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Synthesis and study of 3-(chloroaryl)-5-aryl-1-substituted pyrazolines with various percentage of 1,4-dioxane at different temperature and their effect on vegetable crop plant growth

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ABSTRACT

The 2-Hydroxy-5-chloroacetophenone (IIIa) was prepared by Fries migration of p-chlorophenol acetate (IIa) in presence of $AlCl_3$, The 2-hydroxy-3-bromo-5-chloroacetophenone (IIIb) was prepared by the bromination of acetophenone (IIIa) with bromine in acetic acid, and 2-hydroxy-3-nitro-5-chloroacetophenone was prepared by the nitration of acetophenone (IIIa) with nitrating mixture, then Acetophenone (IIIa-b) on condensation with aldehydes (benzaldehyde and chlorobenzaldehyde) gave corresponding chalcones. and finally,The pyrazolines (Va-Vf) were synthesized by reacting chalcones with thiosemicarbazide in ethanol.The ligand structure were elucidated on the basis of molecular weight,elemental analysis and their spectral data.

Keywords: Acetophenone, Chalcones, Substituted Pyrazolines.

INTRODUCTION

Pyrazoline derivatives have been numerous prominent pharmacological effects[1] such as antimicrobial[2] (antibacterial, antifungal, antiamoebic, antimycobacterial), anti-inflammatory[3], analgesic, antidepressant and anticancer.

Ebraheem Abdu Musad et al[4] synthesized some new 3,5-Bis (substituted) pyrazoles and isoxazoles based on (N'[1]E, N'[3]E)-N'[1], N'[3]-Bis (3,4,5-substituted benzilidene) monohydrazide under solvothermal conditions.Foote R.S. et al[5] reported a new synthesis of substituted pyrazoles form 1,4-dianions of phenylhydrazones having an αhydrogen. Gowramma B. et al[6] studied the synthesis, anticancer activity of some 1-(Bis N,N-(chloroethyl)-amino acetyl)-3,5-disubstituted-1,2-pyrazolines. Parhate et al[7] have been studied synthesis and growth promoting effect of chloro substituted ahaeterocycles on Agricultural crop plants.Study of plant growth regulating activityof (2-chloophenyl)(5-(2-hydroxy phenyl)-3-(pyridine-3-yl)-1H-pyrazol-4-yl) methanone and its Fe(III) and Cu(II) complexes on Trigonella Foenum – graecum reported by Deosarker et al[8]. The synthetic development of pyrazole nucleus from reflux to microwave have been studied by Arora et al[9].

MATERIALS AND METHODS

Preparation of p-chlorophenylacetate (IIa) from p-chlorophenol (Ia)
p-chlorophenol (50 ml), acetic anhydride (60 ml) and 5 gm fused sodium acetate refluxed for 1½ hrs. Then cooled and poured into cold water. Separate the acetate layer, washed with water 3-4 times distillation at 225-235°C.

Preparation of 2-hydroxy3-bromo -5-chloroacetophenone (IIIa) from p-chlorophenylacetate (IIa) :
Distilled p-chlorophenylacetate (50 ml) and anhydrous $AlCl_3$ (aluminium trichloride) (120 gm) were mixed and taken in a oil bath, heat it at 120^0C for about one hour. The resulting mixture was decomposed with cold water containing a little amount of hydrochloric acid. The resulted solid or product was separated and filtered. It was

purified by dissolving in 100% aq. acetic acid and pouring hot solution dropwise with constant stirring into ice cold water. A white solid (IIIa) was obtained.

Preparation of 2-hydroxy-3-bromo-5-chloroacetophenone (IIIb) from 2-hydroxy-5-chloroacetophenone (IIIa)
2-Hydroxy-5-chloroacetophenone (IIIa) (0.01 mole, 1.70 gm) was dissolved in glacial acetic acid (10 ml). 25% bromine in acetic acid solution (7 ml) was added over a period of 15-20 minutes with installments with constant stirring. The product started separating when the reaction was complete. The product was filtered, washed with water and crystallized from ethanol. The 2-hydroxy-3-bromo-5-chloroacetophenone (IIIb) was obtained.

Preparation of 2-hydroxy-3-nitro-5-chloroacetophenone (IIIc) from 2-hydroxy-5-chloroacetophenone (IIIa) :
2-Hydroxy-5-chloroacetophenone (0.01 mole, 1.5 gm) was dissolved in glacial acetic acid (10 ml) containing a little acetic anhydride (0.5 ml). The mixture was cooled by ice cold water. Nitrating mixture (concentrated nitric acid and concentrated sulphuric acid in the ratio 3:2 v/v) containing 5 ml nitric acid was added over a period of 30 minutes to reaction mixture with constant stirring and keeping the temperature below 20°C. The product started separating then the reaction was complete. The product was filtered, washed with water and crystallized from ethanol-acetic acid mixture. Yellow needles of 2-hydroxy-3-nitro-5-chloroacetophenone (IIIc) were obtained.

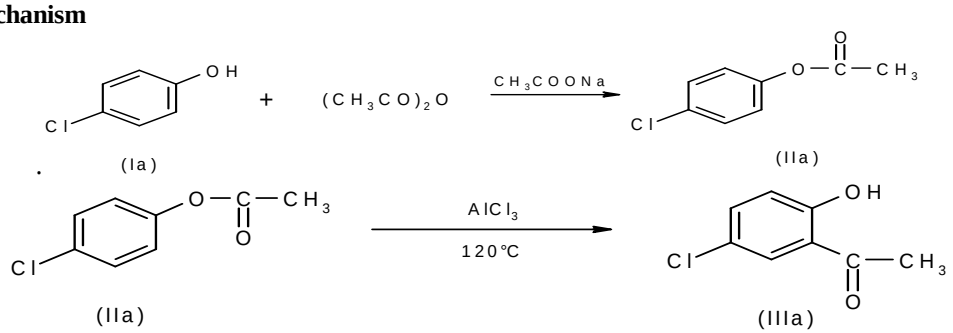
Preparation of 2-hydroxy-3-H/bromo/nitro-3-chlorochalcone (IVa,IVc,IVe).
2-Hydroxy-3H/bromo/nitro-3-chloroacetophenone (IIIa,IIIc,IIIIe) (0.01 mole,) and benzaldehyde (0.01 mole, 1.07 ml) were dissolved in ethanol (25 ml) and the reaction mixture was brought to boiling. To this hot solution aq. NaOH (0.03 mole, 3 ml, 40%) was added with constant stirring, the solution was kept overnight. Next day sodium salt obtained was decomposed by aq. HCl (1:1). The yellow coloured solid obtained was crystallized from ethanol to get yellow crystals of 2-hydroxy-3-H/bromo/nitro-3-chlorochalcone (IVa,IVc,IVe).

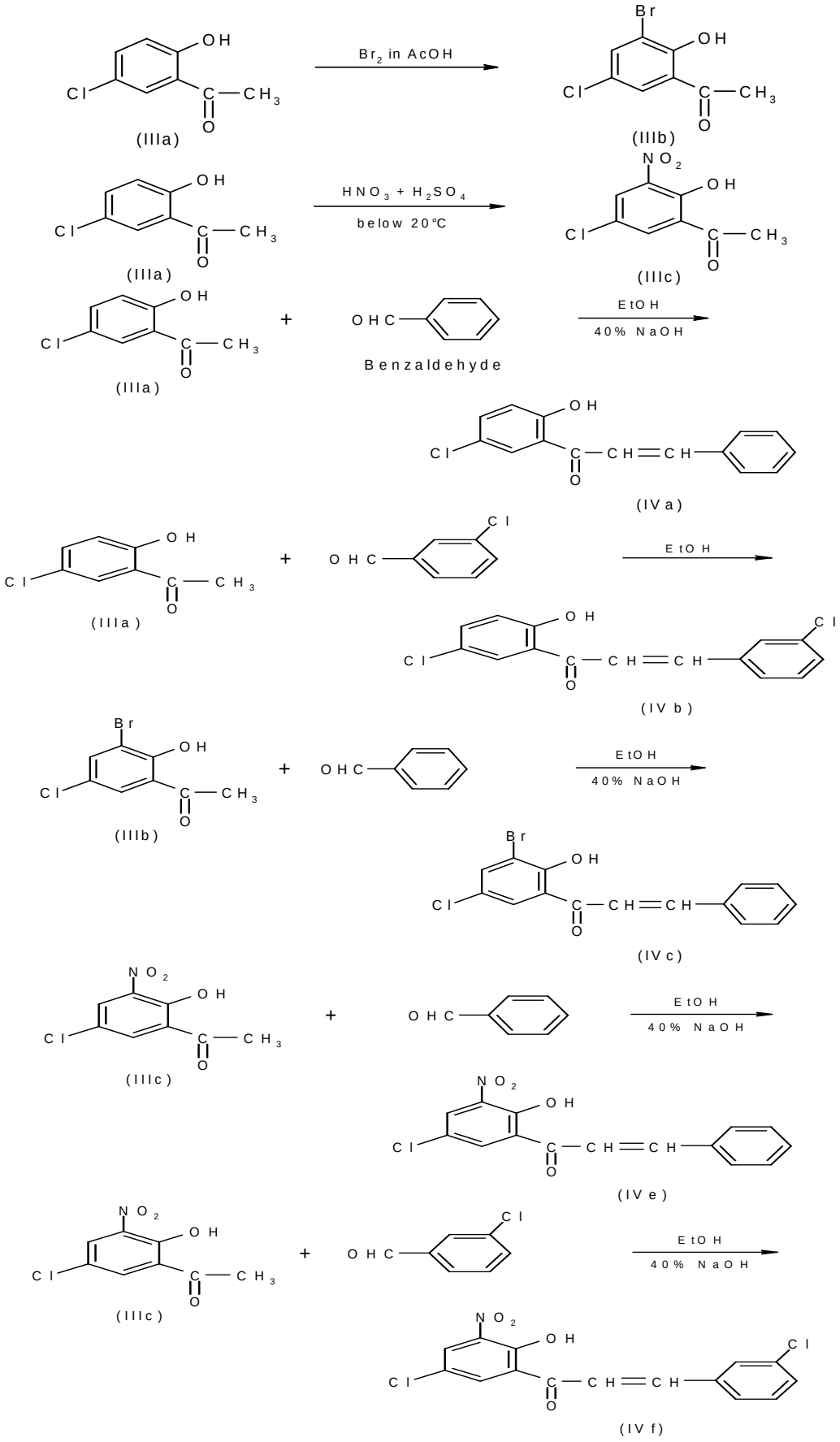
Preparation of 2-hydroxy-3-H/bromo/nitro-5-chloro-3-chlorochalcone (IVb,IVd,IVf) :
2-Hydroxy-3H/bromo/nitro-5-chloroacetophenone (IIIb,IIId,IIIIf) (0.01 mole, 1.7 g) and chlorobenzaldehyde (0.01 mole, 1.41 g) were dissolved in ethanol (25 ml) and the reaction mixture was brought to boiling. To this hot solution aq. NaOH (0.03 mole, 3 ml, 40%) was added with constant stirring. The solution was kept overnight. Next day sodium salt obtained was decomposed by aq. HCl (1:1). solid obtained was crystallized from ethanol to get 2-hydroxy-3H/bromo/nitro-3-chlorochalcone (IVbIVd,IVf) .

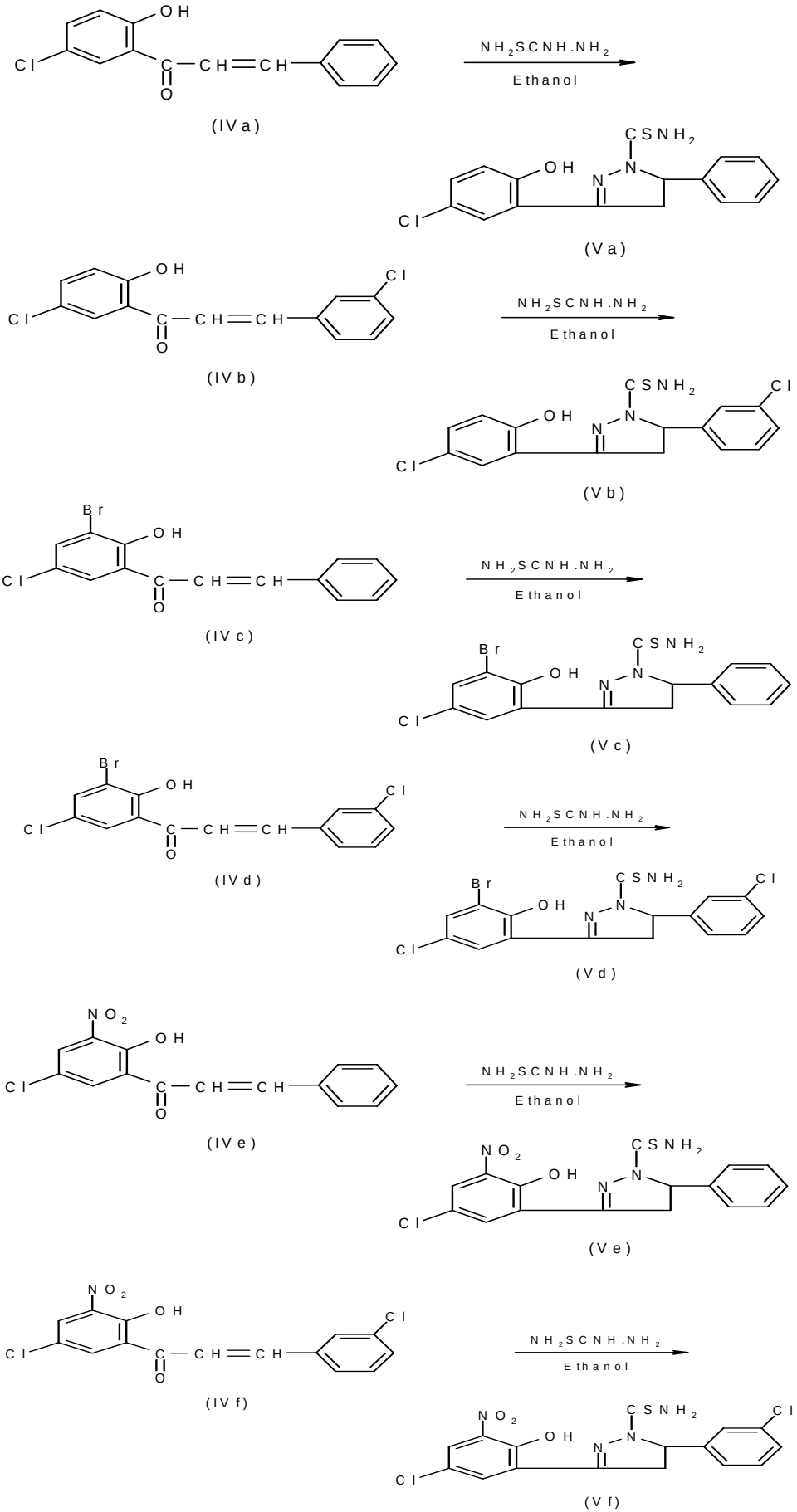
Preparation of 3-(2-hydroxy-3-H/bromo/nitro-5-chlorophenyl)-5-phenyl/3-chlorophenyl)-1-thiocarboxamido pyrazoline (Va-Vf) from 2-hydroxy-5-chloro/bromo/nitro-3-chlorochalcone (IVa-IVf) :
2-hydroxy-5-chloro/bromo/nitro-3-chlorochalcone (IVa-IVf) (0.01 mole) and thiosemicarbazide (0.01 mole, 0.91 g) were refluxed in ethanol (50 ml) for two hours. The reaction mixture was then diluted with water and allowed to cool. The resulting solid was filtered, washed with ethanol and crystallized from ethanol to get 3-(2-hydroxy-3-H/bromo/nitro-5-chlorophenyl)-5-phenyl/3-chlorophenyl)-1-thiocarboxamido pyrazoline (Va-Vf) .

Va] 3-(2-Hydroxy-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline
Vb] 3-(2-Hydroxy-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline
Vc] 3-(2-Hydroxy-3-bromo-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline
Vd] 3-(2-Hydroxy-3-bromo-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline
Ve] 3-(2-Hydroxy-3-nitro-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline
Vf] 3-(2-Hydroxy-3-nitro-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline

Reaction Mechanism




Br2 in AcOH
(IIIa)
(IIIb)
HNO3 + H2SO4
below 20°C
(IIIc)
EtOH
40% NaOH
Benzaldehyde
(IVa)
(IVb)
(IVc)
(IVe)
(IVf)



Physical and analytical data of the synthesized compounds are summarized in the following table.

Table1: Physical and analytical data of the synthesized compounds

Compound	Molecular formula	R	R'	Yield %	M.P.^{O}C	Found/calcu% N%
Va	$C_{16}H_{14}N_3OSCl$	H , Br , No_2	H , Cl	45 ml.	b.p. 232°C	12.49 /12.68
Vb	$C_{16}H_{13}N_3OSCl_2$	H , Br , No_2	H , Cl	70%	55°C	11.35 /11.50
Vc	$C_{16}H_{13}N_3OSClBr$	H , Br , No_2	H , Cl	78%	90°C	9.99 / 10.26
Vd	$C_{16}H_{12}N_3OSCl_2Br$	H , Br , No_2	H , Cl	70%	130°C	9.31 / 9.48
Ve	$C_{16}H_{13}N_4O_3SCl$	H , Br , No_2	H , Cl	70%	60° C	14.41 /14.89
Vf	$C_{16}H_{12}N_4O_3SCl_2$	H , Br , No_2	H , Cl	75%.	124°C	13.39 /13.65

Growth Promoting effect of the tittled compounds on some Vegetable Crop Plants

The beds of black cotton soil with fairly good drainage were prepared on an open field. The seeds of two species like Cucumber and Bitter Gourd under examination were sowed in these beds separately by conventional method.The plant beds 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 the plants from group (B) designated as treated group (B). Plants were sprayed with the compounds being tested. The seeds of group (B) were also treated with test compounds before sowing to screen growt-promoting effects. The spraying solution of newly synthesized chlorosubstituted heterocyclic compounds like pyrazolines was prepared in 1,4-dioxane (0.01 dilution) separately and sprayed at fortnightly intervals (15, 30, 45, 60, 75 and 90 days).

Table – 1

C → Control **T → Treated**

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline (L_1)	15	81.77	85.55	1.33	1.55	--	--	63	77	1.39	1.58	--	--
	30	85.89	86.44	1.45	1.77	--	--	171	181	2.50	3.50	--	--
	45	118.33	120.44	1.50	1.89	5.66	6.66	183	192	3.43	3.58	--	--
	60	138.89	148.64	1.53	2.22	8.66	7.33	196	206	4.50	5.45	9.44	12.22
	75	152.55	167.10	1.69	2.56	7.33	9.33	244	249	5.26	6.31	12.00	14.11
	90	176.22	174.55	2.33	2.89	11.00	12.00	271	281	6.00	7.39	14.33	15.00

Table – 2

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of Branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline (L_2)	15	81.77	112.55	1.33	1.44	--	--	63	83	1.39	1.80	--	--
	30	85.89	129.89	1.45	1.95	--	--	171	220	2.50	3.83	--	--
	45	118.33	131.77	1.50	2.11	5.66	7.33	183	228	3.43	4.24	--	--
	60	138.89	142.66	1.53	2.40	8.66	8.33	196	245	4.50	5.69	9.44	12.44
	75	152.55	159.44	1.69	2.55	7.33	10.33	244	277	5.26	6.64	12.00	15.00
	90	176.22	183.24	2.33	2.64	11.00	12.33	271	320	6.00	7.62	14.33	15.00

Table – 3

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-3-bromo-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline (L_3)	15	81.77	104.77	1.33	1.70	--	--	63	89	1.39	2.16	--	--
	30	85.89	119.89	1.45	1.77	--	--	171	224	2.50	4.30	--	--
	45	118.33	129.07	1.50	1.89	5.66	7.33	183	231	3.43	5.12	--	--
	60	138.89	145.44	1.53	1.96	8.66	10.33	196	249	4.50	5.83	9.44	13.00
	75	152.55	167.78	1.69	2.11	7.33	10.33	244	286	5.26	7.27	12.00	15.00
	90	176.22	185.22	2.33	2.67	11.00	12.33	271	324	6.00	7.75	14.33	16.00

Table – 4

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-3-bromo-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline (L_4)	15	81.77	110.00	1.33	1.71	--	--	63	121	1.39	2.87	--	--
	30	85.89	122.76	1.45	1.79	--	--	171	241	2.50	5.16	--	--
	45	118.33	134.10	1.50	1.90	5.66	7.44	183	253	3.43	6.38	--	--
	60	138.89	152.24	1.53	2.12	8.66	10.88	196	266	4.50	7.10	9.44	14.00
	75	152.55	170.77	1.69	2.35	7.33	11.33	244	292	5.26	7.86	12.00	16.00
	90	176.22	186.91	2.33	2.73	11.00	12.00	271	341	6.00	8.66	14.33	18.00

Table – 5

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-3-nitro-5-chlorophenyl)-5-phenyl-1-thiocarboxamido pyrazoline (L_5)	15	81.77	129.66	1.33	1.73	--	--	63	109	1.39	2.63	--	--
	30	85.89	137.13	1.45	1.92	--	--	171	226	2.50	4.90	--	--
	45	118.33	145.44	1.50	2.11	5.66	7.66	183	245	3.43	5.57	--	--
	60	138.89	158.67	1.53	2.36	8.66	10.00	196	251	4.50	6.24	9.44	14.00
	75	152.55	171.71	1.69	2.64	7.33	12.66	244	269	5.26	7.48	12.00	15.00
	90	176.22	188.33	2.33	2.89	11.00	14.66	271	326	6.00	8.20	14.33	16.00

Table – 6

Name of the test compound	Periodicity of the observation (days)	Cucumber						Bitter gourd					
		Length of vine		No. of branches per plant		No. of fruits per plant		Length of vine		No. of branches per plant		No. of fruits per plant	
		C	T	C	T	C	T	C	T	C	T	C	T
3-(2-Hydroxy-3-nitro-5-chlorophenyl)-5-(3-chlorophenyl)-1-thiocarboxamido pyrazoline (L_6)	15	81.77	130.11	1.33	1.60	--	--	63	111	1.39	2.68	--	--
	30	85.89	142.13	1.45	1.79	--	--	171	231	2.50	4.94	--	--
	45	118.33	146.21	1.50	1.90	5.66	7.77	183	253	3.43	5.60	--	--
	60	138.89	160.64	1.53	1.95	8.66	11.33	196	260	4.50	6.32	9.44	15.00
	75	152.55	173.33	1.69	2.46	7.33	12.77	244	274	5.26	7.51	12.00	15.00
	90	176.22	192.18	2.33	2.88	11.00	14.00	271	331	6.00	8.28	14.33	17.00

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, 75 and 90 days after sowing, corresponding to early vegetative, late vegetative, pod filling and pod maturation stages. The plants were carefully examined and length of vine, number of branches and number of fruits per plant were recorded.

RESULTS AND DISCUSSION

When the comparison of morphological character[10]was made between those of treated and controlled group plants, it was interesting to note that all the treated plants exhibited remarkable growth and considerable increase in the length of vine, number of branches and number of fruits per vine as compared to the untreated ones.

Vegetable crop like cucumber the results shows as follows:

As compared to all ligands, L_5 ligand shows the highest number of branches per plant. The increasing trend of results with ligand like,

$$L_5 > L_2 > L_1 > L_6 > L_4 > L_3 > \text{Control}$$

and in case of number of fruits per plant also the L_5 ligand shows highest result as compared to other ligands.

$$L_5 > L_6 > L_3 > L_2 > L_4 > L_1 > \text{Control}$$

In both cases L_5 ligand shows greatest value of both parameters like number of branches per plant and number of fruits per plant upto 90 days (15 days interval). But control plant shows minimum value of results than treated plant.

In the vegetable crop like bitter gourd, the results shows collectively all parameters like length of vine, number of branches per plant and number of fruits per plant, L_4 ligand shows greatest value of above all parameters upto 90 days (15 days interval). Common increasing trend of result like,

$$L_4 > L_6 > L_5 > L_3 > L_2 > L_1 > \text{Control}$$

Ligand L_4 shows greatest value of results than L_6, L_5, L_3, L_2 and L_1 ligands. But the control plant shows minimum values as compared to other all treated plants. Pyrazolines showed significant results of ligand L_4, L_5 and L_6 showed more positive than L_1, L_2 and L_3, it may be due to presence of substituents present on the ring like –Br and $-NO_2$ group.

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