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PLANT REGULATORY ACTIVITY OF 2-[(1-NAPHTHALEN-1-YL-ETHYLIMINO)-METHYL]-PHENOL AND ITS TRANSITION METAL COMPLEXES ON SEEDS OF CHICK PEA (*CICER ARIETINUM*), MUNG BEAN (*VIGNA RADIATA*) AND RED LENTIL *(LENS CULINARIS)*

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ABSTRACT

A Schiff base ligand and its transition Metal complexes were synthesized. Plant growth regulating activity on seeds of chick pea (*Cicer arietinum*), Mung bean (*Vigna radiata*) and Red Lentil (*Lens culinaris*), has been studied using standard Blotter method for evaluation of inhibitory or stimulatory effects of the synthesized compounds. The plant growth analysis was decided by measurement of parameters like percentage of germination, dry weight, shoot length, root length, protein content and carbohydrate content. The values of these parameters have been used to make a conclusion about plant growth regulating activity of ligand and its complexes.

KEYWORDS

Schiff bases, Metal Complexes, Plant growth studies and Standard Blotter method.

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INTRODUCTON

Plants are the important necessities. Variety of crops is produced and agricultural research is emphasized to produce better varieties of crop plants, protection of plant against, etc. Many substances are abletostir up same plant responses. In this background coordination chemistry plays a important role. Transition metal complexes are used to produce new varieties of crops, improve the quality of plants, and protect the plants from insects, diseases and weeds[1-3]. Transition metal complexes of substituted pyrazoles were tested for their plant growth regulating activity[4]. Piperidene-2-carboxylic acid complexes of bivalent metal ions have been

found to be useful in agriculture as plant growth regulating[5]. Plant growth regulating activity of (2-chlorophenyl) (5-(2- hydroxyphenyl)-3-(pyridin-3-yl)-1H-pyrazol-4-yl) methanone and its Fe (III) and Cu (II) complexes on *Trigonella foenum-graecum* were studied[6]. Many workers have studied the plant growth regulating activities of various organic ligands and their transition metal ion complexes for various plants[7-12].

Present work deals with synthesis of Schiff base ligand (Figure No.1) 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol and its transition metal complexes (Figure No.2) by condensing with metal salts of Ni (II), Cu (II), Co(II), Mn (II) and Zn (II). Further Schiff base and its complexes have been screened for their plant growth activity.

MATERIAL AND METHODS

Chemicals and reagents

The chemicals used are 1-Naphthalen-1-yl-ethylamine (Merck ,AR grade) and Salicyldehyde (Merck, AR grade), Ethyl alcohol (Merck, AR grade), Cobalt (II) chloride dihydrate (Sigma Aldrich), Nickel(II) chloride hexahydrate (Sigma Aldrich), Copper(II) chloride dihydrate (Sigma Aldrich), Zinc (II) chloride (Sigma Aldrich), Manganese (II) chloride tetrahydrate (Sigma Aldrich)

Synthesis of Ligand (NEMP)

The Schiff Base ligand 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol was synthesized (Figure No.1) by condensing amine 1-Naphthalen-1-yl-ethylamine with salicyldehyde in equimolar proportions. To an ethanolic solution (10 ml) of the amine (0.01 mol.) was added salicyldehyde (0.01 mol.) in ethanol (10 mL) with stirring. The mixture was then refluxed for 30 mins. The reaction mixture was then cooled which immediately gave a precipitated product. The product then obtained was filtered, washed with ethanol and then dried. The crude product was then crystallized from aqueous ethanol to give a yield of 80%.

Synthesis of metal complexes

The ligand and metal salt in the molar ratio of 2:1 was dissolved in ethanol and the reaction mixture was heated on water bath for about one hour. It was then cooled when coloured solid separated out which was washed with ethanol and dried. This is the general method employed for the synthesis of metal complexes of ligand with metal chlorides viz Ni(II), Cu(II), Co(II), Mn(II) and Zn(II). The structure of metal complex is given in Figure No.2.

Plant Growth Activity study

The plant growth activity studies were carried out on the seeds of three plant seeds Chick pea (*Cicer arietinum*), Mung bean (*Vigna radiata*) *and* Red Lentil (*Lens culinaris*) by standard blotter method. Metal complex solutions (5 ppm) and ligand solution (5ppm) were prepared using10% DMSO solution in doubly distilled water. The seeds were soaked in water overnight. Healthy seeds of equal size were chosen, and then immersed in distilled water, ligand solution and complex solutions, and standards for 6 hours. The seeds soaked were taken out of each solution and washed thoroughly with distilled water. The seeds were then placed on Petri plate with 20 seeds per plate containing moistened blotters. The plates were observed for germination, root-shoot length for 10 days.

RESULTS AND DISCUSSION

Ligand (NEMP)

Bright Yellow solid, 80 % yield; 91 ºC; $C_{19}H_{17}NO$, M.W 276, Elemental analysis Obs (Cal): %C 82.55(82.88), %H 5.98 (6.22), %N 5.32(5.09), %O5.72(5.81); NMR-CH=N 8.8 δ, OH 5.6 δ; IR (KBr pallets) υ (HC=N) 1625.07 cm^{-1} and υ (OH) 3039.33 cm^{-1}; UV 34602 cm^{-1} and 35665 cm^{-1}

NEMP-Ni complex

Greenish yellow solid, 75% yield, 291 ºC, IR (KBr pallets) υ (HC=N) 1610.98 cm^{-1} , υ (co-ordinated H_2O) 3350.34 cm^{-1}, υ (M-O) 455.80 cm^{-1} and υ (M-N) 541.15 cm^{-1} ,UV 28571^{-1}, 25125 cm^{-1} and 21052 cm^{-1} [13]and 2.89 B.M suggests an octahedral geometry; molar conductance 23.40 mhos cm^2 mol^{-1}.

NEMP-Co complex

Buff solid, 59% yield, 270 ºC, IR (KBr pallets) υ (HC=N) 1615.47 cm^{-1} , υ (co-ordinated H_2O) 3414.64 cm^{-1}, υ (M-O) 436.58 $cm^{-1}$and υ (M-N) 570.22 cm^{-1}, UV 28735 $^{-1}$ and 28985 cm^{-1} and 3.9

B.M suggests an octahedral environment[14,15], molar conductance 93.60 mhos cm^2 mol^{-1}.

NEMP-Cu complex

Brown solid, 68% yield, 269 ºC, IR (KBr pallets) υ (HC=N) 1610.58 cm^{-1} , υ (co-ordinated H_2O) 3397.49 cm^{-1}, υ (M-O) 468.96 $cm^{-1}$and υ (M-N) 507.83 cm^{-1} , UV 30565 cm^{-1}, and 22259 cm^{-1} [12] and 1.57 B.M suggests an distorted octahedral geometry[16,17], molar conductance 31.20 mhos cm^2 mol^{-1}, ESR: gll 2.4077, g⊥ value 2.0605, gavg 2.1762

G = 7.001.

NEMP-Mn complex

Blackish Green solid, 72% yield, 240 ºC, IR (KBr pallets) υ (HC=N) 1576.89 cm^{-1} , υ (co-ordinated H_2O) 3338.33 cm^{-1}, υ (M-O) 436.58 $cm^{-1}$and υ (M-N) 570.45 cm^{-1} , UV 29411 cm^{-1} and 28571 cm^{-1} and 5.5 B.M indicate an octahedral environment[18], molar conductance 54.60 mhos cm^2 mol^{-1}.

NEMP-Zn complex

Light yellow solid, 78% yield, 253 ºC, IR (KBr pallets) υ (HC=N) 1607.66 cm^{-1} , υ (co-ordinated H_2O) 3494.99 cm^{-1}, υ (M-O) 579.94 cm^{-1} and υ (M-N) 424.00 cm^{-1}, 28011 and 26881 cm^{-1} and 0.00 B.M suggesting diamagnetic, molar conductance 70.20 mhos cm^2 mol^{-1}

Plant growth activity

The general order of plant growth activity of ligand and its complexes compared to water, cytokinin, geberallic acid and indole acetic acidand the values plant growth parameters such as percentage of germination, shoot length, root length, protein content, carbohydrate for Chick pea (*Cicer arietinum*), Mung bean (*Vigna radiata*) *and* Red Lentil (Lens culinaris) are reported in Table No. (1), Table No. (2) and Table No. (3).

The results presented in table No.1, 2 and 3 show similar pattern for the standards and synthesized compounds. The values indicate that the percentage germination is somewhat less than control and the standards and the root, shoot lengths are smaller than the standards. However the results are closer to the activity of water. Best results were observed with cytokinin. The protein content and carbohydrate content values are more in all the three standards and reasonable values are obtained for the synthesized compounds. But the values of all the parameters for metal complexes are less than the ligand indicating that the Schiff base is having more activity than the metal chelates. Also the activity of water and ligand are comparatively similar.

Table No.1: Effects of 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol and its Ni(II), Cu(II), Co(II), Mn(II) and Zn(II)complexes on growth parameters for Chick pea (*Cicer arietinum*)

Treatment	% Germination	Fresh Wt. (gm)	Dry Wt. (gm)	Root Length (cm)	Shoot Length (cm)	Protein (µg/ml)	Carbohydrate
Ligand	60	0.51	0.018	5.1	2.4	400	18.0
NEMP-Ni	50	0.47	0.016	4.0	2.1	375	17.0
NEMP-Cu	50	0.46	0.014	4.7	2.2	385	15.0
NEMP-Co	50	0.47	0.017	3.9	2. 4	370	14.0
NEMP-Mn	50	0.50	0.018	4.2	2.3	345	17.0
NEMP-Zn	50	0.48	0.014	4.8	2.2	400	15.0
Water	70	0.65	0.018	5.2	2.5	500	19.0
Cytokinin	80	0.53	0.016	3.7	5.0	700	13.2
Gibberellic acid	90	1.13	0.020	4.1	3.7	600	18.1
Indole acetic acid	60	0.71	0.021	5.0	3.3	450	20.0

Table No.2: Effect of 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol and its Ni(II), Cu(II), Co(II), Mn(II) and Zn(II) complexes on growth parameters for Mung bean (*Vigna radiata*)

Treatment	% Germination	Fresh Wt. (gm)	Dry Wt. (gm)	Length of root (cm)	Length of shoot (cm)	Protein (µg/ml)	Carbohydrate
Ligand	60	0.54	0.017	5.1	2.4	400	17.0
NEMP-Ni	50	0.30	0.015	4.0	2.1	375	16.0
NEMP-Cu	50	0.47	0.014	4.1	2.2	350	15.0
NEMP-Co	50	0.45	0.016	4.1	2. 2	375	16.0
NEMP-Mn	40	0.37	0.017	5.0	2.3	365	15.0
NEMP-Zn	40	0.46	0.015	4.0	2.2	375	15.0
Water	60	0.55	0.018	5.3	2.3	475	18.0
Cytokinin	60	0.43	0.017	3.7	5.1	600	14.2
Gibberellic acid	80	1.03	0.019	4.5	3.7	590	18.3
Indole acetic acid	70	0.61	0.020	5.5	3.3	420	19.0

Table No.3: Effect of 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol and its Ni(II), Cu(II), Co(II), Mn(II) and Zn(II) complexes on growth parameters for *and* Red Lentil (*Lens culinaris*) plant

Treatment	% Germination	Fresh Wt. (gm)	Dry Wt. (gm)	Length of root (cm)	Length of shoot (cm)	Protein (µg/ml)	Carbohydrate
Ligand	60	0.58	0.016	3.1	1.9	275	16.0
NEMP-Ni	50	0.43	0.013	3.0	1.4	250	14.0
NEMP-Cu	50	0.43	0.012	3.7	1.2	300	14.0
NEMP-Co	50	0.50	0.014	2.9	1. 4	275	16.0
NEMP-Mn	50	0.49	0.014	3.2	1.5	275	16.0
NEMP-Zn	50	0.57	0.012	3.7	2.2	300	14.0
Water	70	0.75	0.016	4.2	2.3	400	18.0
Cytokinin	70	0.63	0.014	3.5	3.0	600	12.2
Gibberellic acid	80	1.23	0.018	3.8	2.8	500	19.1
Indole acetic acid	60	0.81	0.019	4.9	2.3	350	21.0

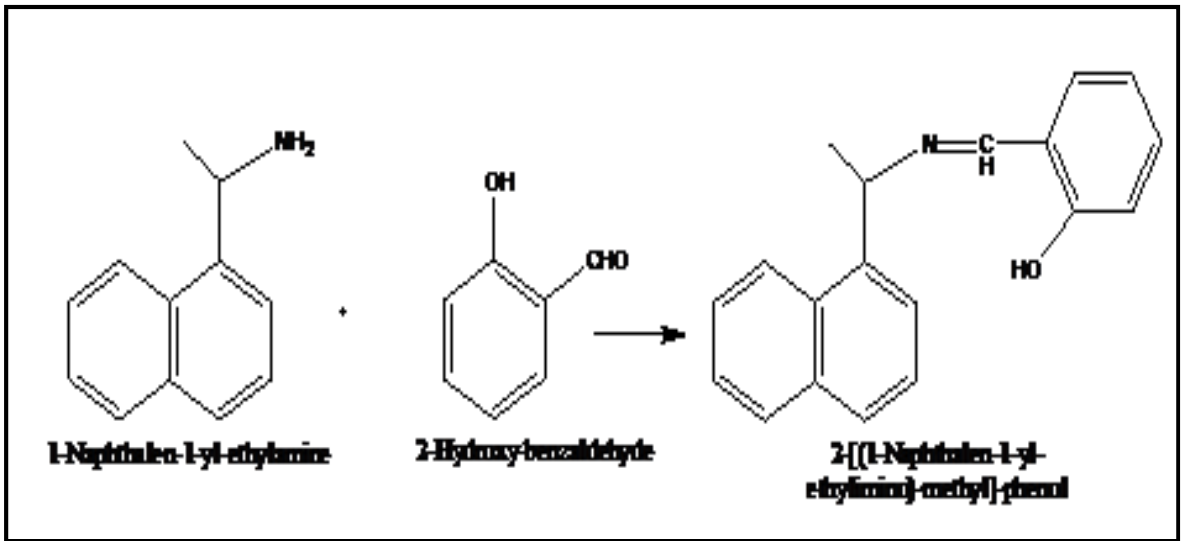

Figure No.1: Reaction of formation of Schiff base ligand 2-[(1-Naphthalen-1-yl-ethylimino)-methyl]-phenol

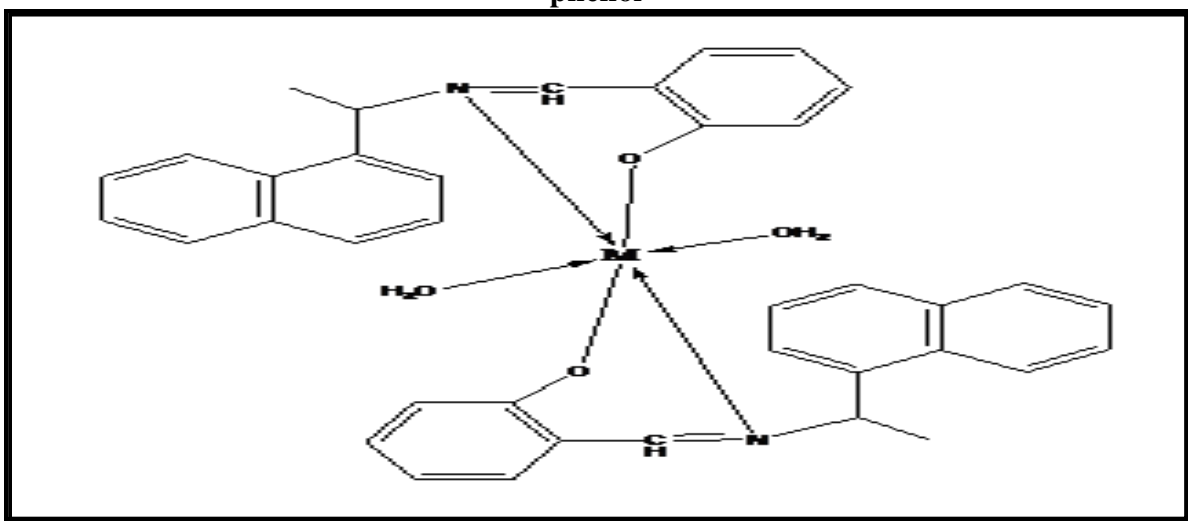

Figure No.2: Structure of metal complex (M= Ni, Cu, Co, Mn, Zn)

CONCLUSION

From the results of the plant growth study on the seeds of the above plants, it was concluded that the synthesized complexes have plant inhibitory activity rather than plant growth activity. The activity can be summarized in a decreasing order as follows: Giberallic acid > Cytokinin > Indole acetic acid < Water ~ Ligand > Metal complexes.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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