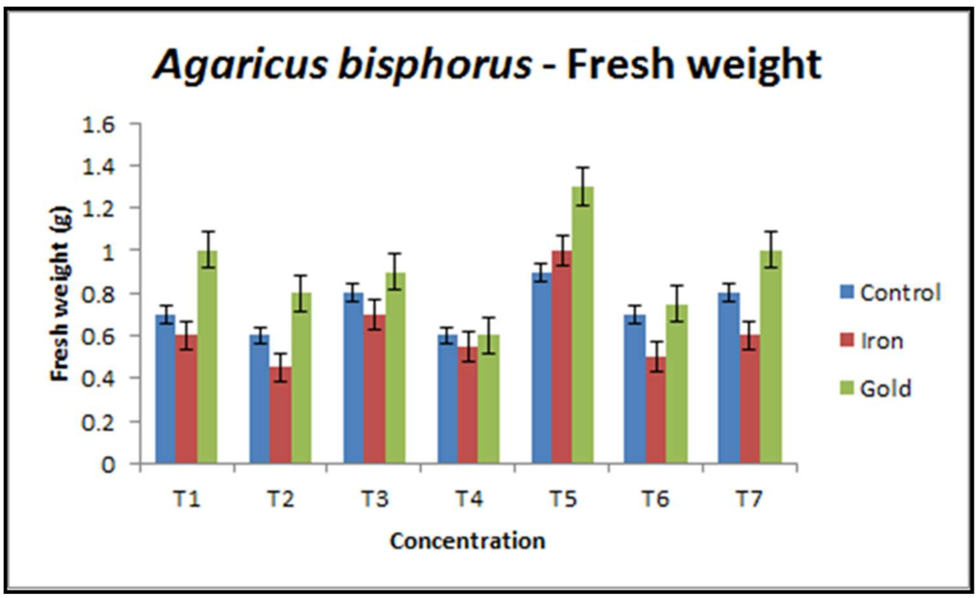

Figure 10: Agaricus bisphorus of Fresh weight

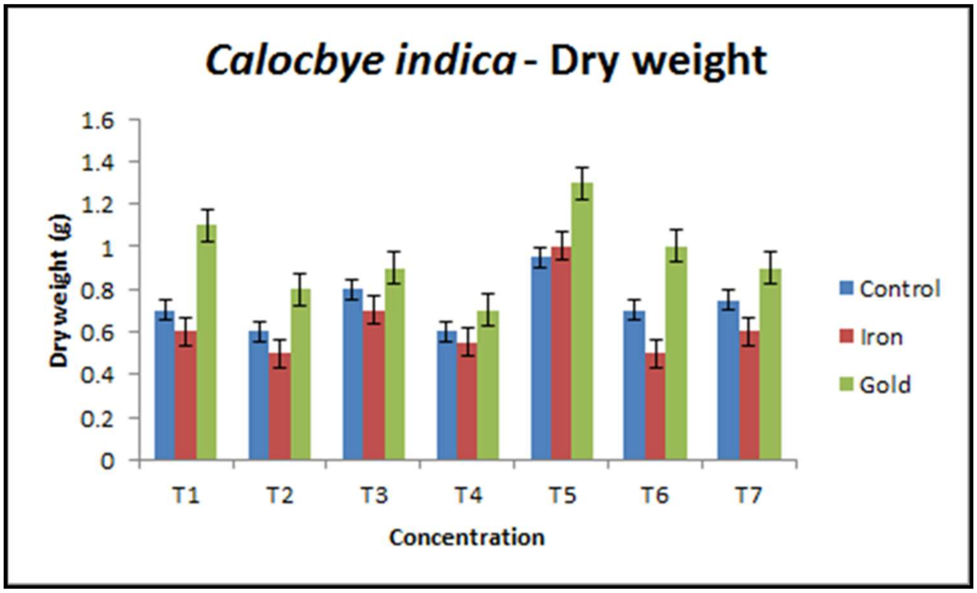

Figure 11: Calocbye indica of Dry weight

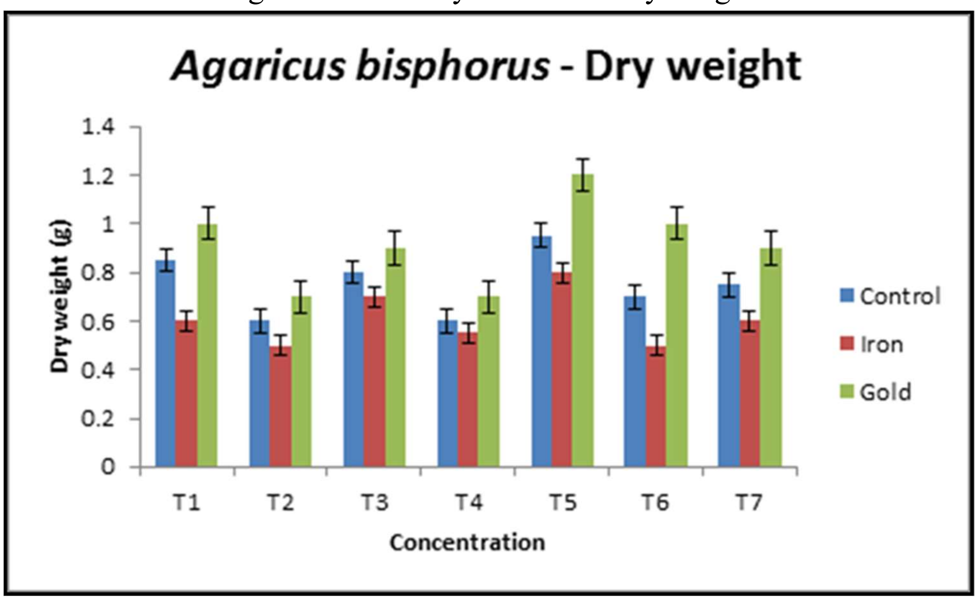

Figure 12: Agaricus bisphorus of Dry weight

Photosynthesis pigment content was significantly ($p<0.05$) increased by iron at a concentration of 0.5 g/l (T4 treatment). A similar trend of a drop in the chlorophyll level was noticed in the plant samples treated with increased concentration (1 and 2 g/l) of green and chemical NPs. The decline within the overall chlorophyll contents, as well as the growth inhibited, can be regarded as general responses associated with metal toxicity. Mukherjee et al. observed lower in chlorophyll level in leaves, compared to control plant treated with ZnO NPS or bulk ZnO in organic matter enriched the soil. Salama proved the effect of AgNPs on the carbohydrate content of common bean (Phaseolus vulgaris) and corn (Zea mays) plant at higher doses which may be attributed to a toxic level of causing a subsequent decline in growth. [10]

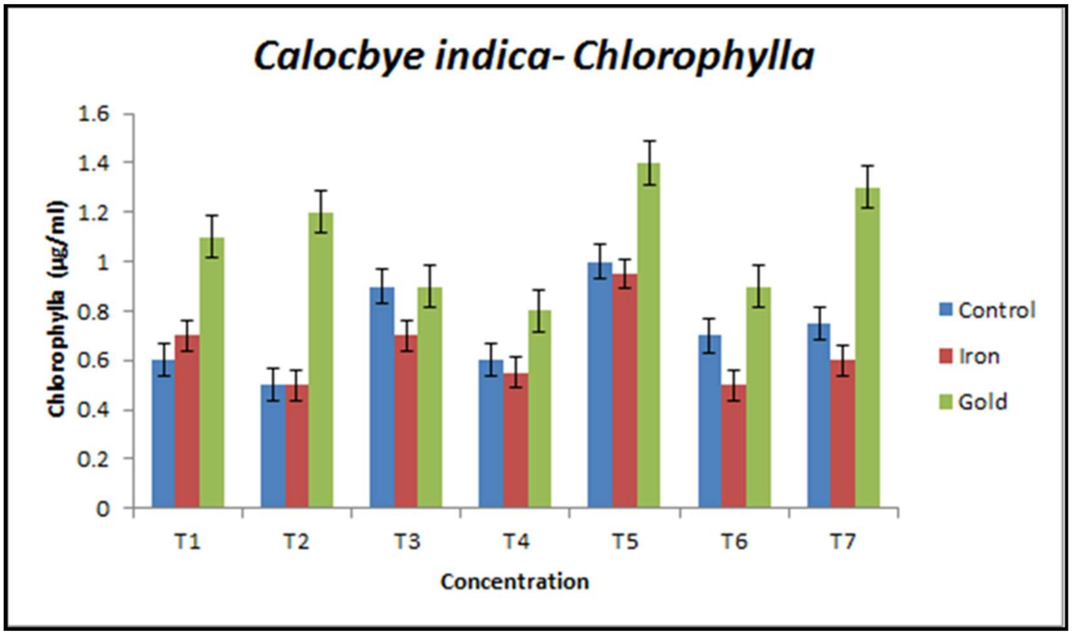

Figure 13: Calocbye indica of chlorophyll

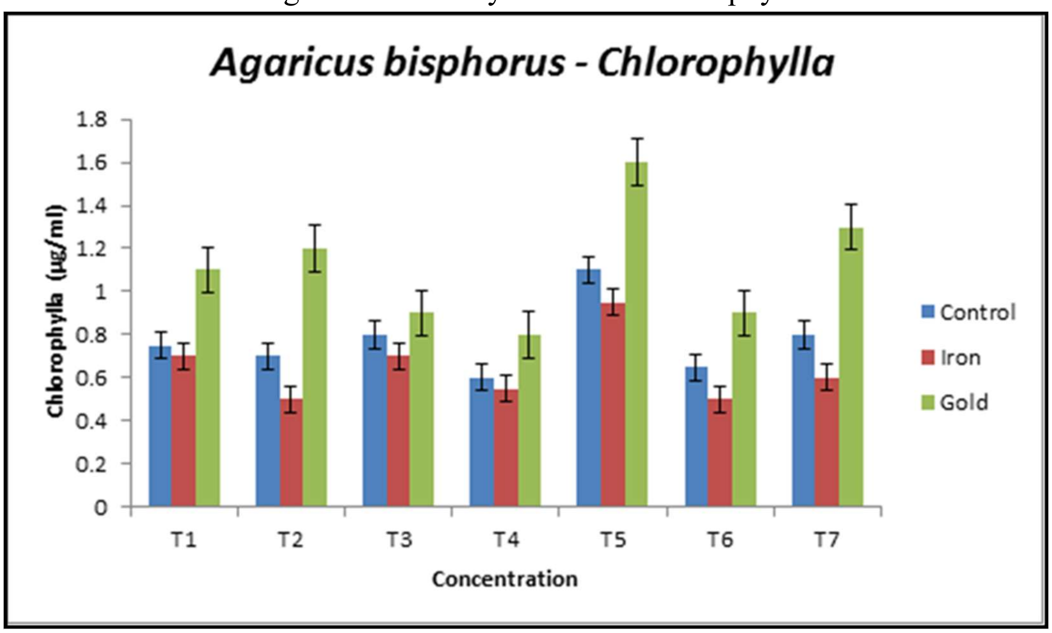

Figure 14: Agaricus bisphorus of chlorophyll

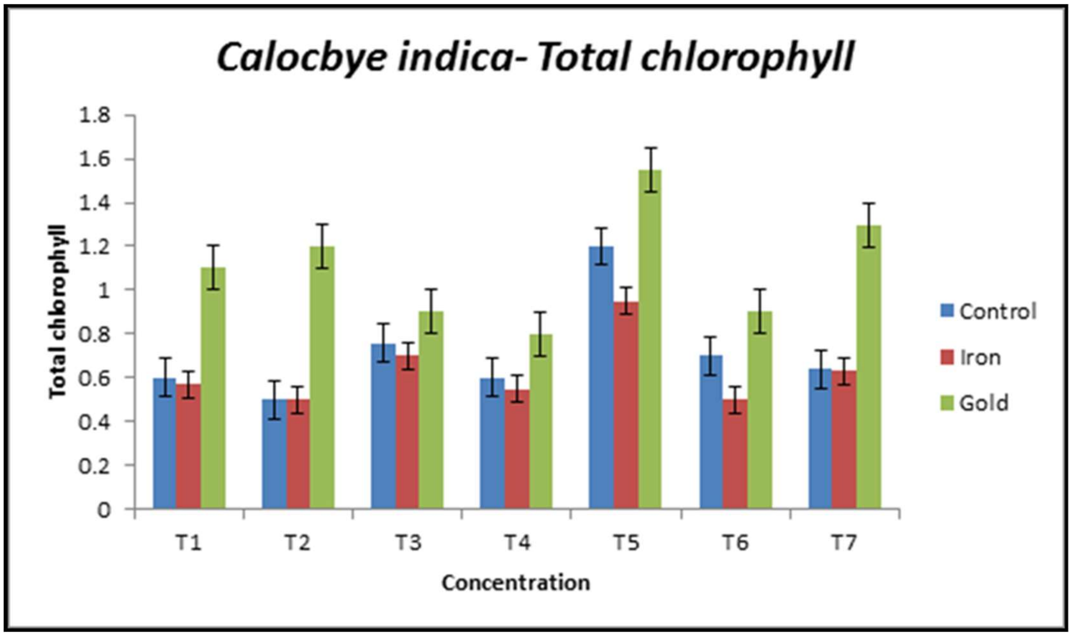

Figure 15: Calocbye indica of Total Chlorophyll

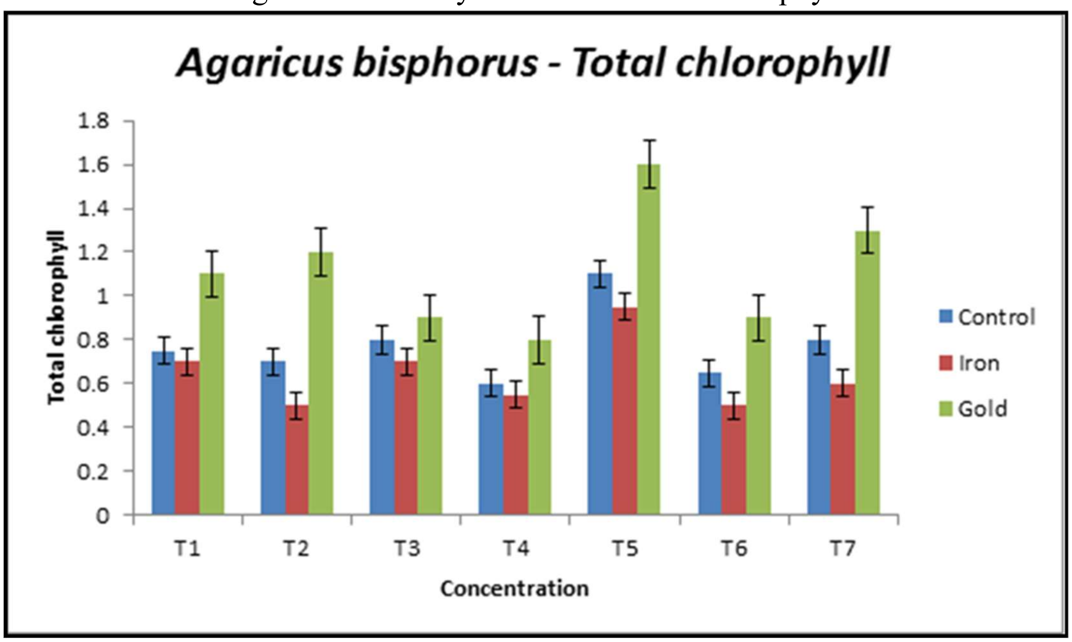

Figure 16: Agaricus bisphorus of Total Chlorophyll

Quality parameters for Calocbye indica and Agaricus bisphorus The effect of various doses of Iron and gold on diverse treatments on photosynthetic pigment (chlorophyll and total chlorophyll) contents of sesame (fig. 13,14,15,16). On 15 DAS, the plant sample indicates chlorophyll (T1: 0.07 and T4: 0.20 mg/g) and total chlorophyll content (T1: 0.13 and T4: 0.43 mg/g) level had been high in T4 treatment, whereas the plant samples treated with higher concentration of T5 and T4 showed decreased level of chlorophyll. In previous studies Gold treated plant samples showed maximum chlorophyll (T1: 0.07 and T4: 0.16 mg/g), total chlorophyll content (T1: 0.13 and T4: 0.43 mg/g) level were high in T5 treatment. These results are confirmed with the results obtained from other studies carried out by Karthick and Chitrakala. [11]

Farshian et al. showed a reduction in the protein total content of lettuce plant, which might be caused by the toxic effect of chemically synthesized ZnO on the protein synthesis. Protein and sugar were significantly reduced in this concentration as reported by Tandon and Gupta at increased doses of heavy metal (14). Qiang et al. reported decreased in the sugar soluble content

of on the application of slow release fertilizer coated and felted by nanomaterials. The same result was obtained by Liu et al. who demonstrated that low concentration of nano calcium carbonate caused increasing soluble sugar and peanut protein. From the phytotoxicity above studies prove that chemically synthesized are more toxic to the plant environment when compared green synthesis. [12]

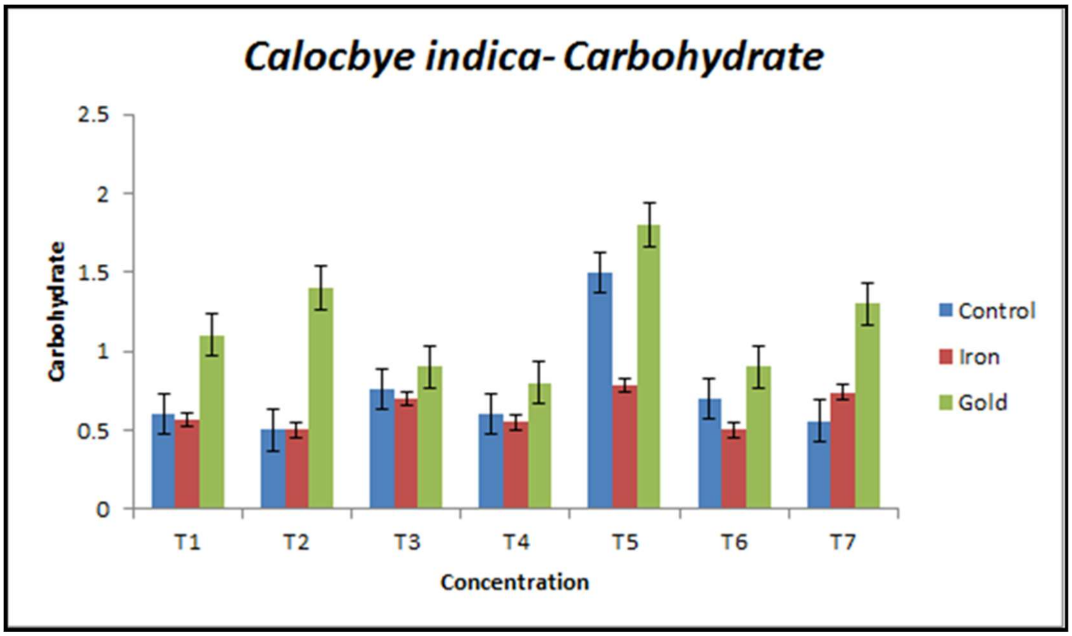

Figure 17: Calocbye indica of Carbohydrate

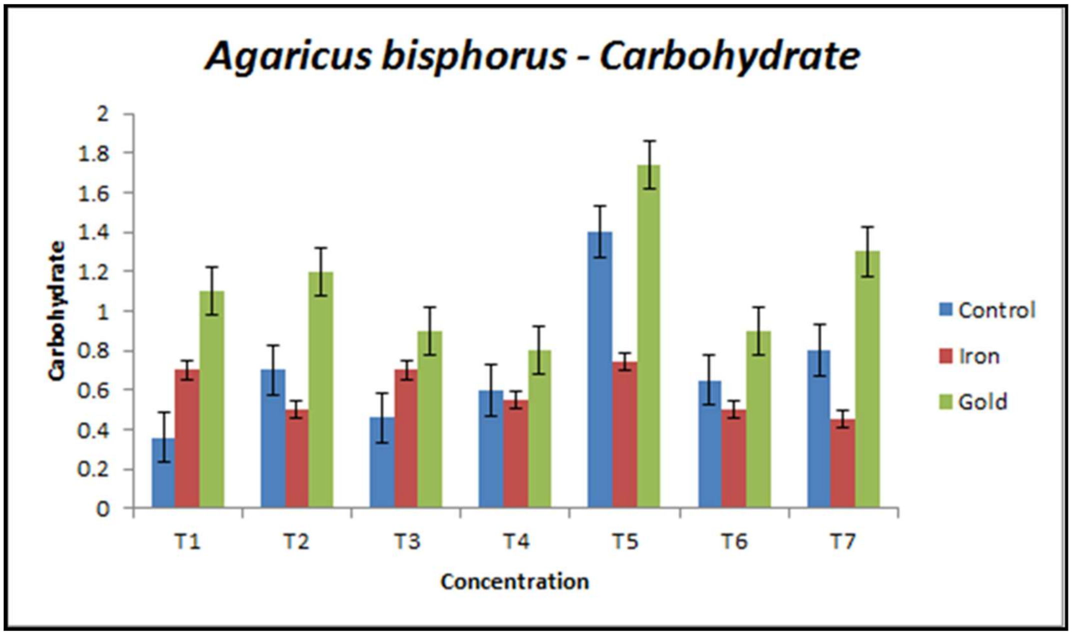

Figure 18: Agaricus bisphorus of Carbohydrate

The carbohydrate content of the plant sample treated with various concentrations predicted in the fig.17, 18. The control samples display carbohydrate level of 2.40 mg/g in zinc-deficient soil. Higher carbohydrate level of 4.82, 5.13 and 5.59 mg/g (Iron) and 4.31, 4.63 and 5.08 mg/g (Gold) was noted at a concentration of 0.1, 0.25 and 0.5 g/l at the end of 15th DAS. Likewise, 1 and 2 g/l of gold exhibited 4.39 and 4.58 mg/g of carbohydrate, whereas 4.33 and 4.08 mg/g carbohydrate was noted for the plant sample treated with gold NPs. The plant carbohydrate levels displayed are in the significant range ($p<0.05$). [13]

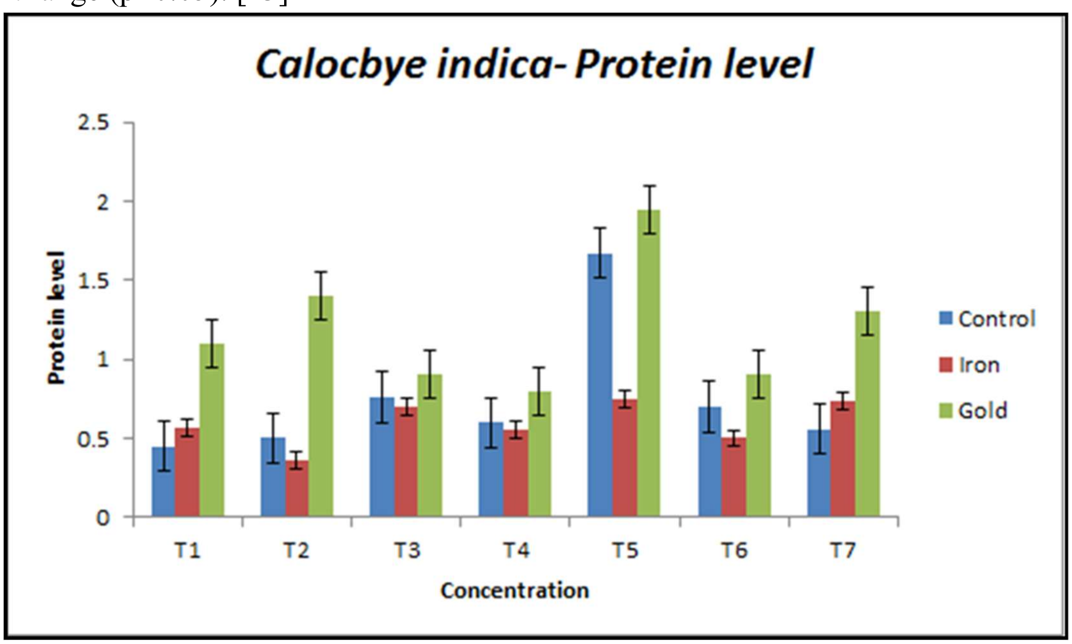

Figure 19: Calocbye indica of Protein level

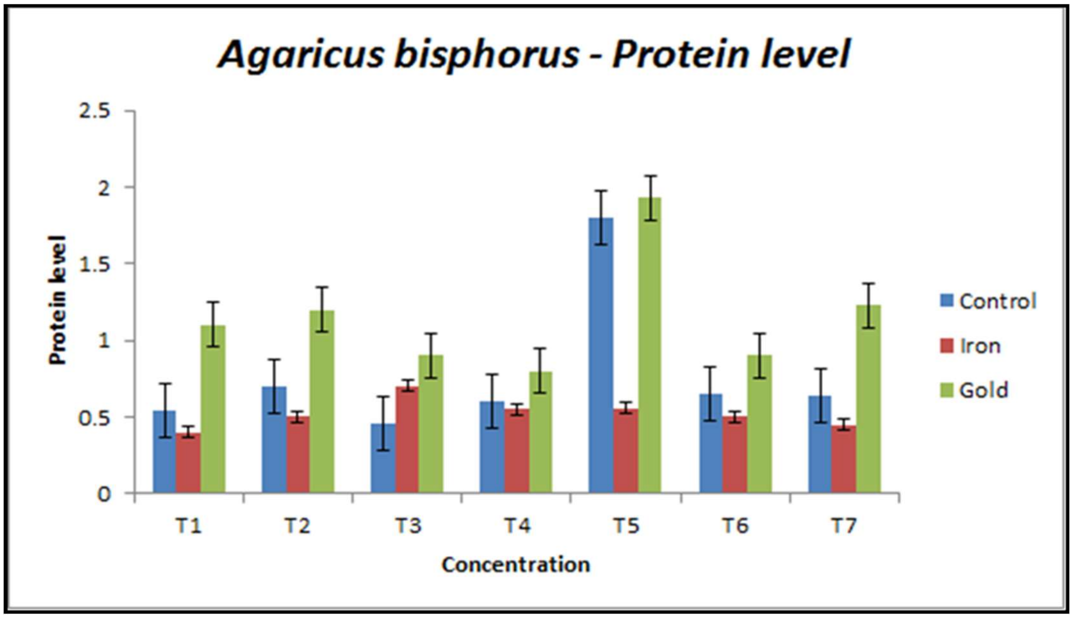

Figure 20: Agaricus bisphorus of Protein level

On 15 DAS, the control samples showed protein level of 0.78 mg/g in zinc-deficient soil. The plant sample was treated with Iron which show highest protein content (0.71, 1.22 and 1.73 mg/g) was found to be in 0.1, 0.25 and 0.5 g/l. Treated samples showed maximum protein content (0.69, 1.00 and 1.23 mg/g). But at the concentration of 1 g/l and 2 g/l treated plant showed a reduction in protein level. DAS Likewise, 1 and 2 g/l of Iron exhibited 4.39 and 4.58 mg/g of carbohydrate, whereas 4.33 and 4.08 mg/g carbohydrate was noted for the plant sample treated. The plant carbohydrate levels displayed are in the significant range ($p<0.05$). [14]

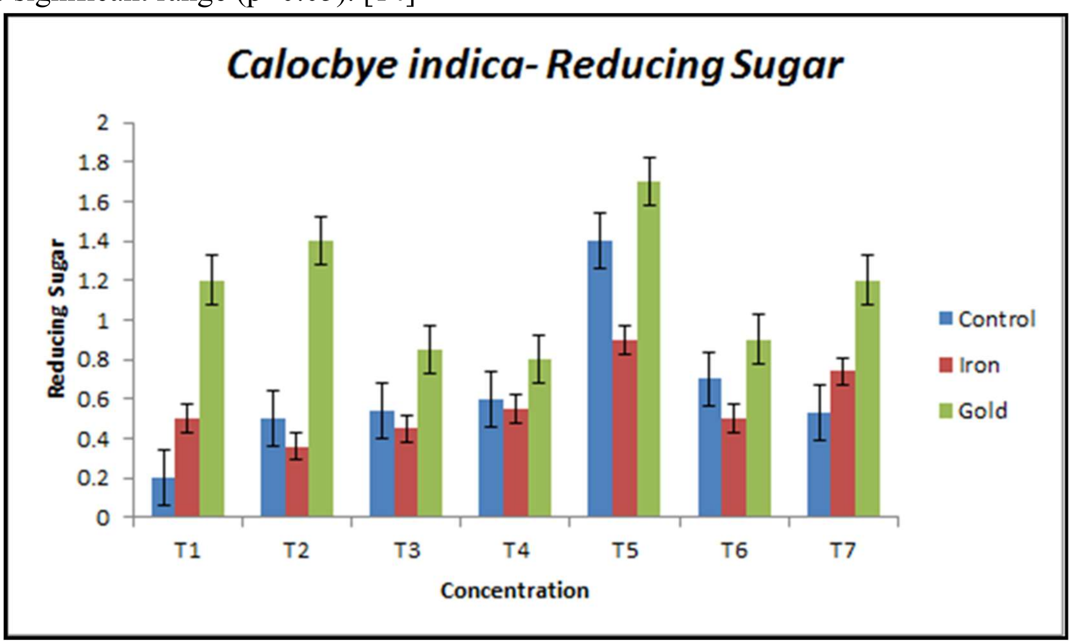

Figure 21: Calocbye indica of Reducing sugar

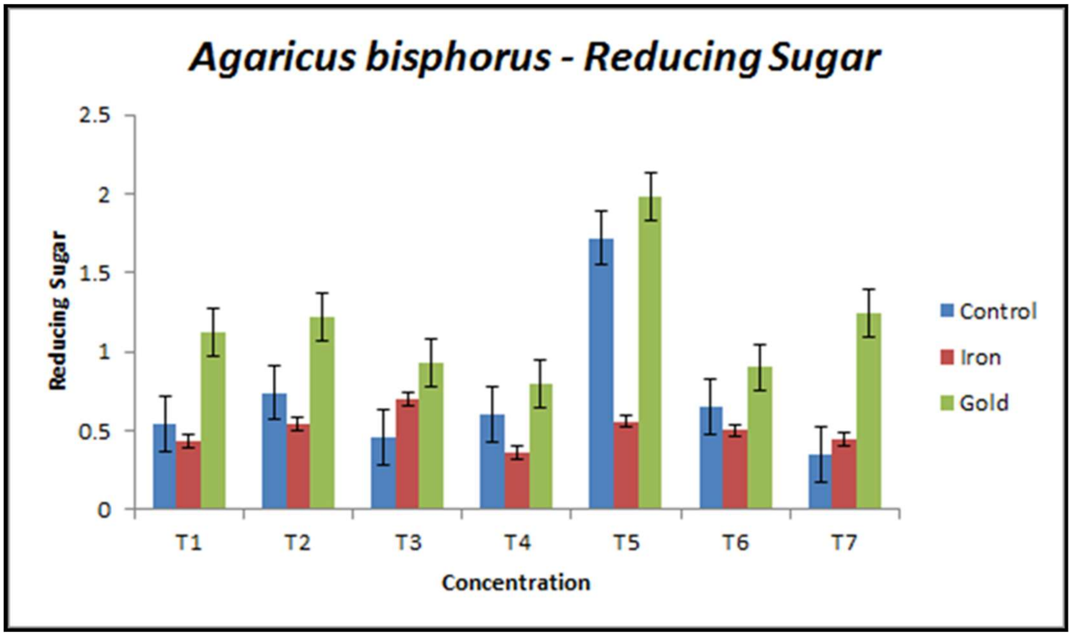

Figure 22: Agaricus bisphorus of Reducing sugar

The amount of reducing sugar present in the plant sample upon various treatments is shown in the fig. 21 and 22. The control samples display reducing sugar level of 4.07 mg/g in zinc-deficient soil. that the plant sample was treated with 0.1, 0.25 and 0.5 g/l with extract recorded 4.23, 4.43 and 4.83 mg/g of reducing sugar, whereas 4.2 and 4.06 mg/g (1 and 2 g/l) of reducing sugar was noticed at the end of 15th DAS. The gold treated plant sample displayed maximum sugar level of 3.73, 3.93 and 4.33 mg/g at the concentration of 0.1, 0.25 and 0.5 g/l whereas 4.00 and 3.58 mg/g (1 and 2 g/l) of reducing sugar exhibited at the end of 15th DAS. Thus plant samples showed significant reducing sugar ($p<0.05$). [15]

CONCLUSION

Milky mushroom grows best at 30°C which is higher than required by other cultivated mushrooms. Regarding media used to culture the mycelium that is used for further spawn making, PDA is the best media. Amongthe locally available lignocellulosic substrates, wheat straw supplemented with wheat bran improved total yield and other agronomic and nutritional characteristics for milky mushroom production. However, with a global political shift towards sustainable and green bioremediation technologies, the use of spent mushroom substrate to remove heavy metals from water waste provides an efficient, economic and sustainable green remediation technology.

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