



Effect Of Metal-Ligand Complex On Germination of some vegetable plants

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Plant physiology will probably also assume an increasingly important role in agricultural research problems. As world population increases, mankind faces enormously complex problems. One of the primary tasks of the future will be to increase food, forage, fiber and wood production substantially throughout the world. Today the application of various chemical salts to soils is a basic feature of agricultural practice.

In the present work, Chalcone (an α,β -dihydroxy Ketone) treatment on Vegetable plant' is selected for study as they have both nutritional as well as medicinal value. Since organic drugs have intense biological activity and since no work is reported on the biological applications of binary complexes of Fe (III) with ligand (chalcone) and comparing with pure ligand, metal and control solution doubly distilled water to study the effect of complex, metal, ligand and control solution on germination survival, seedling height, etc. on Tomato, Chilly, Spanish & Lady finger plants in order to make suggestion whether complex, metal and ligands can be used as plant growth regulators.

The following aspects were studied in laboratory.

- 1) Estimation of Root / Shoot Ratio in soil & soilless media.
- 2) Estimation of chlorophyll contents in soil & soilless media.

EXPERIMENTAL:-

The information about the role of metal complexes in biological systems, their concentration and presence in different equilibria is of immense importance. Greshon et. al.^{1, 2} reported that the activity of metal chelates is considerably increased as compared to that of the free metal and ligand alone on their complexation. The Shel et. al.³ and



Shashindharam et. al.⁴ observed the antifungal and antibacterial activities of complexes shows that they are more active as compared to free ligand and metal involved.

Rare earth ions are used as probe in bio-chemistry of calcium. Zielinski et. al.⁵ showed that, Lanthanide ion could substitute the calcium ion to produce active enzyme system. Some bivalent metal ions have been reported to be useful in agriculture as plant growth regulators. Such a vast uses of lanthanide necessitate concentrating on the study of lanthanides and ligands for studying the germination pattern.

The complexes of transition metal with bis-alkyl thiourea are prepared and their herbicidal and plant growth regulating activity are tested with wheat and cucumbers by Darnall et. al.⁶.

Sayed amir et.al.⁷ studied effect of some heavy metals on seed germination of canola, wheat, safflower evaluate phytoremedial potential.

K. Abraham et. al.⁸ also studied effect of heavy metals on seed germination of archis hypogaeae. L

Shivakumar C. K. et. al.⁹ also observed the presence of beneficial fungus and effect of copper and zinc metal absorption on growth and metal uptake of legumeneous plants as although these metals are required in traces but are important for growth.

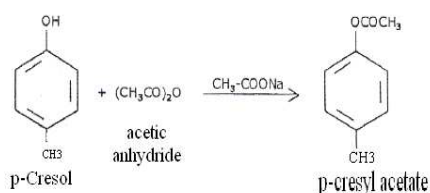
A. A. Ramteke et. al.¹⁰ studied the effect of chlorosubstituted pyrrazole and their complexes on spinach at different pH.

C. Aydinalp et. al.¹¹ also studied heavy metal effect on seed germination and plant growth and alfalfa plant (medicago sativa)

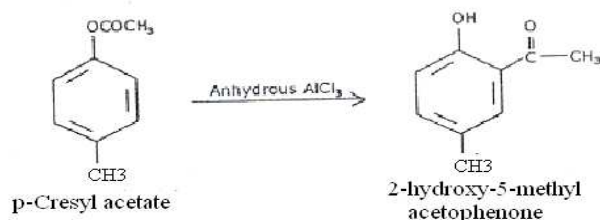
SYNTHESIS OF CHALCONE BY KNOWN METHOD

The chalcone was prepared by known literature method and was confirmed by melting point and also the structure was confirmed by IR spectroscopy as shown in spectra.

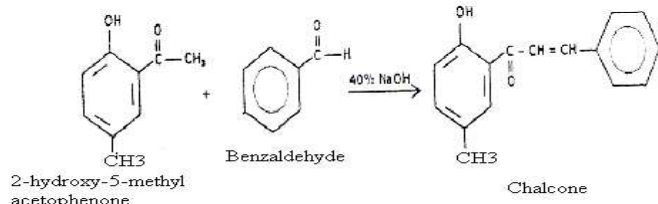
Step I: Preparation of p-cresyl acetate from p-cresol



Step II: Preparation of 2-hydroxy-5-methylacetophenone from p-cresyl acetate



Step III: Preparation of chalcone from 2-hydroxy-5-methylacetophenone



MATERIAL AND EXPERIMENTAL METHODS

- **Metal ions:-**

The solutions of metal ion in the form of FeCl_3 and MgCl_2 of 0.1 M concentration were prepared using distilled water and the seeds of tomato, chilly, Spanish & lady finger were soaked in both metal solvents.

- **Ligand:-**

The organic compound was prepared were dissolved in proper solvent and above seeds are soaked for 2-3 hours.



Metal ion + Ligand:- The mixture of FeCl_3 and organic compound (chalcone) and MgCl_2 and organic compound (chalcone) were dissolved in the distilled water and seeds are soaked.

Media:-For the germination of the above vegetables seeds, two types of the medias are used.

- 1) Soil media (media A)
- 2) Soilless media (media B)

EXPERIMENTS PERFORMED :-

In general practice, various chemicals are used in agricultural as an important ingredient of various pesticides, insecticides, fertilizers, etc. to improve the crop yield. Amongst several economical important plants Chilly ,tomato, Lady finger and Spanich are selected as a plants system. These plants are in ideal systems to study the germination and growth pattern. Further, their economical importance is reflected by its wide use for the dying purposes. The important uses these plants in daily life are persuasive to study its response against metal ion, ligand and its complex regarding to physiological processes; particularly germination is a vital process for the growth of plants. Therefore, these plants are selected as a plant system.

1]Healthy seeds were taken and thoroughly washed using doubly distilled water. Seeds from these healthy seeds of equal size were chosen, immersed in tested solution. These seeds soaked were taken out of each solution.the seeds are sown in germination trays of all medias.

2]Effect of ligand, metal Fe (III), complex and metal Mg (II), complex on chlorophyll in the leaves of vegetables plants were studied.

After sufficient growth, green fresh leaves were collected, as they contain chlorophyll pigments and chlorophyll content was determined spectrophotometrically given by Jahagirdar D. V.¹²



ESTIMATION OF CHLOROPHYLL IN LEAF PIGMENT:-

Procedure:-

Collect the fresh leaves weigh around 1 gm of leaves and cut them into small pieces. Add 5 ml of water and transfer the mixture to a blender. Homogenize the mixture by blending it intermittently for 3-4 minutes.

Take 0.5 ml of homogenous mixture and add 4.5 ml of 80% acetone to it. Thoroughly shake the content, centrifuge it. Collect the supernatant liquid and measure its optical density at 645 and 663 nm.

Parameters:-

Plants growth is decided on the basis of parameters such as percentage of germination survival, seedling height, shoot length, root length (root length / shoot length) and thickness of young leaf having high values compared to control system. The germination was noted after 9 days and 14 days for all Plants.

After noting the survival of the plants, they were taken out of the medias. The seedling height (root length / shoot length) was measured. The average values of these parameters are presented in Table 1

RESULT AND DISCUSSION

Some attempts have been made by Bera et. al.¹³ to study the effect of tannery effluent on seed germination, seedling growth and chloroplast pigment content in mungbean. Adhikari et. al.¹⁴ have observed the effect of raw savage water on mustard. Recently Farzin M. Parabia et. al.¹⁵ in their present investigation, effect of ligand, complex and metal ion on percentage seed germination, root length, shoot length (root / shoot ratio) has been studied.



ROOT LENGTH, SHOOT LENGTH AND ROOT / SHOOT RATIO

Germination starts when the seed shows emergence phase of growth, which begins, with penetration of embryo from the seed coat and end with development of root and shoot system. The elongation of shoot axis follows emergence of radical.

The rate and extent of elongation is subjected to a variety of controls, including nutrition, hormones and environmental factors. Though the root and shoot development start within a fraction of time but the further developments may vary according to the nutrients required for the development of root and shoot independently.

Therefore, root and shoot length differs from each other.

Table 1:-Effect of Different Treatment on Vegetable Plant in Respect of Parameters in Soil and Soilless Media.

Sr. No.	Parameters	Tomato		Chilli		Spanish		Lady finger	
		Soil	Soilless	Soil	Soilless	Soil	Soilless	Soil	Soilless
1	% Germination	63.6 %	70 %	65.6 %	88.6%	88%	90.4%	46 %	69.8%
2	Seedling Height(cm)	11.98	12.2 6	4.38	6.54	9.77	10.6	10.2 7	10.76
3	Shoot Length(cm)	6.44	6.46	2.84	3.86	6.04	6.29	6.69	7.0
4	Root length(cm)	5.52	5.76	1.54	2.68	3.74	4.28	3.58	3.77
5	Shoot/Root Ratio	1.11	1.15	1.84	1.44	1.68	1.50	1.86	1.88

Table 1 clearly indicates that percent germination in soilless medium is higher followed soil media.



Similarly the root length and shoot length which is called as seedling height shows a significant development of root / shoot length i.e. height of seedling highest in chalcone + Mg as compared to over all the treatments and subsequently followed by chalcone + Fe, metal ion Mg, chalcone and control (d/w) respectively in all cases.

When we compare the performance of all the treatments for different parameters in soil and soilless media. The germination & growth parameters are studied in soil and soilless media. Soilless media shows better performance as against soil media in all the treatments.

Mg is a major constituent for the formation of chlorophyll molecule which helps in the process of photosynthesis for the production of food materials in the plant i.e. sugar synthesis. With combination of chalcone + Mg plays a pinnacle role in keeping all the system working properly. This may be the reason for the better performance.

Fe plays major role in energy transfer within the plants and also brings about chlorophyll development and formation. It is also a constituent of certain enzyme and protein. With the combination of chalcone plays a major role in keeping all the plant system working properly may be the reason for a good performance.

The germination of seed and development of the seedling is better in soilless media than the soil media. Because there is less resistance for the root development and shoot development in soilless media than the soil media may be the reason for better, overall development of the plant.

• **CHLOROPHYLL CONTENT**

Photosynthesis is the process in which the light energy will be converted into chemical energy. There are some basic requirements for the process of photosynthesis as CO_2 , H_2O and light energy besides of course, the structural framework of green plant in the form of chloroplast, which is a unique cell having most important role in all the physiological reactions, starting from the absorption of light energy.



Basically, among the smallest group of coordinating pigment molecules necessary to effect a photochemical

act, the most important pigments involved in photosynthesis are chlorophyll and carotenoid.

Table 2-3 clearly shows that absorption of plant leaves is higher at 663 nm in all the treatments. These tables also clearly indicates that the amount of chlorophyll is more in chalcone + Mg. Followed by chalcone + Fe, metal ion Mg, chalcone and control (d/w) in both soil and soilless media.

Obviously the chlorophyll content is highest in chalcone + Mg in both soil and soilless medias. Because of Mg is major constituent for the formation of chlorophyll.

Table 1:-Effect of different treatment on chlorophyll content in respect to soil media

Sr.No.	Name of vegetable plants	Treatment with Ligand	Treatment with Ligand+Mg	Treatment with Ligand+Fe	Treatment with Metal ion Mg	Treatment with distilled water
1	Tomoto	8.22×10^{-3}	10.162×10^{-3}	8.363×10^{-3}	11×10^{-3}	5.64×10^{-3}
2	Chilli	7.3×10^{-3}	25.83×10^{-3}	24.61×10^{-3}	12.67×10^{-3}	6.22×10^{-3}
3	Spanich	4.71×10^{-3}	7.65×10^{-3}	5.61×10^{-3}	8.09×10^{-3}	4.50×10^{-3}
4	Lady finger	12.7×10^{-3}	32.22×10^{-3}	21.34×10^{-3}	37.50×10^{-3}	7.095×10^{-3}

Table 2:-Effect of different treatment on chlorophyll content in respect to soilless media



Sr.No.	Name of vegetable plants	Treatment with Ligand	Treatment with Ligand+Mg	Treatment with Ligand+Fe	Treatment with Metal ion Mg	Treatment with distilled water
1	Tomato	11.9×10^{-3}	14.8×10^{-3}	12.5×10^{-3}	19.3×10^{-3}	10.3×10^{-3}
2	Chilli	6.77×10^{-3}	16.37×10^{-3}	9.94×10^{-3}	9.88×10^{-3}	6.01×10^{-3}
3	Spanich	7.41×10^{-3}	8.45×10^{-3}	8.31×10^{-3}	9.93×10^{-3}	5.41×10^{-3}
4	Lady finger	13.13×10^{-3}	36.31×10^{-3}	25.35×10^{-3}	40.49×10^{-3}	7.1×10^{-3}

When we compare the performance of all treatments for different parameters, in soil and soilless Media. It is clearly observed that soil less media shows better result in respect of germination percentage, development of seedling during the experimental period.

Result of effect of metal ion Mg, Chalcone, Chalcone+ Mg and control (d/W) and chalcone+ fe, on germination, seedling development clearly reveals that, Chalcone +Mg shows significant better performance overall the treatments. All the parameters are considered, while finding out the results. In general order in all the parameters performance wise Chalcone+Mg stood first followed by metal ion Mg, Chalcone Chalcone+fe and control (D/W).

The germination and growth parameter are studied in soil and soilless media. The soilless media shows better performance as against the soil media in all the treatments.

Mg is major constituents for the formation of chlorophyll molecule which helps in the process of photosynthesis for the production of food materials in the plants, i.e. sugar synthesis. With the combination of Mg chalcone plays a pinnacle role in keeping all the plant system working properly may be the reason for a better performance.

Mg is a secondary importance element essential for the plant growth. Which is also a constituents of many enzyme the detail information about Mg is already mention in the above para. So, keeping in view of all the characteristics of Mg plays a pivotal role for a good performance against the other treatments.



Germination of seed and development of seedling is better in the soilless media than the soil media, because there is less resistance for the root development and shoot development in the soilless media than the soil media, may be the reason for better overall development of the plant.

The analysis performed for finding out the total chlorophyll in green leaves of the plant. The results of analysis clearly indicate that metal ion Mg is having the highest chlorophyll content in both soil and soilless media than the remaining treatments like Chalcone+Mg, Chalcone+Fe, Chalcone and control (D/W).

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