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Biogenic synthesis and characterization of Metal Sulphide nanocomposites and its application to seed germination

Kezia Elizabeth
School of science, GITAM Deemed To Be University, Visakhapatnam-

R Uma Devi
School of science, GITAM Deemed To Be University, Hyderabad- 502329
Corresponding author email: urandhi@gitam.edu

A Ratnamala
School of science, GITAM Deemed To Be University, Hyderabad- 502329

M Sathish Kumar
Quality control Unit, Dr.Reddy's Laboratories, Hyderabad

K Phani Raja
School of science, GITAM Deemed To Be University, Hyderabad- 502329

***Abstract*---**A new agricultural revolution is needed to enhance crop yield and ensure the quality and safety of food in a sustainable manner. Agricultural sustainability can be improved with the use of nanotechnology. In addition to impacting germination and seedling establishment, effective seed nano-priming can alter seed metabolism and signalling pathways, and also affecting the entire plant life span. The present study provides an overview of benefits of Cobalt Sulphide Nanocomposites and the germination *of Trigonella foenum-graecum* and *Brassica nigra* seeds as a contribution to efficient agricultural practices. The synthesised Metalsulphide nanocomposites were characterized by UV-visible DRS, SEM and X-ray powder diffraction (XRD) methods. In Petri dishes, Cobalt Sulphide Nanocomposites were evaluated for the germination of *Trigonella foenum-graecum* and, *Brassica nigra* seeds. Several germination parameters have been investigated in relation to the concentration of Cobalt Sulphide Nanocomposites. The results shown an improvement in germination, shoot and root length, and germination time compared to the control treatment. It was discovered that a modest amount of time spent for soaking of the seeds helped them to germinate well.

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***Keywords*---**Nanocomposites, Green Synthesis, Germination, Root length, Germinability.

Introduction

In recent years, nanotechnology has attracted a great deal of attention due to the wide range of uses in various fields such as medicine, pharmaceuticals, catalysis, energy, and various types of building materials. There are several physical, chemical, and biological approaches to synthesise Nanocomposites (NCs) [Ghidan et al., 2017a]. There are several methods for the synthesising nano particles such as physical, chemical and biological processes. Scaling up the process, isolating and purifying Nanocomposites from micro-emulsion, and using a large amount of surfactants are all drawbacks of the most of the techniques. Green nanoparticle synthesis with plant extracts is favourable since it is simple, convenient, eco-friendly, and requires less reaction time as shown in Figure 1. Nanomaterials made with environmental friendly and green processes could improve agriculture's ability to progress fertilisation, plant growth regulators, and reduce the usage of synthetic pesticides in the near future. Even though nanotechnology has lately acquired attention due to its wide range of applications in several fields, such as medicine, the environment, and agriculture, this technology also helps to reduce several environmental contaminants [Huang et al., 2015].

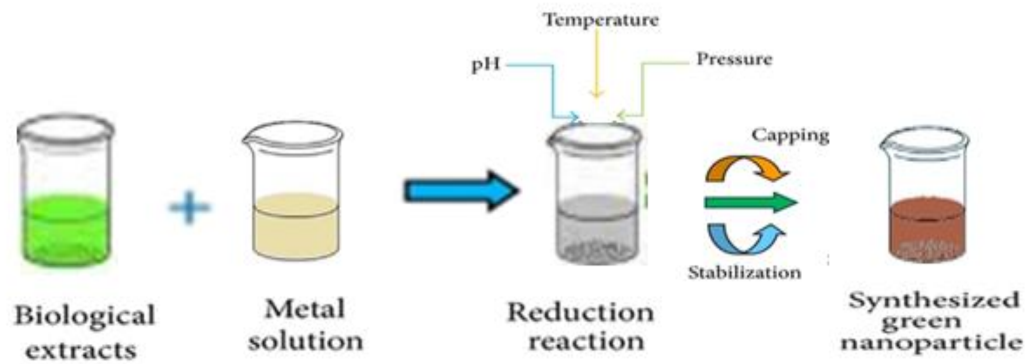

Figure -1Biological synthesis of Nanocomposites using green technology

Agricultural nanotechnology has gained speed in the recent decade thanks, but the field is still in an early stage of growth despite the fact that numerous ways have come to be classified as nanoagriculture. Because of the open nature of farm production, energy and matter can be freely traded, which may be a contributing factor. In contrast to industrial nanoproducts, the need for input materials is always high due to the lack of control over the input of nanomaterials [Kah et al., 2014]. It is a further refinement of nanotechnology that utilises sustainable manufacturing procedures to manufacture safe and benign nanoscale biomaterials for agricultural purposes. Seed priming with plant-based Nanocomposites has been speculated by some to boost germination/emergence,

seedling vigour, and other growth characteristics of due to their unique physical and chemical properties [Kasote et al., 2019]. Agriculture is an area that has been modified with the inclusion of a variety of nanomaterials, increased nutritional values of plants, significantly improved crop yields, and improved environmental monitoring of farming conditions. Only research in nanotechnology has been conducted in recent years that has concentrated on the interactions between plants and NCs as well as the impacts of NCs on ecological, human health, and the food chain; To better accurately evaluate the benefits and drawbacks of NCs, interdisciplinary understanding is required [Auffan et al., 2009]. NCs concentrations can affect seed germination, growth, phytotoxicity, and crop improvement in plant protection against various abiotic factors. The next stage of expansion of genetically modified crops, chemical pesticides, animal feed production, and precision farming techniques is anticipated to be aided and framed by nanotechnology research and development on nanomaterials' interactions with plants [Harris, et al., 2000]. The role of NCs in plant morphology influences a variety of plant system functions. The use of NCs affects several important aspects of plant growth and development, including photosynthesis, seedling vigour, and root and shoot expansion. Because plants may be found everywhere, they must endure harsh climatic circumstances such as drought, salt stress, high temperatures, UV radiation, and salt stress [Rejeb et al., 2014].
Hordeum vulgare (Barley), a grass family member, is a popular cereal grain farmed worldwide in temperate areas. It was one of the earliest grains to be cultivated in Eurasia 10,000 years ago. Globally, 70% of barley production is used as animal fodder, with the remaining 30% utilised as a fermentable ingredient for beer and some distilled beverages, as well as a component of various cuisines. Malt is generally manufactured from barley grains in a traditional and ancient way [Zohary et al., 2000]. Biofuels and ecologically friendly methods have sparked interest in barley research for ethanol production for fuel (Tada et al., 2000). Another fascinating area of research is the use of barley hay to inhibit algae growth in ponds and rivers (Xie et al., 2008). Green nanotechnology is the use of plant-based materials for the creation of Nanocomposites. It is extremely sustainable because it has little to no detrimental influence on natural resources, the environment, species, and people. As a result, this work looks into the impact of seed priming with cobalt sulphide Nanocomposites made from *Hordeum Vulgare*on many aspects of seed germination.

Materials and Methods

Synthesis Of leaf extract of HordeumVulgare

Hordeum Vulgare grains sown for 25 days in GITAM Deemed To Be University, Hyderabad. These leaves were collected and dried in the shade at room temperature for 24 hrs. The dried leaves are grinded to powder. 100 ml of 10% (w/v) plant extract solution is boiled for 90 Minutes and 80^{o}C. This mixture is subjected to centrifugation at 3000 RPM, 5 minutes. The obtained supernatant liquid is collected and stored at 4^{o}C.

Synthesis of Cobalt Sulphide (Cos/CoS_2-C) Nanocomposites (NCs)

The CoS/CoS_2-C NCs were prepared by the reaction of Cobalt Nitrate ($CoNO_3$) and Sodium Sulphide (Na_2S) in an aqueous solution. This method involves the preparation of 1M solution of Cobalt Nitrate and 1M solution of Sodium Sulphide. Then 1M Cobalt Nitrate of 50 ml is taken in a beaker and heated at a temperature of 40^0C for 50 minutes. In another beaker, 50 ml of 1M Sodium Sulfide is stirred at 40^0C for 50 min on a magnetic stirrer. Then 50 ml of Na_2S (1M) is taken in a burette and added drop-wise to the Cobalt Nitrate (1M) solution to observe the precipitation of Cobalt Sulphide NCs by continuously stirring for 3 hours (Pilarska et al., 2013). As drops of Na_2S are added to the $CoNO_3$ solution, the precipitate of Cobalt Sulphide (CoS/CoS_2-C) NCs forms the solution. The CoS/CoS_2-C Nanocomposites precipitates are separated, and the sample is washed with distilled water to remove impurities. Then place the sample in Oven at 80^0C for drying for five hours. Then the dried sample was crushed into fine powder with a mortal pestle to obtain fine powder of CoS/CoS_2-C Nanocomposites. The dry powder of CoS/CoS_2-C Nanocomposites was collected by the chemical precipitation method.

Synthesis of CoS/CoS_2-C Nanocomposites from *Hordeum vulgare* leaves by Green Synthesis

The synthesized leaf extract of *Hordeum Vulgare* was taken in equal amounts to the Cobalt Nitrate for preparing the CoS/CoS_2-C Nanocomposites. Then 1M Cobalt nitrate of 50 ml is taken with an equal amount of *Hordeum Vulgare* leaf extract in a beaker and heated at a temperature of 40^0c for 50 minutes. In another beaker, 50 ml of 1M Sodium Sulfide is stirred at 40^0c for 50 minutes on the magnetic stirrer. Then 50 ml of Na_2S (1M) is taken in a burette and added drop-wise to the *Hordeum vulgare* leaf extract capped Cobalt Nitrate (1M) solution to observe the precipitation of Cobalt Sulphide NCs by continuously stirring for 3 hours. As drops of Na_2S are added to the $CoNO_3$ solution, the precipitate of *Hordeum vulgare* leaf extract capped Cobalt Sulphide NCs form in the solution (Afsheen et al., 2020).

Hordeum vulgare leaf extract capped CoS/CoS_2-C NCs precipitate was separated by separation funnel and filter paper. The precipitate is washed thoroughly with Ethanol and distilled water, and dried in a hot air oven at 80^0c for 5 hours. Then the dried sample is crushed into a fine powder using a mortar pestle, and the obtained fine powder of *Hordeum vulgare* (Barley) capped CoS/CoS_2-C NCs were collected by green synthesis and used for further studies. The size and shape of NCs was investigated by using the UV–Vis, XRD, and SEM techniques. The synthesised NCs were used to examine the effect of CoS/CoS_2-C Nanocomposites on germination rate, shroot and root length of *Trigonella foenum-graecum* (Fenugreek) and *Brassica nigra* (mustard) seeds.

Results and Discussion

UV–vis analysis of CoS/CoS_2-C Nanocomposites (NCs)

Absorption spectroscopy or reflectance spectroscopy in a portion of the ultraviolet and the complete, nearby visible parts of the electromagnetic spectrum are the two types of spectroscopy that are referred to as UV–visible spectrophotometry (UV/Vis). The hypothesised straight line nature of the CoS/CoS_2-C Nanocomposites is a type of material known as direct banding. The calculated band gap for CoS/CoS_2-C Nanocomposites came to 2.0 eV as an estimated value. The highly crystalline character of the newly synthesised metal sulphide Nanocomposites is demonstrated by the presence of a significant band gap emission. This shift to the blue side of the band gap is caused by the quantum confinement effect; it is also the result of decrease in size of nano particls and it is evidence that nanoparticle materials are present. The earlier findings and these current findings agree with one another very well. Figure 2 depicts a graph of the relationship between absorbance and wavelength. Using the tauc plotting method, the band gap for CoS/CoS_2-C Nanocomposites was also estimated; the computed band gap was 2.0 eV, and the wavelength absorption for CoS/CoS_2-C Nanocomposites showed a blue shift due to the quantum confinement effect.

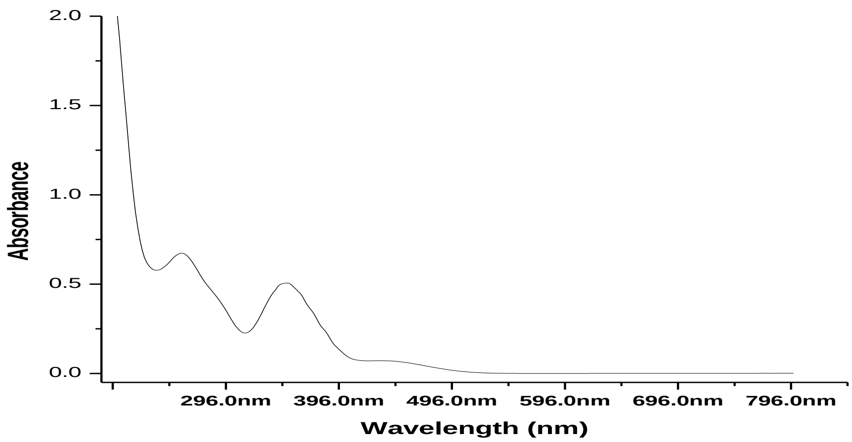

Figure 2. UV Vis analysis of CoS/CoS_2-C NCs

XRD Analysis for CoS/CoS_2-C Nanocomposites

The capacity of X-ray diffraction, also known as XRD, to interact with the electrons that make up an atom's inner shell has led to it becoming one of the most popular methods for characterising Nanocomposites. After placing the sample powders that had been prepared on a conventional glass sample case, they were moved into the X-ray generating chamber and subjected to an acceleration voltage of 15 kV. Additional data was analysed using the software that cameith the X-ray diffractometer as well as the JCPDS cards. Within this pattern, diffraction peaks are observed that match to various crystal planes, as was reported using JCPDS for CoS/CoS_2-C Nanocomposites isolated from

Hordeum vulgare leaves extract (Figure 3). These peaks are in good accordance with the previously reported scientific literature [Subedi.et., 2004].

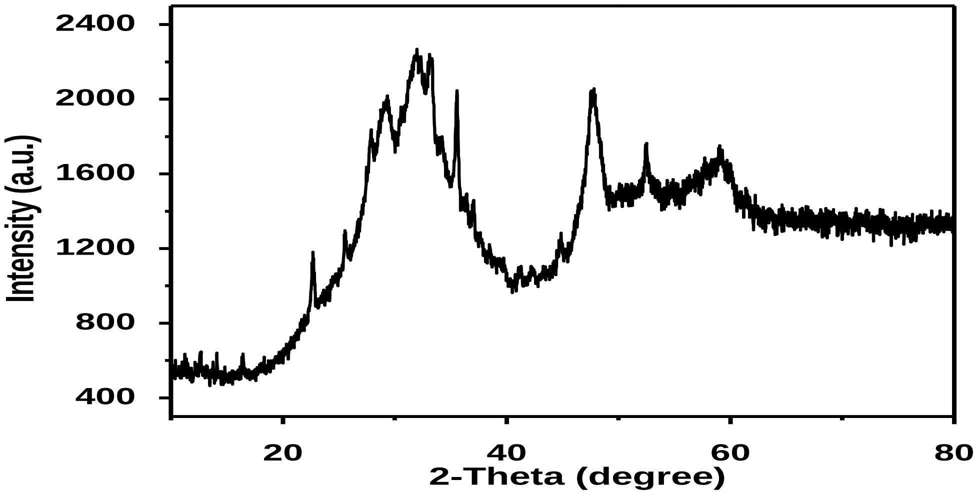

Figure-3 XRD pattern of CoS/CoS_2-C NCs from *Hordeum vulgare*

The XRD patterns of the as synthesized barley grass assisted synthesis of CoS/CoS_2-C mixture as given in (Figure 3). The peaks obtained at two theta of 29.4 °, 34.8 °, 47.6 ° and 54.6° which corresponds to 100, 101 102 and 110 planes respectively. The presence of these peaks indicate the hexagonal phase of CoS/CoS_2-C which is in accordance with that of JCPDS card No: 65-3418 and peaks obtained at 32.0, 35.78, 46 corresponding to CoS/CoS_2-C phase (JCPDS 70-2866). the presence of carbon which comes at 26 and 45 is also seen from the XRD data (Wan et al., 2022).

Morphological analysis of CoS/CoS_2-C* Nanocomposites *by SEM

The scanning electron microscope (SEM) is one of the most often used tools for analysing nanomaterials and nanostructures. The signals produced by electron-sample interactions provide information about the sample such as surface morphology (texture) and chemical composition. CoS/CoS_2-C Nanocomposites had an average particle size of roughly 1 nm and were spherical in form as seen in Figure 4.

The morphology of nano-cobalt sulphide was studied using scanning electron microscopy (SEM). Figures 5 and Figure 6 show SEM pictures of cobalt sulphide at various magnifications. CoS/CoS_2-C possessed a hollow tube structure with a length of 0.4-8.8 m and a width of 0.1-0.9 m, as seen in Figure 5 at low magnification. Figure 6 depicts the microscopic morphology of CoS/CoS_2-C at a greater magnification; the figure 5 displays some particle deposits on the tubular structure. SEM pictures of CoS/CoS_2-C Nanocomposites revealed a variety of morphologies, including spherical, bean-like, and irregular shapes, which are consistent with the literature [Sulekh et al., 2004].

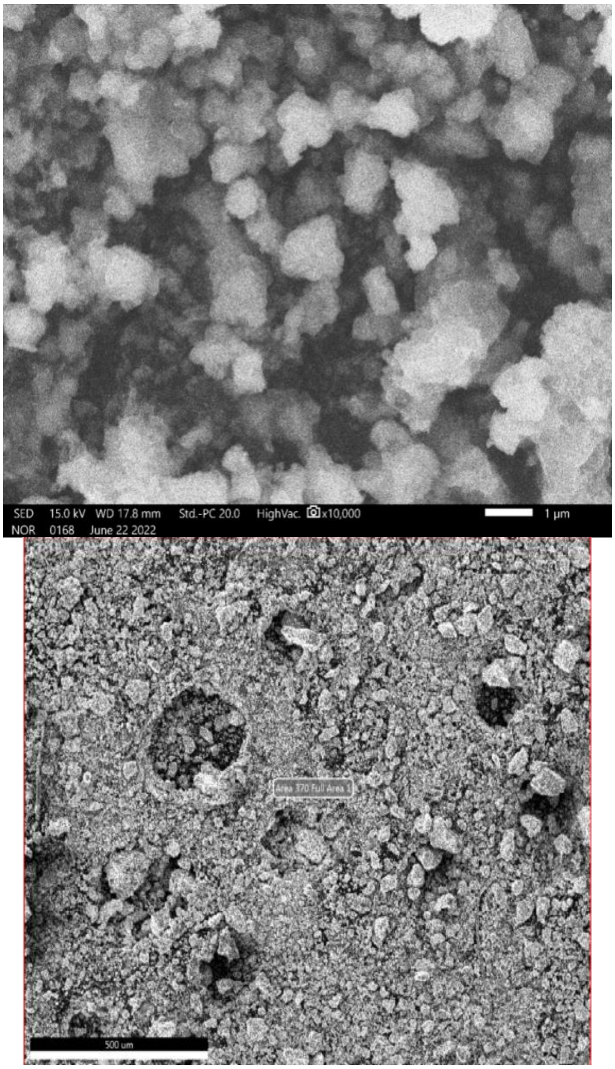

Figure 4. SEM image of CoS/CoS_2-C Nanocomposites

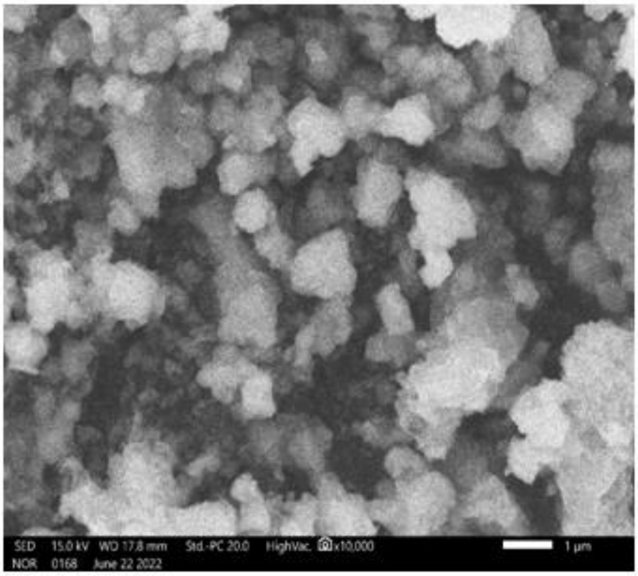

Figure 5 SEM images of Green synthesis

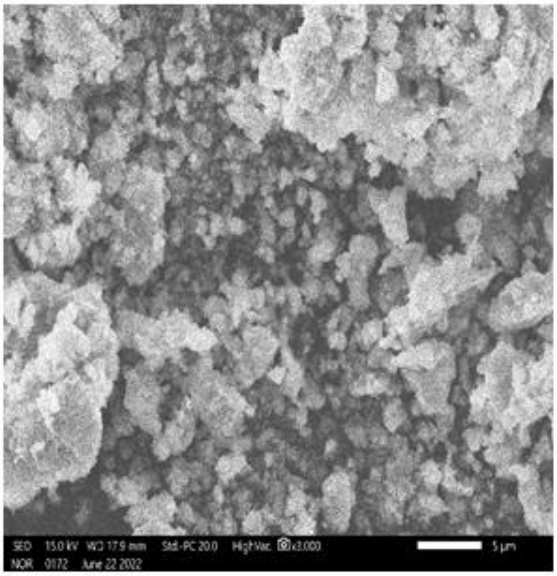

Figure 6 SEM images of Green synthesis

The SEM images of the obtained Nanocomposites are seen in Figures 4,5,6. From the SEM images it is clearly seem that there is agglomeration of particles due to extremely small dimensions and high energies. the clusters are spherical to hexagonal in shape. The average agglomerated cluster size determined by SEM analysis is around 40-60 nm. The majority of the particles are equally dispersed and are of identical size and shape.

Effect of NCs on Seed Germination

Plant growth can speed up by a healthy germination, which guarantees that moisture is maintained and that the plants can stand on their own. Nanocomposites have the potential to facilitate the entry of water and other nutrients into seeds without causing structural damage due to small size. As a result of their tiny size and increased surface area, Nanocomposites help plants to absorb more nutrients with less waste [West, 1974]. This may help the plant system function more effectively, which could boost the plant's ability to absorb and use nutrients. In the presence of a CoS/CoS_2-C NCs suspension produced from an extract of *Hordeum vulgare* leaves, the germination and growth rates of *Trigonella foenum-graecum* and *Brassica nigra*seeds were examined at various intervals and compared to seeds with the control.

Germination tests

The percentage of viable seeds present in a given seed lot can be ascertained through the use of a germination test. Even though the rate of germination can vary significantly across different types, seeds should be able to absorb moisture within two days and form a root and the first leaf within four days of being planted. At this point, we consider the seed to have started its germination process [Dahal and Bradford, 1990]. Recently developed methods for boosting the rate of seed germination and controlling plant behaviour in order to boost plant development includes the synthesis, characterization, and application of Nanocomposites to seeds and crops. In order to study the effect of CoS/CoS_2-C Nanocomposites on seed germination, we prepared suspensions containing 5 mg of metal sulphide NCs in 100 ml of distilled water, 10 mg/100 ml, 15 mg/100 ml, 20 mg/100 ml, and 30 mg/100 ml for each type of NCs synthesised by chemical technique and green synthesis. Petri dishes were added with double distilled water and Cobalt sulphide Nanocomposites with two different types of seeds namely *Trigonella foenum-graecum* and *Brassica nigra*. In the presence of metal sulphide nanoparticle suspensions, various parameters such as germinability, germination rate, mean germination time, root, and shoot length, and were studied [Sevik and Guney., 2013].

In order to determine whether or not Nanocomposites have an effect on the ability of seeds to germinate, 15 seeds of each type of NCs suspension were grown in 12 petri dishes at varying concentrations (control, 5 mg/100 ml, 10 mg/100 ml, 15 mg/100 ml, 20 mg/100 ml, 30 mg/100 ml) along with control for both types of seeds (*Trigonella foenum-graecum* and *Brassica nigra*seeds). On the third day and the seventh day, observations of germination were carried out in order to calculate germinability utilising Eq. (1).

$$\% \text{ GE} = C / E \text{ X}100 \qquad [1]$$

Where C is the number of seeds that have germinated by the third day and E represents the total number of seeds that were tested.
The rate of seed germination can be calculated by dividing the number of seeds that germinated on the seventh day by the total number of seeds tested (the formula for this calculation can be found in Eq) (2).

$$\text{Germination rate } \% = D / E \text{ x}100 \qquad [2]$$

Where D is the total number of seeds that were planted in the Petri dish and E is the number of seeds that germinated after seven days. After carrying out the identical experiment three times, we recorded all of our observations. After seven days, the root and shoot length was measured in centimetres for each concentration of Nanocomposites individually. Every reading, especially the quantity of germinated seeds, was counted on a daily basis throughout the counting process. At the end, the average amount of time needed for germination was calculated by using the formula found in Eq(3).

$$\text{MGT} = \sum(n \times di) / N, \qquad [3]$$

Where n represents the number of newly germinated seeds on the ith day, di is the number of days.

Effect of CoS/CoS_2-C Nanocomposites *on germinability*

The results shown that the CoS/CoS_2-C Nanocomposite suspensions alter the percentage of germination rate relative to the control treatment. Figure 10 depicts the germinability of CoS/CoS_2-C Nanocomposites from the chemical Synthesis and CoS/CoS_2-C Nanocomposites from the green synthesis of *Hordeum vulgare* leaves. Whereas Figure 9 depicts the germination rate under control treatment. The percentage of germination rate is derived by dividing the number of germinated seeds by the total number of seeds sowed. From the results, 15 mg/100 ml and 20 mg/100 ml produced the highest germination rates. The increased concentration of 30 mg/100 ml promotes germination but has no effect on germination rate [Fathi et al., 2017]. A high percentage of *Trigonella foenum-graecum* seeds were germinated at low concentrations, i.e. 5 mg/100 ml and 10 mg/100 ml, whereas *Brassica nigra* seeds require a suspension of Nanocomposites at a high concentration with the chemically synthesized NCs. With green synthesis mehtod, CoS/CoS_2-C Nanocomposites showed high germination rate for both types of seeds. Green synthesised CoS/CoS_2-C Nanocomposites suspension has a 100 percent germination rate for *Trigonella foenum-graecum* at 20 mg/100 ml and an 86 percent germination rate for mustard seeds at 15 mg/100 ml. While 30 mg/100 ml in both types of seeds decreases germination rate. In all cases, the control treatment yielded a much lower germination rate, even when compared to the 30 mg/100 ml nanoparticle dispersion at a high concentration (Figure 7 and Figur 8).

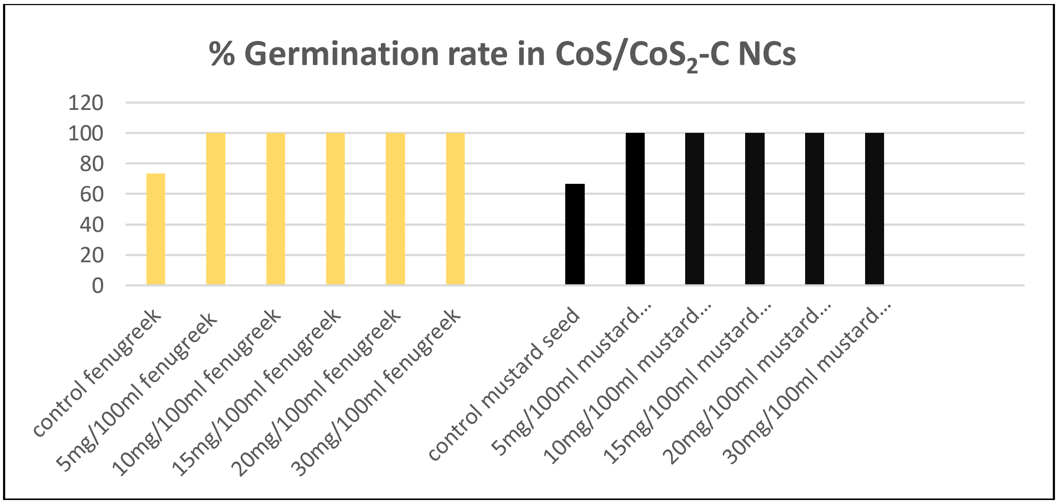

Figure 7 Germination rate of CoS/CoS_2-C NCs in Chemical synthesis process

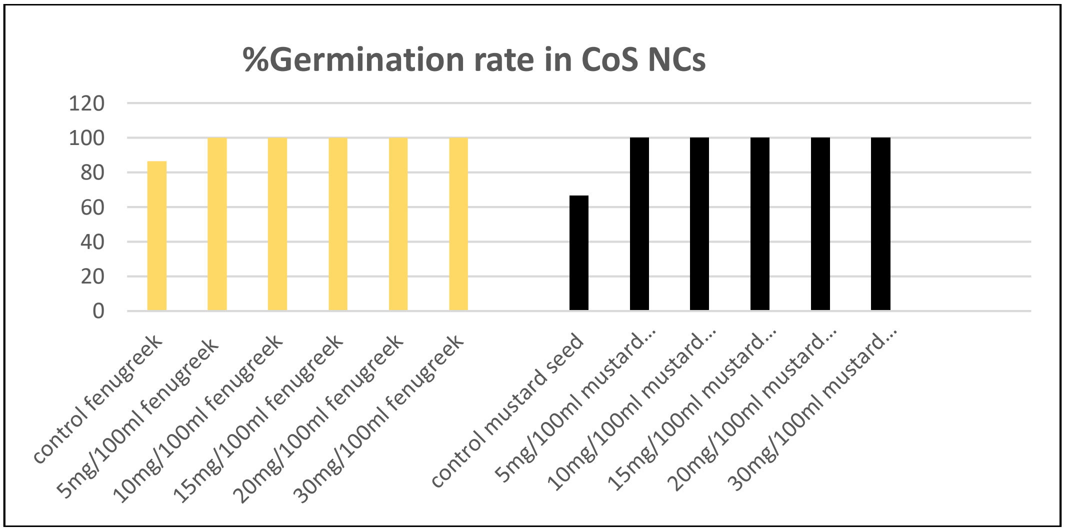

Figure 8 Germination rate of CoS/CoS_2-C NCs in Green synthesis process

The seed priming helped in initiating germination in *Trigonella foenum-graecum* and *Brassica nigra*seeds as there was increase in germinability in CoS/CoS_2-C Nanocomposites exposed seeds when compared to control and un treated seeds.

Effect of CO metal sulphide NCs on root length

When the seeds were grown in suspension of metal sulphide Nanocomposites, the root length of *Trigonella foenum-graecum* and *Brassica nigra* increased when compared to control seeds [Zhang et al., 2007]. The only exception to this was at a concentration of 30 mg/100 ml of NCs for both seeds, which showed a significantly reduced root length as shown in Figure 9. For both varieties of seeds, the root length has larger values for 10 mg/100 ml, 15 mg/100 ml, and 20 mg/100 ml respectively. The maximum length for *Trigonella foenum-graecum* was determined at 10 mg/100 ml, while the maximum length for *Brassica nigra* seeds was determined to be 15 mg/100 ml. The 30 mg/100 ml dose seems to have an effect on the root length response, as a higher concentrated dose of Nanocomposites significantly reduces the root length. The metal sulphide NCs have enabled water and light absorption in a better way that is required for growth, which has resulted in an increase in root length. However, a higher concentration of NCs, which are more reactive and toxic, may harm and suppress the growth process, which has resulted in root length that is not as high [Mathew et al., 2014]. In this study, the maximum root length for *Trigonella foenum-graecum* was 2.0 centimetres in chemical precipitation method and 3.1 centimetres in the green synthesis method of CoS/CoS_2-C Nanocomposites. For *Brassica nigra* seeds, the maximum length noted was 0.3 centimetres for chemical precipitation method extracted CoS/CoS_2-C Nanocomposites, and 0.9 centimetres for CoS/CoS_2-C Nanocomposites respectively, which has significantly higher values than the seeds that received the control treatment. It has been discovered that the root length is greatest when treated with a CoS/CoS_2-C Nanocomposites suspension of 10 mg/100 ml and 15 mg/100 ml for both *Trigonella foenum-graecum* and *Brassica nigra* seeds. When the concentration is increased to 20 mg/100 ml, however, the root length becomes extremely short. Root length of both seeds is reduced when exposed to higher quantities (such as 20 mg/100 ml or 30 mg/100 ml), respectively. It has been found that the root length has a large value at lower concentrations, which indicates that an appropriate concentration of NCs suspension can be utilised to improve root length [Finch et al., 2004].

Effect of metal sulphide NCs and their composite on shoot length

The application of varied concentrations of CoS/CoS_2-C metal sulphide nanoparticle suspensions also improved shoot length. However, the effect of each concentration varies greatly, but in all concentrations, shoot length is greater than in the control treatment demonstrated in (Figure 10). The greatest shoot length for 7 days with CoS/CoS_2-C Nanocomposites suspension was 3.5 cm at 15mg/100 ml and only 2.0 cm and 1.9 cm with higher concentrations at 20mg/100 ml and 30mg/100 ml, respectively. *Brassica nigra* seeds had a maximum length of 2.5 cm at a concentration of 15mg/100 ml, with all other concentrations yielding low results. As a result, it was determined that the concentration of CoS/CoS_2-C Nanocomposites for longer shoot length is observed at 15mg/100 ml [Albrecht et al., 2006].

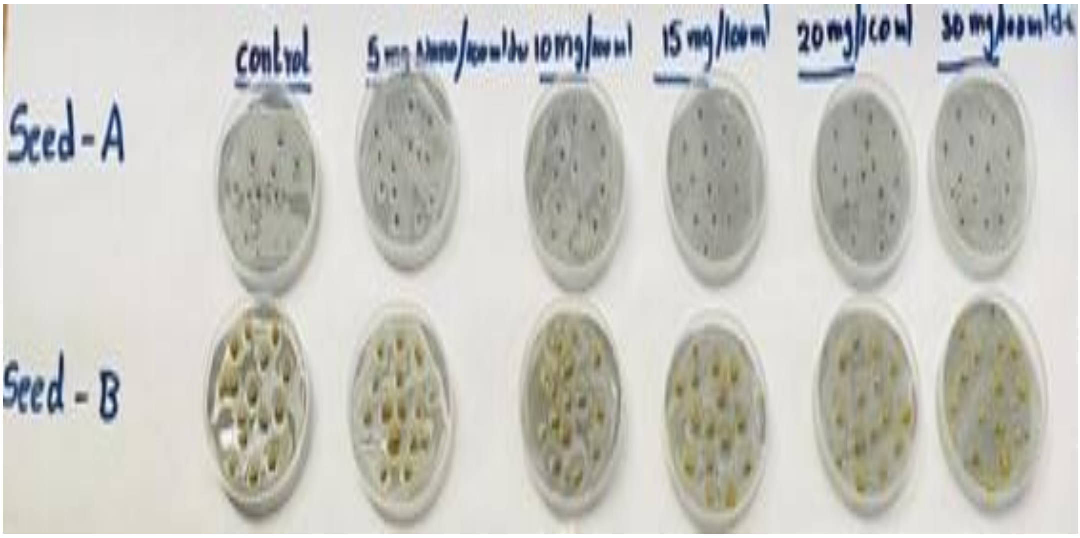

Figure-9 Seed Germination using CoS/CoS_2-C NCs

Figure 10 Shoot and Root developed in CoS/CoS_2-C NCs treated seeds

Analysis of mean germination time (MGT)

Mean germination time was calculated by using the following equation (4):

$$\mathbf{MGT = \sum(n \times d) /} \quad \mathbf{(4)}$$

where, N = total number of seeds germinated at the termination of the experiment, n = number of seeds germinated on each day, and d = number of days from the beginning of the test.

The treatment with Cobalt metal sulphide NCs reduced MGT for *Trigonella foenum-graecum* seeds at doses of 15 mg/100 ml and 20 mg/100 ml to 1.4 days as opposed to 1.9 for control seeds, and for *Brassica nigra* seed MGT studied as 1.3 compared to control treatment 1.6. MGT concentrations for *Trigonella foenum-graecum* and *Brassica nigra* seeds are shown in Table 1. It was discovered that a low concentration of CoS/CoS_2-C Nanocomposites, such as 10 mg/100 ml, decreases MGT to 1.2 days for *Trigonella foenum-graecum* seeds and 1.1 days for *Brassica nigra* seeds. It was also discovered that the MGT for seeds to grow got smaller with low concentrations, and that the number of seeds that germinated increased regardless of their future growth rate [Adhikari et al., 2016]. The germination period for *Trigonella foenum-graecum* seeds can be reduced with the help of NCs by employing only a sufficient amount of NCs because at high concentrations, such as 30 mg/100 ml, the germination time was approximately 2 days.

Table 1 Germinability of CoS/CoS_2-C Nanocomposites treated Seeds

SEEDS	GERMINABILITY (3rd Day)	GERMINATION RATE (7^{th} Day)
Fenugreek		
Control	73.3	100
5mg/100ml	86.6	100
10mg/100ml	86.6	100
15mg/100ml	93.3	100
20mg/100ml	86.6	100
30mg/100ml	73.3	100
Mustard seeds		
Control	93.3	100
5mg/100ml	66.6	100
10mg/100ml	80	100
15mg/100ml	80	100
20mg/100ml	86.6	100
30mg/100ml	73.3	100

Soaking seeds in metal sulphide Nanocomposites at different intervals affects seedling development and germination rates. Germination assays were conducted using time intervals of 3, 6, and 9 hours of soaking. The seeds were immersed in a solution containing 20 mg of CoS/CoS_2-C Nanocomposites per 100 ml distilled water for three, six, and nine hours to measure the average germination time as good germination rate is found at this concentration [Farahani et al.,2011]. The comparative investigation of soaking seeds with and without Nanocomposites reveals that Nanocomposites have a positive impact on germination rate and growth metrics. As in the beginning period, the seed requires active nutrition uptake and metabolic activation, which are efficiently activated by Nanocomposites [Praveen and Rao., 2015].

Soaking of seeds for 3 hours improves germination and 9 hours increases root length. When compared to suspension, the CoS/CoS_2-C Nanocomposites isolated from *Hordeum vulgare* for *Brassica nigra* (mustard) and *Trigonella foenum-graecum* (Fenugreek) has extremely good germinability, but the germination rate is relatively low for all soaking times. After 3 hours of soaking, the root and shoot lengths were increased. These results proved that to boost agricultural productivity, the seeds better to be soaked for 3 hours and the optimal concentration of CoS/CoS_2-C Nanocomposites must be used.

Conclusion

Plants' psychological responses can be altered to improve growth by synthesising, characterising, and applying Nanocomposites to seeds and crops. CoS/CoS_2-C Nanocomposites were effectively synthesised using the chemical precipitation method and a green synthesis from *Hordeum vulgare*leaves extract. These were subsequently characterised by UV-visible, SEM, and X-ray powder Diffractometer techniques (XRD). CoS/CoS_2-C Nanocomposites were formed with an average crystallographic size of 1-5 nm and high purity. CoS/CoS_2-C possessed a hollow tube structure with a length of 0.4-8.8 m and a width of 0.1-0.9 m. SEM pictures of CoS/CoS_2-C Nanocomposites revealed a variety of morphologies, including spherical, bean-like, and irregular shapes. The effects of CoS/CoS_2-C metal sulphide nanoparticle suspensions on rate of germination rate, shoot and root length, and mean germination time were investigated at different concentrations for *Trigonella foenum-graecum* and *Brassica nigra*seeds. The results proved that Cobalt sulphide Nanocomposites assist to regulate the nutrients flow for seedlings, which aids in plant elongation and growth. Soaking the seeds in distilled water with 20 mg of CoS/CoS_2-C Nanocomposites for 3 hours, resulted in enhanced germination and increased root length for *Trigonella foenum-graecum* and *Brassica nigra*seeds, respectively. *Trigonella foenum-graecum* and *Brassica nigra*seeds benefited greatly from the use of CoS/CoS_2-C Nanocomposites from the green synthesis process because they grown longer roots and shoots and germinated more quickly. The findings of this study open up new areas for the study of green nanotechnology in agricultural development.

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