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Synthesis and Study Of 2–Hydroxy Substituted Quinoxaline Effects on Different Crop Plant Growth

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Abstract

As the population of the world is increasing day by day and land holding capacity is going to decreasing. So it is great challenge to feed the nation by increasing the productivity of crop. Synthesis of 2-hydroxy substituted quinoxaline prepared by using 2-hydroxy substituted chalcone dibromide and chalcone dibromide condensed with BDA in methanol solvent. 2-Hydroxy substituted quinoxaline gives 2-(2-hydroxy-5-chloro) benzyl-3,4-methoxyphenyl quinoxaline, 2-(2-hydroxy-5-chloro) benzyl-3-phenyl quinoxaline, 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-(4-methoxy phenyl) quinoxaline and 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-phenyl quinoxaline respectively. The structure of ligands was elucidated on the basis of molecular weight, elemental analysis and spectral data. In crop growth, growth hormones may play important role such as increase in height of plant, number of leaves per plant, number of pods per plant etc., which reflects yield of crop. The synthesized substituted quinoxalines were used for seed treatment as well as foliar application to find out their effect on plant growth as well as in respect of seed yield viz. Soybean (*Glycine max* (L.) Merill), Groundnut (*Arachis hypogaea*) and Chickpea (*Cicer arientinum*). The synthesized ligands showed significant effect on crop plants growth.

Keywords:- Chalcone dibromide, Substituted quinoxaline, Growth promotion hormonal effect, Soybean, Groundnut, Chickpea

Introduction

Chalcone have been associated with diverse biological activities, e.g. cardiovascular, antiviral[1], anticancer and industrial application[2]. Utale et al[3] reported chalcone dibromide by the reaction of bromine in 25% w/v acetic acid with 3-substituted-2-hydroxy-5-chloro chalcone. Khadsan et al[4] synthesized the α,β-acrylophenone dibromide from acrylophenones by bromination using acetic acid.

Antibacterial activity of novel substituted quinoxaline were studied by Noorulla and Sreenivasulu[5]. Antimicrobial activities of some substituted quinoxaline-2-(1H)-one derivatives were studied by Ghadge and Shirote[6]. The novel quinoxaline derivatives were studied by More et al[7]. Maurya et al[8] reported the growth promoting effects of pyrazolines and isoxazoline on agriculture crop plants. Substituted isoxazolines and pyrazolines in 70% dioxane-water mixture and effect on seed germination were studied by Meshram et al[9]. Ramteke et al[10] have been studied the effect of chlorosubstituted pyrazoles and their complexes on Spinach (Spinacia oleracea L.) at different pH. Synthesis and growth promoting effects of chloro-substituted heterocycles on agricultural crop plants have been studied by Parhate et al[11]. Synthesis and study of 2-hydroxy substituted chalcone dibromide effects on different crop plant reported by Kalambe et al[12].

MATERIALS AND METHODS

All chemicals used to synthesize substituted chalcone dibromide and substituted quinoxaline were of IR grade. The structure of ligands was elucidated on the basis of molecular weight, elemental analysis and spectral data. Physical and analytical data of synthesized compounds are summarized in Table-1.

Preparation of 2-hydroxy substituted chalcone dibromide

The 2-hydroxy substituted chalcone was dissolved in boiled glacial acetic acid. A solution of bromine in acetic acid was added to this solution with constant stirring. The product of 2-hydroxy substituted chalcone dibromide was filtered and washed with alcohol followed by petroleum ether.

a. 5-Chloro-2-hydroxy chlacone dibromide (1)
b. 5-Chloro-2-hydroxy-4-methoxy chlacone dibromide (2)
c. 3-Bromo-5-chloro-2-hydroxy chlacone dibromide (3)
d. 3-Bromo-5-chloro-2-hydroxy-4-methoxy chlacone dibromide (4)

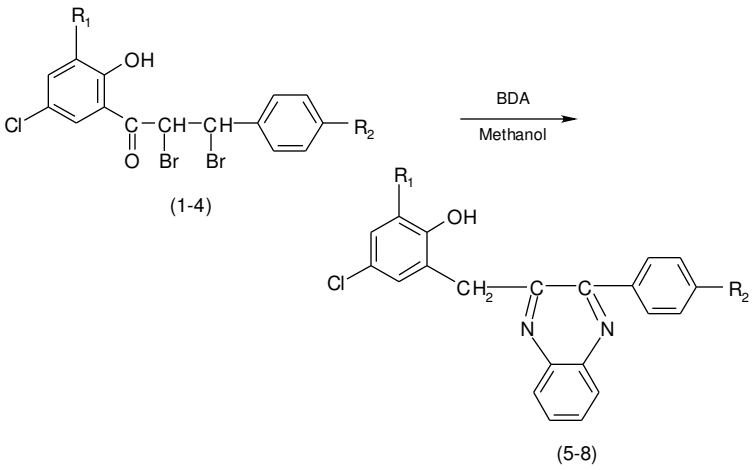
Preparation of 2-hydroxy substituted quinoxaline

The 2-hydroxy substituted chalcone dibromide and BDA were condensed in methanol. A few drops of concentrated H_2SO_4 were added and heated on water bath. It was diluted with water and crude mass was extracted with solvent ether. Ether was removed and solid residue was

crystallized from dilute ethanol to get the product of 2-hydroxy substituted quinoxaline.

I. 2-(2-hydroxy-5-chloro) benzyl-3-(4-methoxyphenyl) quinoxaline (5)
II. 2-(2-hydroxy-5-chloro) benzyl-3-phenyl quinoxaline (6)
III. 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-(4-methoxyphenyl) quinoxaline (7)
IV. 2-(2-hydroxy-3-bromo-5-chloro) benzyl-3-phenyl quinoxaline (8)

Scheme



Where R_1 → H, Br
R_2 → H, OCH_3

Growth promoting effect

The bed of black cotton soil with fairly good drainage was prepared on an open field. The seed of three species like soybean, groundnut and chickpea under examination were sowed in these beds separately by conventional method. The plant bends were irrigated as and when required with tap water. The plants from each bed were divided into two groups A and B. The group A plants were kept unsprayed and termed as control group whereas treated group B plants were sprayed with the compound being tested. The seeds of group B were also treated with test compounds before sowing to screen growth promoting effects. The spraying solution of synthesized quinoxaline was prepared in 1,4-dioxane (0.01 M) separately and sprayed at fortnightly intervals (15, 30, 45, 60 and 75 days). All the field experiments were conducted to compare the treated plants of group B with the plants from control group A. The samples were taken at 15, 30, 45, 60 and 75 days after sowing. The plants were carefully examined and height, number of functional leaves per plant, number of pods per plant and seed yields per hectare was recorded.

RESULTS AND DISCUSSION

When the comparison of morphological character[13-15] was made between those of treated and controlled group plants, it was interesting to note that all treated plants exhibited remarkable growth and considerable increase in height, number of leaves, number of pods per plant and yield as compared to the untreated ones (Table 2-6).

Soybean

In soybean crop, L_2 ligand shows the maximum height, highest number of leaves, maximum number of pods per plant and maximum yield. But control plant shows minimum value of results than treated plant. The trend of ligands as follows,

$L_2 > L_3 > L_1 > L_4 >$ Control

Groundnut

In groundnut crop, L_4 ligand shows the maximum height as compared to other ligands. Maximum number of leaves found in ligand L_1. L_3 ligand shows maximum number of pods per plant and yield than other ligands. But the control plants shows minimum values as compared to other all treated plants.

Chickpea

In the crop chickpea, L_4 ligand shows the maximum number of branches, number of pods per plant and yield at 30, 60 and 75 days as compared to other ligands. The activity trend of ligands as follows,

$L_4 > L_2 > L_3 > L_1 >$ Control

Table 1 : Analytical and physical data of synthesized compounds

Compound	Molecular formula	% of yield	m.p. (°C)	Found / Calcd.					
				C	H	O	N	Cl	Br
5 (L_1)	$C_{22}H_{17}O_2N_2Cl$	80	141	73.31 (72.73)	4.23 (4.33)	4.71 (4.62)	7.99 (8.08)	10.12 (10.23)	
6 (L_2)	$C_{21}H_{15}ON_2Cl$	82	174	73.31 (72.73)	4.23 (4.33)	4.71 (4.62)	7.99 (8.08)	10.12 (10.23)	
7 (L_3)	$C_{22}H_{16}O_2N_2ClBr$	85	156	59.12 (57.97)	3.44 (3.51)	7.13 (7.03)	6.06 (6.15)	7.73 (7.80)	17.42 (17.55)
8 (L_4)	$C_{21}H_{14}ON_2ClBr$	80	130	60.12 (59.24)	3.14 (3.29)	3.92 (3.76)	6.48 (6.58)	8.21 (8.33)	18.65 (18.78)

Table 2 : Effect of synthesized ligand L_1 on height and number of leaves of plants

Test Compd.	Periodicity of the Obs. days	Soybean				Groundnut				Chickpea			
		Height		No. of leaves		Height		No. of leaves		Height		No. of leaves	
		C	T	C	T	C	T	C	T	C	T	C	T
L_1	15	12.47	14.0	2.00	2.67	6.9	7.7	9.33	14.6	--	--	--	--
	30	24.27	36.0	5.33	11.0	12.3	13.7	30.3	30.6	18.1	21.8	2.0	2.6
	45	27.57	37.3	10.0	15.6	29.0	30.0	34.6	34.3	--	--	--	--
	60	29.43	38.5	14.3	18.6	40.0	38.9	38.6	41.6	26.6	31.4	4.0	5.0
	75	45.67	61.0	9.67	12.6	47.0	53.0	42.0	45.3	27.5	37.3	4.3	6.3

Table 3 : Effect of synthesized ligand L_2 on height and number of leaves of plants

Test Compd.	Periodicity of the Obs. days	Soybean				Groundnut				Chickpea			
		Height		No. of leaves		Height		No. of leaves		Height		No. of leaves	
		C	T	C	T	C	T	C	T	C	T	C	T
L_2	15	12.47	15.4	2.00	3.0	6.9	7.4	9.33	13.6	--	--	--	--
	30	24.27	38.5	5.33	12.6	12.3	13.7	30.3	30.3	18.1	23.2	2.0	3.0
	45	27.57	42.1	10.0	18.3	29.0	30.3	34.6	33.0	--	--	--	--
	60	29.43	43.8	14.3	21.6	40.0	39.9	38.6	40.0	26.6	36.9	4.0	6.0
	75	45.67	66.3	9.67	14.6	47.0	51.0	42.0	43.6	27.5	40.8	4.3	6.6

Table 4 : Effect of synthesized ligand L_3 on height and number of leaves of plants

Test Compd.	Periodicity of the Obs. days	Soybean				Groundnut				Chickpea			
		Height		No. of leaves		Height		No. of leaves		Height		No. of leaves	
		C	T	C	T	C	T	C	T	C	T	C	T
L_3	15	12.47	12.8	2.00	2.67	6.9	7.4	9.33	13.0	--	--	--	--
	30	24.27	36.7	5.33	11.3	12.3	11.2	30.3	29.6	18.1	19.8	2.0	2.0
	45	27.57	39.9	10.0	15.6	29.0	23.7	34.6	35.0	--	--	--	--
	60	29.43	43.4	14.3	18.0	40.0	32.6	38.6	40.0	26.6	29.0	4.0	4.6
	75	45.67	65.0	9.67	13.3	47.0	47.3	42.0	43.3	27.5	33.6	4.3	5.3

Table 5 : Effect of synthesized ligand L_4 on height and number of leaves of plants

Test Compd.	Periodicity of the Obs. days	Soybean				Groundnut				Chickpea			
		Height		No. of leaves		Height		No. of leaves		Height		No. of leaves	
		C	T	C	T	C	T	C	T	C	T	C	T
L_4	15	12.47	12.7	2.00	2.6	6.9	8.9	9.33	14.3	--	--	--	--
	30	24.27	30.3	5.33	12.0	12.3	15.3	30.3	32.3	18.1	22.2	2.0	2.6
	45	27.57	33.4	10.0	15.3	29.0	33.0	34.6	35.0	--	--	--	--
	60	29.43	35.5	14.3	17.3	40.0	44.2	38.6	40.6	26.6	34.6	4.0	5.6
	75	45.67	56.6	9.67	12.0	47.0	57.3	42.0	43.3	27.5	39.2	4.3	7.3

Table 6 : Effect of synthesized ligands on number of pods per plant at harvest and yield (q/ha) of plant

Plant	Treatment	No. of pods per plant	Yield (q/ha)
Soybean	Control	14.27	18.10
	Solvent	16.13	20.38
	L_1	20.80	19.96
	L_2	26.27	23.90
	L_3	17.67	21.48
	L_4	20.33	17.41
Groundnut	Control	11	21.30
	Solvent	15	25.58
	L_1	11	22.03
	L_2	14	24.33
	L_3	14	24.63
	L_4	13	22.83
Chickpea	Control	14.00	12.45
	Solvent	21.00	16.68
	L_1	20.33	12.83
	L_2	23.00	19.64
	L_3	18.33	14.25
	L_4	20.00	18.74

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