**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**

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**Abstract**

ThePlant Growth Regulating Activity of 2’-Hydroxy,3’-Bromo,5’-Chloro-4-Methoxy-N[Orthonitrophenyl] Chalcone Imine & its Complexof Pr (III) on Trigonella (Methi) plant have been studied at pH 3.6, 7.00 & 10.5in order tomake suggestions whether this ligand & its complex can be used as plant growth regulator. The plant growth was decided by measurement of parameters like percentage of germination, survival, seedling height, shoot length, root length, root/shoot ratio, Chlorophyll content & width of young leaf. The average values of these parameters have been used to make conclusion about plant growth regulating activity of ligand & its complex.

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

 **I.Introduction**

 Plant physiology will probably also assume an increasingly important role in agricultural research problems. As world populations increases, mankind faces enormously complex problems. Their solutions will require input from many sources, social, economical, technological & agricultural. One of the primary tasks of the future will be to increase food, forage, fibre & wood production substantially throughout the world. Future agricultural research programme will continue, as in the present, to have as their major goals the production of new & better varieties & strains of crop plants, the improvement of plant protection against insects,diseases & weeds, the control of soils fertility & an increase in mechanization efficiency. But in addition,there will be a sharp intensification of demand of plant physiologists not only to supply basic information regarding how plants grow & develop but also to undertake research programmes designed specially to increase yields of plant products.

 One of the important contributions of the nineteenth century experimental plant physiology to agricultural was the discovery that soil fertility & crop yields could be increased by adding several nutrients to the soil prior to the nineteenth century, the common method for increasing crop production was to apply plant & animal to so. It was not released that this treatment returned to the soil only a portion of nutrients that had been extracted by plants. another centuries old agricultural practice was to rotate crops periodically with other crops. This practice resulted in increased growth of crops only in the 1800’s, agricultural scientists realize that crop plants grow in proportion to the amounts of various nutrients present in soils.the principle was adopted by nineteenth century agronomists. Today the applications of various salts to soils is a basic feature of agricultural practice. Without the application of these & other fertilizer to soils the larger crops yields obtained in developing countries throughout the world during the past 50 years or more could not be possible.in modern agricultural practice,various chemicals in solution or aqueous suspension are sprayed on to the crop plants within the object of accelerating & modifying the plant growth & development.

 Powerful support for the connection between chelation & cancer has come out from discovery that some of the coordination cpds of platinum are very effective in inhibiting the growth of tumors.

**II. Aim of the Present Work**

 Greshon et al 1,2 reported that the activity of metal chelates is considerably increased as compared to that of the free metal & ligand alone on their complexation. The observation of antifungal & antibacterial activities of complexes show that they are more active as compared to free ligand & metal involved3,4.

 The biological activity of metal ion & ligand of Cu(II) complexes towards some fungi & bacteria are evaluated5. Rare earth metal ions, when they replace the metal ion Ca2+ in complex, spectral properties of the systems are modified with no change in functonalities of the complex6. Rare earth ions are used as probe in bio-chemistry of calcium.Zielinski et al7 showed that, lanthanides ion could substitute the calcium ion to produce active enzyme system.

 The complexes of transition metal with bis-alkyl thiourea are prepared & their herbicidal & plant growth regulating activity are tested with wheat & cucumbers by Darnall et al8. Complexes of piperidene-2-carboxylic acid with some bivalent metal ions have been reported to be useful in agriculture as plant growth regulators9. The complexes of rare earth with peptides showed the herbicidal & plant growth regularity activity with wheat & barley plant10.

 Since organic drugs have intense biological activity & since no work is reported on the biological applications of binary complexes of Pr(III) with 2’-Hydroxy,3’-bromo,5’-chloro-4-methoxy-N[orthonitrophenyl] chalcone imine (HBCMNCI) & comparing with pure ligand, metal & control solution with doubly distilled water to study the effect of complex, metal, ligand & control solution on germination survival, seedling height etc. on Methi (Trigonella) plant in order to make suggestion whether complex, metal & ligands can be used as plant growth regulators.

The following aspects were studied in laboratory

1. Estimation of chlorophyll contents
2. Estimation of percentage of nitrogen & protein

**III. Material & Experimental Methods**

 **Metal Ions :-** The solutions of metal ions in the form of nitrates of the concentrations of 0.01M were prepared using doubly distilled water.

**Ligand :-** 0.01 M solutions of ligands were prepared in distilled water

 The applications of complex, metal, ligand solution are studied by dissolving it in proper solvent at desired pH

 The biological applications are therefore studied in aqueous medium at 3.60, 7.00 & 10.5 pH & at constant ionic strength of 0.01 m potassium nitrate solution.

**Soil:**- Fertilized soil was collected from Lonar Lake & Satpuda, Chikhaldara stone & other material were removed from it. It was then grind & filtered .two parts of this finely powdered soil was mixed with one part of filtered pink stone sand. This soil was then filled in two wooden trays having four compartments of equal size. The soil in the tray was moistened with water. Sowing of seeds was done in this soil after one hour.

**IV. Experiments performed**

In general practice, various chemicals are used in agricultural as an important ingredients of vaarious pesticides, insecticides, fertilizers etc. to improve the crop yield. Amongst several economical important plants Methi (Trigonella) are selected as a plant system. These plant are in ideal systems to study the germination & growth pattern.further,their economical importance is reflected by its wide use for the vegetable purposes. The important uses of Methi in daily life are persuasive to study its response against metal ion, ligand & 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 of Methi of same germination were taken & thoroughly washed using doubly distilled water.100 seeds from these healthy seeds of equal size were chosen,immersed in tested solution of pH 3.6,7.00 & 10.5 for about 6 hours .These seeds soaked were taken out of each solution. The seeds were sowed in the wooden trays in a row. The experiments were carried out during 28th Juneto 28th Jully 2022, the wooden trays were kept under the atmospheric pressure at room temperature

3] Effect of ligand, metal ion, complex solution on growth of Abelmoschus esculentus plants was studied at different pH (3.6,7.00 & 10.5) the seeds being immersed in solution at about 4, 6 & 8 hours.

4] Effect of ligand, metal Pr(III) complex on percentage of nitrogen, percentage of proteins & chlorophyll in the leaves of Methi (Trigonella) plants was studied.

5] For the estimation of chlorophyll content, All the vegetables selected for the purpose were green. They contain chlorophyll pigments in the chloroplasts. The attempt was made to find out total chlorophyll pigments in 1gm of fresh leaves. This was determined by spectrophotometry method given by Jahagirdar11.

 The total amount of chlorophyll & chlorophyll ‘a’ & chlorophyll ‘b’ reported in table 1 (a) & 1 (b) determined by using-

 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.

 The total nitrogen present in the leaves of treated plants has been calculated. The percentage of protein was calculated by multiplying 6.25 to the total amount of nitrogen. 6.25 is the constant known as protein factors in plant material

**V. 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) & thickness of young leaf having high values compared to control system the germination was noted after 1 & 1/2 days & 10 days for Methi (Trigonella) plant.

 After noting the survival of the plant, they were taken out of soil. The seedling height (root length/shoot length) & thickness (width length) of young leaf of survived plant were measured. The average values of these parameters are presented in tables (1-3).

**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 H2O** | **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 H2O** | **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 observed from tables (1-3) that percentage of survival of seeds is more than that of germination in many cases. This is due to the facts some seeds germinated after recording of germination.

**VI. Result & Discussion**

 Some attempts have been made by Bera et al12 study the effect of tannery effluent on seed germination, seedling growth & chloroplast pigment content in mungbean. Adhikari et al13 have observed the effect of raw savage water on mustard. In the present investigation, effect of ligand, complex & metal ion on percentage seed germination, root length, shoot length (root/shoot ratio) has been studied. The work also deals with the study of chlorophyll,percentage of nitrogen & protein estimation.

**VII. Percent Germination**

 To understanding seed germination is one of the major goals of plant physiology. Actually, development is an organism goes through in its life cycle. Plant development is a cyclic process. If any cycle can be said to have a beginning in plants, beginning would be germination of seed is a convenient place to begin because seeds are quiescent or resting organs that represents a normal hiatus in life cycle. When the conditions are appropriate the seed will renew its growth & germinates. Such an important phenomenon will be affected by different conditions.

 It was cleared from tables (1-3) that the percent germination in all the treatment almost increases than that of control.

**VIII. Root Length, Shoot Length & Root/Shoot Ratio**

From Tables 1 to 3 it is clearly indicate that average root length in HBCMNCI, complex, Pr (III) at all pH increase over control for Methi (Trigonella) plant system. In the shoot length, for Methi plant system (Table1-3), it is seen that in Pr (III)-complex with HBCMNCI showed decrease in shoot length but increase as compared to control.

 The changes in the growth pattern of root & shoot were studied by the proportional growth in Methi (Trigonella) plant system. The root & shoot ratio reflects the same & represents the developments in root & shoot simultaneously.

**IX. Chlorophyll Content**

 Basically among the smallest group of coordinating pigment molecules necessary to effect a photo chemical act, the most important pigments involved in the photosynthesis are chlorophyll & carotenoid. Chlorophyll ‘a’ appears blue green in transmitted light but reddish in reflected light & is the principal pigment involved in trapping the light of wave length 670 nm. Chlorophyll ‘b’ is yellowish green in transmitted light but reddish in reflected light & traps light of wavelength 645 nm.Table-4 shows the absorption of leaves plants which is higher at 663 nm for Methi (Trigonella) plant system.

**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. | H2O 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. | H2O or Control  | 6.124 x 10-3 | 4.714 x 10-3 | 1.358 x 10-3 |
| 2. | Ligand | 5.725 x 10-3 | 4.821 x 10-3 | 1.6136 x 10-3 |
| 3. | Complex | 6.2130 x 10-3 | 4.8451 x 10-3 | 1.883 x 10-3 |
| 4. | Metal Pr(III)  | 7.413 x 10-3 | 5.497 x 10-3 | 2.292 x 10-3 |

 **Order of total Chlorophyll** :- Metal > Complex > Control > Ligand

 For MI plant system

 Chlorophyll pigments were found affected in Methi (Trigonella) by the treatments. It can be seen from Table-5 that, the order of total chlorophyll is found to be as Metal > Complex > Control > Ligand for Methi (Trigonella) plant system.

**Conclusion**

 It is conclude from all above discussion that, Percentage of survival of seeds is more than that of germination in many cases. This is due to the facts some seeds germinated after recording of germination. Percent germination in all the treatment almost increases than that of control. Also the order of total chlorophyll is found to be as Metal > Complex > Control > Ligand for Methi (Trigonella) plant system.

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