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Study of 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*

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ABSTRACT

The plant growth regulating activity of (2-chlorophenyl) (5-(2-hydroxyphenyl)-3-(pyridin-3-yl)-1H-pyrazol-4-yl) methanone and its binary complexes of Fe (III) and Cu (II) on Trigonella foenum-graecum (Methi) have been studied at pH 4.5 and 9.0 in order to make suggestions whether this ligand and its binary complexes of can be used as plant growth regulators. The plant growth was decided by measurement of parameters like percentage of germination, survival, seedling height, soot length, root length, root/soot ratio and width of young leaf. The average values of these parameters have been used to make a conclusion about plant growth regulating activity of ligand and its complexes.

Keywords: Plant growth regulators, germination, soot length, root length, root/soot ratio.

INTRODUCTION

We are completely and absolutely dependent on plants for the necessities of life. 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. The major goals of agricultural research is the production of new and better varieties of crop plants, the improvement of plant protection against insects, diseases and weeds, the control of soil fertility. The biological activity of metal chelate increased compared to that of free metal and ligand alone [1-2]. The antifungal and antibacterial activities of metal complexes show that they are more active as compared to free metal and ligand.

The uses of unnatural chelating agents in biological systems have been reported [3]. The role of ternary complexes in transport of physiological active substances has also been studied [4]. The biological properties of some rare earth complexes [5] and physiological effects of transition

metal complexes on *Hordeum vulgare* [6] have been reported. Plant growth regulating activity of complexes of transition metals with substituted pyrazoles were tested [7]. Complexes of piperidene-2-carboxylic acid with some bivalent metal ions have been reported to be useful in agriculture as plant growth regulating [8]. The transition metal complexes of some substituted isoxazolines and pyrazolines have been investigated as plant growth regulators for *Triticum aestivum* (wheat) and *Trigunella* (methi) [9]. Biological studies of some newly synthesized substituted phenyl pyrazol pyridin-2-amine derivatives have been carried out [10]. The negative effect of concentrations of cadmium chloride on wet and dry biomass of shoots and roots in *Triticum aestivum* has been studied [11].

Among several economical plants *Trigonella* (Methi) is selected as a plant system because this plant is in ideal system to study the germination and growth pattern. Further, economical importance of this plant is reflected by its wide use for the vegetable purposes. No work has been reported on the plant growth regulating activities of (2-chlorophenyl) (5-(2-hydroxyphenyl)-3-(pyridin-3-yl)-1H-pyrazol-4-yl) methanone and its binary complexes with Fe (III) and Cu (II), therefore, the present work is carried out to study the plant growth regulating activity of this ligand and its complexes on methi plant.

EXPERIMENTAL SECTION

The metal ion solutions (0.01M) and ligand solution (0.01M) were prepared using doubly distilled water. The ligand was recrystallized before use. Weighing of chemicals and dry weight of plant was done Mechaniki Zaktady Precyzyjnej Gdansk Balance ($\pm$ 0.001g). The Plants contain mostly water; therefore they were dried overnight in oven first at 70°C and later at 100°C to obtain a constant weight for the determination of root: shoot ratio. The biological applications were studied at pH 4.5 and 9.00 and at constant ionic strength of 0.1 M aqueous potassium nitrate solution. The pH measurement was done using ELICO-pH meter-L1-10 (accuracy $\pm$ 0.05 units).

Fertilized soil was collected from agricultural land of Deosari, Yavatmal (MS). Stones and other hard materials were removed from it. Two parts of this finely powdered soil were mixed with one part of filtered pink-stone-sand. This soil was filled in wooden trays, the germination tray having compartments of equal size (diameter 20 cm and height 20 cm). These trays were sterilized with 0.01% of $HgCl_2$ solution for 2 minutes. The soil in the tray was moistened with water. Sowing of seeds was done in the soil after one hour.

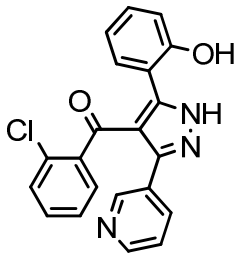

Figure (1): Structure of (2-chlorophenyl) (5-(2-hydroxyphenyl)-3-(pyridin-3-yl)-1H-pyrazol-4-yl) methanone

The seeds were soaked in water and kept in refrigerator for 4 hours. The healthy seeds of equal size were chosen, out of which 50 seeds were immersed in distilled water, ligand solution and binary complex solution of Fe (III) and Cu (II) of pH 4.5 and 9.00 for 6 hours. The seeds soaked were taken out of each solution and washed thoroughly with distilled water. The seeds were

sowed in wooden trays. The wooden trays were kept under the atmospheric pressure and at room temperature. The growth parameters were measured for all the systems.

The structure of the ligand used in this work is presented in Figure (1).

RESULTS AND DISCUSSION

The values plant growth parameters such as percentage of germination, survival, seedling height, soot length, root length, root/soot ratio, vigor index and thickness of young leaf are reported in Table (1).

Vigor index was determined [12] using equation (1):

$$\text{Vigour index} = \%\,\text{germination} \times (\text{root length} + \text{soot length}) \quad ..(1)$$

The vigor index values for various treatments indicate that, the treatment of Fe (III) complex at pH 4.5 and Cu (II) complex at pH 9.0 has increased the vigor index compared to control.

The root/shoot ratio was determined by using equation (2):

$$\text{root/shoot ratio} = \text{dry weight for roots/dry weight for top of plant} \quad ...(2)$$

The root: shoot ratio is one of the measures of overall health of the plants. Change in the root: shoot ratio over control (water) indicates change in overall health of the plant. In present investigation the root: shoot ratio has increased for Fe (III) complex at pH 4.5 and for Cu (II) complex at pH 9.0 compared to control treatment, this increase is an indication of a healthier plant compared to other treatments. Increase in this ratio came from greater root size and not from a decrease in shoot weight.

Plants absorb water and nutrients from soil through roots; therefore, the good root system of a plant is an indication of healthy plant. In present study, the root length has increased in Fe (III) complex compared to water at pH of 4.5 and as pH increased to 9.0, the root length has increased in case of Cu (II) complex. Same order has been observed in shoot length and seedling height.

The seeds and leaves and shoot system of *Trigonella foenum-graecum* is shown in Figure (2).

(a) (b)

Figure (2): *Trigonella foenum-graecum*: a) Seeds and b) leaves and shoot system

Table (1): Effect of (2-chlorophenyl) (5-(2-hydroxyphenyl)-3-(pyridin-3-yl)-1H-pyrazol-4-yl) methanone (Ligand) and its Fe (III) and Cu (II) complexes on growth parameters for *Trigonella foenum-graecum* (Methi) plant

Parameters	Effect of		Effect of complexes		Order of plant growth regulator
	Water	Ligand	Fe (III)	Cu (II)	
pH=4.5					
Germination seed number	50	50	50	50	Fe (III) complex > Ligand > Water > Cu (II) complex
% Germination after $2^{1/2}$ days	61	65	71	59	
% Survival after 10 days	75	79	83	72	
Seedling height (cm)	6.81	6.92	7.14	6.68	
Root length (cm)	2.9	3.1	3.5	2.6	
Shoot length (cm)	4.2	4.6	5.1	3.8	
Vigor index	4941	5655	6816	4366	
Root-shoot ratio	0.76	0.81	0.88	0.70	
Width of young leaf (cm)	0.51	0.56	0.62	0.48	
pH=9.0					
Germination seed number	50	50	50	50	Cu (II) complex > Fe (III) complex > Ligand > Water
% Germination after $2^{1/2}$ days	62	63	64	67	
% Survival after 10 days	77	78	81	85	
Seedling height (cm)	6.94	7.01	7.10	7.28	
Root length (cm)	2.3	2.6	3.1	3.5	
Shoot length (cm)	3.2	3.5	3.8	4.1	
Vigor index	3410	3843	4416	5092	
Root-shoot ratio	0.70	0.75	0.78	0.83	
Width of young leaf (cm)	0.55	0.54	0.60	0.65	

The general order of plant growth regulating activity of ligand and its complexes compared to water is shown in Table (1). It can be concluded, therefore, that Fe (III) complex of this ligand favors the plant growth at atmospheric pressure, room temperature and at 4.5 pH. Also, Cu (II) complex of this ligand can be used as a plant growth regulator at atmospheric pressure, room temperature and at 9.0 pH conditions.

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