STUDY OF PLANT GROWTH REGULATING ACTIVITY OF 2’-HYDROXY,3’-BROMO,5’-CHLORO-4- METHOXY-N[ORTHONITROPHENYL] CHALCONE IMINE & ITS PR (III) COMPLEX ON TRIGONELLA PLANT

Abstract

The Impact of 3'-Bromo, 5'-Chloro-4-Methoxy-N-[Orthonitrophenyl], and 2'-Hydroxy on the Growth-Regulating Activity of Plants Chalcone Imine and its Complex of Pr (III) on the Trigonella (Methi) plant have been examined at pH 3.6, 7.00, and 10.5 in order to give suggestions regarding the potential application of this ligand and its complex as a plant growth regulator. The growth of the plant was evaluated based on measurements of criteria such as the percentage of seeds that germinated, the percentage of seeds that survived, the height of the seedlings, the length of the shoots and roots, the root-to-shoot ratio, the chlorophyll content, and the breadth of the young leaves. On the basis of the average values of these parameters, a conclusion has been drawn regarding the action of ligand and its complex in controlling the development of plants.

Keywords: Plant Growth regulators, Germination, Shoot length, Root length, root/shoot ratio, Seedling height & chlorophyll content etc.

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I. INTRODUCTION

There is a good chance that plant physiology will play an increasingly significant part in agricultural research issues. The increasing complexity of the issues that humanity encounters is directly correlated to the growth of the global population. Their answers will require input from a wide variety of sources, including the social, agricultural, economic, and technical spheres. In the not-too-distant future, one of the most important things that has to be done all around the planet is the production of significantly more food, forage, fiber, and wood. The creation of novel and enhanced crop plant strains and varieties, enhanced plant defense against pests, diseases, and weeds, management of soil fertility, and increased mechanization efficiency will remain the main objectives of agricultural research programs, just as they do now. There will be a sharp rise in the need for plant physiologists to conduct research projects with the express goal of boosting the yields of plant products, in addition to the need for them to impart basic knowledge about how plants grow and develop. These two facets of plant physiology are expected to be in great demand.

The most common method of increasing crop output before to the eighteenth century was the application of plant and animal components to the soil. One of the most significant advances in agricultural research throughout the 1800s came from experimental plant physiology, which revealed that adding a variety of nutrients to the soil might increase crop yields and soil fertility. One of the main discoveries of experimental plant physiology was this. Without a question, one of the most important discoveries in the history of agricultural science was this one. The fact that the soil treatment restored just a tiny fraction of the nutrients that the plants had removed from the soil was disclosed, albeit it was not made obvious. Another agricultural method that has been around for a while is crop rotation, which is switching out one crop for another on a regular basis. This method has been used for several generations. The use of this method caused the crops' growth to accelerate noticeably. The quantity of various nutrients that are present in the soil directly affects how crop plants grow, yet agricultural experts did not fully comprehend this connection until the 1800s.The first people to use this idea were agronomists in the seventeenth century. It is widely acknowledged that one of the most important aspects of more modern agricultural techniques is the addition of different salts to soils. Over the past fifty years or more, developing nations all over the world have been able to increase their agricultural yields due to the addition of these and other types of fertilizer to the soil; however, this would not have been possible without the use of fertilizer in the first place.Applying different chemicals to crop plants via spraying them with a solution or aqueous suspension is standard procedure in today's farming operations. The purpose of this technique is to accelerate or modify the rate of growth and development of the plant.

The finding that certain platinum coordination complexes are particularly useful in stopping the growth of malignant tumors provides strong support for the hypothesis between chelation therapy and cancer.

II. AIM OF THE PRESENT WORK

Greshon et al[1,2] The complexation of metals with ligands has been shown to considerably improve their activity, as compared to that of the free metal and ligand alone. In comparison to the behavior of the unbound metal and ligand, this is a significant improvement. Independent evaluations of the free ligand and metal in the process show that the complexes are more active than the free ligand when it comes to inhibiting the growth of bacteria and fungi.[3,4].

This study was conducted with the intention of determining the level of antibacterial activity shown by Cu(II) complex ligands and metal ions in relation to a wide variety of harmful microorganisms.[5] The spectrum features of a system are altered when Ca2+ is replaced with rare earth metal ions in a complex, however this does not have any effect on the complex's ability to perform its intended function.[6] In the study of calcium's biochemistry, rare earth ions are utilized as probes.The names Zielinski et al. [7] shown that the lanthanides ion might serve as a replacement for the calcium ion in order to generate an active enzyme system.

In the work, Darnall et al. employed bis-alkyl thiourea as the starting material to synthesize transition metal complexes using wheat and cucumbers. They next investigated how these complexes affected plant development and had herbicidal properties. The results obtained from these tests were positive.[8] In a number of studies that have been published, it has been proposed that complexes of piperidene-2-carboxylic acid with certain bivalent metal ions might act as possible growth regulators for plants.[9] Wheat and barley plants were used in an experiment to demonstrate the herbicidal and growth-regulating effects of rare earth complexes containing peptides.[10]

Because of the strong biological activity of organic medicines and the absence of prior study on this issue, binary complexes of Pr(III) with 2'-Hydroxy,3'-bromo,5'-chloro-4'-methoxy- N[orthonitrophenyl] chalcone imine (HBCMNCI) were examined for their possible biological uses.

Experiments in the following areas were conducted to investigate their respective topics:

- Calculation of the chlorophyll content
- Calculation of the nitrogen and protein content as a percentage of the total

III. MATERIAL & EXPERIMENTAL METHODS

1. **Metal Ions :** Using water that had been through two separate distillation procedures, solutions of metal nitrates with a concentration of 0.01M were created and used in the preparation. These solutions were put to use so that metal ions may be produced.

2. **Ligand :** In distilled water, solutions of ligands at a concentration of 0.01 M were made.

   In order to investigate the applications of complex metal ligand solutions, they are first dissolved in the appropriate solvent at the required pH.

   As a result of this, we put the biological applications through water testing at pH values of 3.60, 7.00, and 10.5, while maintaining a constant ionic strength of 0.01 m potassium nitrate solution.

3. **Soil:** When the lush dirt that surrounded Lonar Lake was removed, many stones and minerals were extracted from the ground. Stones such as the Satpuda stone and the Chikhaldara stone are two examples of this kind. After being crushed into a powder, it was put through the filtering process.The end result was achieved by mixing together four parts of this earth powder and one part of screened pink stone sand. After that, bits of dirt of similar size were removed and placed in two separate wooden trays. There were four distinct slots in each of these trays. The soil in the tray was made more moist by incorporating water into it. After waiting an hour, the seedlings were planted in this area.

IV. EXPERIMENTS PERFORMED

In agriculture, several different chemicals are typically utilized as essential components of a wide variety of pesticides, insecticides, fertilizers, and other types of agricultural products in order to increase crop productivity. Methi, also known as Trigonella, is chosen as the plant system among a number of other economically significant plants. These plants are growing in environments that are perfect for research on germination and growth patterns.In addition, the widespread use of their products in the vegetable industry contributes to the economic significance of these products. The numerous practical applications of methi in everyday life make it compelling to investigate the plant's reaction to metal ions, ligands, and their complexes in relation to physiological processes. The process of germination in particular is an important one for the development of plants. As a result, we have chosen these plants to function as a plant system.

1. Vibrant seeds of methi with the same germination were collected and given a thorough washing with water that had been thrice distilled.One hundred of these wholesome seeds of the same size were selected, and they were submerged in a solution with a pH of 3.6, 7.00, and 10.5 for approximately six hours.These seeds were removed from their respective solutions after being steeped.

2. The seeds were planted in succession in the wooden trays that were lined up in a row. The studies were conducted out between the 28th of June and the 28th of July 2022, and the wooden trays were maintained at room temperature while being subjected to air pressure.

3. Plants of the species Abelmoschus esculentus were grown in soil with various concentrations of ligand, metal ions, and complex solutions at three varied pH values (3.6, 7.00, and 10.5) in order to study their responses to these conditions. The seeds were left immersed in the solution for 4, 6, and 8 hours respectively. According to the findings, the solution with a higher degree of complexity had the largest impact on the development of the plants.

4. The effects of the ligand and metal Pr(III) complex were examined in relation to the nitrogen, protein, and chlorophyll levels found in the leaves of Trigonella methi (methi) plants.

5. All of the green vegetables that were chosen for the purpose of determining chlorophyll content have this characteristic in common. Chlorophyll pigments are present in the chloroplasts of these organisms. One gram of fresh leaves was analyzed in an effort to determine the total amount of chlorophyll pigments present. Spectrophotometry was the method that Jahagirdar recommended for determining this, and it came to that conclusion.[11].

Using the information provided there, the total amount of chlorophyll as well as the amounts of chlorophyll 'a' and 'b' that were listed in tables 1 (a) & 1 (b) were calculated.

- Total Chlorophyll (g/lit) = 0,0202 (O.D) 645 + 0.00802 (O.D) 663.
- Chlorophyll 'a' (g/lit) = 0.0127 (O.D) 663 – 0.00269 (O.D) 645.
- Chlorophyll 'b' (g/lit) = 0.0229 (O.D) 645 – 0.00488 (O.D) 480.

It has been determined how much total nitrogen is found in the plant leaves that have been treated. To get the proportion of protein, we multiplied the total amount of nitrogen by

6.25 and then did the same thing with protein. 6.25 is the constant in plant material that is referred to as the protein factors.

V. PARAMETERS

Some indicators of a plant's health and development include the germination rate, the percentage of seedlings that make it to maturity, the length of the shoots, the root length (root length/shoot length), and the thickness of the first set of leaves. If these metrics have high values, they are seen positively when compared to the control system. After 1.5 days and 10 days, respectively, germination was seen in the methi (Trigonella) plant.

The cuttings were taken out of the soil once it was determined that the plant was still alive. On the plants that had survived, we measured the thickness (width in ratio to length) and seedling height (root length in relation to shoot length). Tables (1) through (3) provide average values for various parameters.

Table 1: Effect of Ligand, Metal Ion & Complexes on Germination, Survival, Seedling Height etc.on Trigonella (Methi) Test System

(seed soaked in solution for 4 hours)

pH = 3.60
μ = 0.1M

Parameters	**Effect of**				**General Order of Plant Growth Regulators**
	Water or Control	**Ligand**	**Complex**	**Metal**	
% Germination after 2 & 1/2 days	50.00	70.00	63.33	70.00	Metal > Ligand > Complex > Control
% Survival after 10 Days	52.00	76.00	72.00	68.00	
Seedling Height (cm)	1.27	1.32	1.30	1.29	
Root Length(cm)	3.05	3.15	3.10	3.08	
Shoot Length (cm)	4.01	4.23	4.20	4.12	
Root/Shoot	0.7605	0.9446	0.7380	0.7403	
Width length of Young Leaf (cm)	0.9851	0.9215	0.9900	1.0052	

LIGAND – HBCMNCI CONTROL – Distilled
Water COMPLEX – Pr(III)-HBCMNCI METAL –Pr(III)

Table 2: Effect of Ligand & Control on Germination, Survival, Seedling Height etc.on Trigonella (Methi) Test System

(Seed soaked in solution for 6 hours) **μ** = 0.1M

Parameters	Effect At Different pH					
	Control or H_2O			Ligand		
	3.60	**7.00**	**10.5**	**3.60**	**7.00**	**10.5**
% Germination after 2 & 1/2 days	50.20	50.25	50.30	72.00	72.10	72.30
% Survival after 10 Days	52.00	76.00	72.00	68.00	68.90	69.00
Seedling Height (cm)	1.28	1.29	1.30	1.30	1.32	1.35
Root Length(cm)	3.08	3.09	3.10	3.18	3.20	3.22
Shoot Length (cm)	4.02	4.03	4.05	4.25	4.27	4.29
Root/Shoot	0.7661	0.7664	0.7654	0.7482	0.7494	0.7505
Width length of Young Leaf (cm)	0.9880	0.9356	0.9958	0.9855	0.9889	0.9980

Table 3: Effect of Complex & Metal Ions on Germination, Survival, Seedling Height etc.on Trigonella (Methi) Test System

(seed soaked in solution for 6 hours) **μ** = 0.1M

Parameters	Effect At Different pH					
	Control or H_2O			Ligand		
	3.60	7.00	10.5	3.60	7.00	10.5
% Germination after 2 & 1/2 days	63.50	63.58	63.65	71.00	71.06	71.15
% Survival after 10 Days	72.50	77.00	73.05	69.00	70.05	71.00
Seedling Height (cm)	1.32	1.34	1.35	1.31	1.33	1.34
Root Length(cm)	3.07	3.18	3.12	3.10	3.12	3.13
Shoot Length (cm)	4.02	4.06	4.07	4.01	4.08	4.10
Root/Shoot	0.7636	0.7832	0.7741	0.7730	0.7647	0.7634
Width length of Young Leaf (cm)	0.9881	0.9350	0.9952	0.9725	0.9735	0.9982

It is clear from looking at tables (1-3) that the percentage of seeds that survive is, in many instances, higher than the percentage of seeds that germinate. This is because the germination of some seeds occurred after the recording of the germination process.

VI. RESULT & DISCUSSION

Other researchers have also attempted this, including Bera et al.[12] Examine the effects that tannery effluent has on mungbean chloroplast pigment levels, seed germination, and seedling growth. Adhikari et al. are the names.[13] have seen firsthand the effects of unfiltered, unrefined water on mustard. In the current experiment, the effects of ligand, complex, and metal ions were assessed with respect to the percentage of seed germination, root length, and shoot length (root/shoot ratio). Furthermore, the work quantifies the amount of protein, computes the proportion of nitrogen, and analyzes chlorophyl.

VII. PERCENT GERMINATION

One of the primary objectives of the study of plant physiology is to comprehend the process of seed germination. In point of fact, development is a stage that occurs throughout the life cycle of an organism. The development of a plant takes place in cycles. Since seeds are quiescent or resting organs that symbolize a common pause in the life cycle, germination of seeds is an easy place to start. If any cycle can be claimed to have a beginning in plants, then starting would be considered to be the beginning of that cycle. When the right circumstances are present, the seed will begin the process of germinating and renewing its development. Certainly, situations of different kinds will have an impact on anything of this magnitude.

It was evident from the tables (1-3) that the percentage of germination in all of the treatments virtually increased as compared to the control.

VIII. ROOT LENGTH, SHOOT LENGTH & ROOT/SHOOT RATIO

The data presented in Tables 1 through 3 make it abundantly evident that, under HBCMNCI, complex, and Pr (III), the average root length of the control Methi (Trigonella) plant system increased throughout all pH ranges. Table 1-3 shows that the Pr (III)-complex with HBCMNCI showed a decrease in shoot length relative to the control, but an increase in shoot length overall. These observations are made based on the length of shoots produced by the Methi plant system. The fact that the Pr (III)-complex with HBCMNCI resulted in shorter shoots than the control might be the cause of this discrepancy.

By evaluating the proportional growth of the Methi (Trigonella) plant system, researchers were able to look at the differences in the growth pattern of the plant's root and shoot. The changes that occur simultaneously in the root and the shoot are reflected and illustrated by the root-to-shoot ratio.

IX. CHLOROPHYLL CONTENT

Two of the most crucial and essential components of photosynthesis are the pigments carotenoid and chlorophyll. The smallest set of coordinating pigment molecules required to complete a photochemical reaction includes both of these pigments. The reaction cannot occur without these components. Chlorophyll an is the main pigment that absorbs light with a wave length of 670 nm. When light is passing through it, it appears bluish-green, but when light is reflected off of it, it turns crimson. The color of chlorophyll b changes as light is transmitted, going from a yellowish green to a reddish tint when light is reflected. It has the capacity to absorb light with a 645 nanometer wavelength.Table 4 displays the rates of absorption of plant leaves. Measuring at 663 nm, it is evident that the Methi (Trigonella) plant system has the highest values.

Table 4: Measurement of Optical Density for Methi (Trigonella) Plant System

Sr. No.	Leaves of Plants with Treatment of Following	Optical Density At		
		480 nm	645 nm	663 nm
1.	H_2O or Control	0.306	0.142	0.406
2.	Ligand	0.270	0.128	0.391
3.	Complex	0.300	0.144	0.412
4.	Metal Pr(III)	0.275	0.180	0.471

Table 5: Estimation of Chlorophyll For Methi (Trigonella) Plant System

Sr. No.	Leaves of Plants with Treatment of Following	Total Chlorophyll g/lit	Total Chlorophyll 'a' g/lit	Total Chlorophyll 'b' g/lit
1.	H_2O or Control	6.124×10^{-3}	4.714×10^{-3}	1.358×10^{-3}
2.	Ligand	5.725×10^{-3}	4.821×10^{-3}	1.6136×10^{-3}
3.	Complex	6.2130×10^{-3}	4.8451×10^{-3}	1.883×10^{-3}
4.	Metal Pr(III)	7.413×10^{-3}	5.497×10^{-3}	2.292×10^{-3}

X. ORDER OF TOTAL CHLOROPHYLL

Metal > Complex > Control > Ligand For MI plant system

It was shown that the methi (Trigonella) chlorophyll pigments were impacted by the treatments. According to Table 5, the Methi (Trigonella) plant system has the following total chlorophyll order: Ligand > Metal > Complex > Control. This is obviously visible while examining the table.

XI. CONCLUSION

It can be deduced from all of the talk that was done above that the percentage of seeds that survive is, in many instances, a higher number than the percentage of seeds that germinate.

This is because the germination of some seeds occurred after the recording of the germination process. The percentage of seeds that germinated in all of the treatments is virtually as high as it was in the control group. In the case of the Methi (Trigonella) plant system, the order of metal, complex, control, and ligand was discovered to determine the overall chlorophyll content.

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