BIO CHEMICAL IMPACT OF COFFEE EXTRACT ON PLANT DEVELOPMENT: SPECIAL REFERENCE TO SEEDLING GROWTH IN *PHASEOLUS LUNATUS*

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Abstract: Coffee is an important beverage taken and inhaled practically by all persons of the world. How does it affect individual's specially biological materials? It has been a point of querry in a number of medicinal studies taken over on human health. Similar study on plants i.e. biochemical impact of coffee extract on plant development specially growth has been taken over here. The investigation is specially taken over with special reference to seedling growth in *Phaseolus lunatus.*

Coffee beans with a number of biochemical ingredients including chiefly caffeic acid and chlorogenic acid typically influence plant growth. Seedling growth in *Phaseolus lunatus* is taken here as an example. Coffee extract is taken at concentrations W/V – 1:200; 1:250; 1:500 and 1:1000. The effect of seedling growth is studied both in light and dark.

In light favourable concentration of coffee extract for seedling growth specially for root length, shoot length and total seedling length was found to be W/V – 1:200. For shoot ratio it was W/V – 1:1000.

In dark root length, shoot length and total seedling length showed decline in coffee extract at all concentration except at W/V – 1:200. In dark at root ratio 1, shoot ratio showed decline in coffee extract. However, minimum decline was observed at concentration W/V – 1:1000. In dark leaf expansion was also studied. Increase in leaf length and leaf breadth was found at concentration, W/V – 1:200, as compared to control. Rest of the concentrations showed irregular changes.

Keywords: Biochemical impact, Coffee extracts, Plant development, Seedling growth, Root length, Shoot length, Total seedling length, Root/Shoot ratio, Leaf expansion

INTRODUCTION

Use of coffee as a beverage is a well known fact. Its effect on human system has been a point of study medicinally. (Kaye and Freedman, 1961). It is however, important to note its effect on biological system specially seedling growth. Much studies have been taken on effect of plant parts on seedling growth. (Yardeni and Evenari, 1952). Skin irritant effects of coffee on human health has also been studied (Behl & Captain, 1979).

Biochemicals present such as chlorogenic acid enhances plant growth (Umemoto, 1971) Caffeic acid present in roasted coffee beans also influence plant growth. (Thimann *et al.,* 1962).

Here effect of coffee i.e. roasted beans of *coffea arabica* is studied on plant growth with special reference to seedling growth in *Phaseolus lunatus*. Such studies have not been taken earlier hence this work undertaken. Earlier effect of alternating periods of light and darkness was studied. (Al-Subai & Horwath, 1981). Here studies were performed in continuous light conditions and in continuous dark separately.

MATERIALS AND METHODS

Seeds of *Phaseolus lunatus* were purchased from local market at Meerut. They were stored properly in dry place. Commercial sample of Nescafe coffee was purchased from the market. To make coffee extract, stock solution was prepared first by dissolving 10 gms of coffee in 1000 cc of distilled water, bearing concentration, W/V – 1:1000. From this various other dilutions were prepared viz. W/V – 1: 200, 1:250; 1:500, 1:1000 respectively. The solutions were stored in refrigerator. The details of

investigated species and the plant part used in preparing extract are shown in Table - 1.

Table 1. Materials

S. N	Name of Plant investigated/Plant part used for extract			Family	Source
	Botanical Name	Common Name	Plant used for Test		
1.	*Phaseolus lunatus*	Lobia	Fresh Seeds	Leguminosae (Fabaceae) Sub-family Papilionatae	Local Market, Meerut
2.	*Coffea arabica*	Coffee	Roasted Coffee Beans	Rubiace	Commercial Nescafe Coffee sample from local market, Meerut

Seeds were surface sterilized with 0.1% Mercuric chloride solution to make them aseptic and washed with distilled water. Petridishes were also sterilized along with filter paper used. Seeds were now transferred into petridishes. The volume of plant extract or water used as control was sufficient for wetting of seeds.

Four sets of aqueous extract of coffee at each concentration and in water control were taken. 36 healthy seeds in 4 groups of 9 each were taken in each concentration. Experiments were performed in laboratory conditions in vitro. Two light conditions were taken. First condition was diffused day light and the second, total darkness. The experiments were performed at room temperature. Observations were made on 4^{th}, 5^{th}, 6^{th} and 7^{th} days respectively. Growing food plants in room conditions is the latest technique used by the scientists now days. Laboratory conditions provided are, therefore, according to present day trend.

RESULTS & DISCUSSION

Bonner (1965) has rightly said that "Development is first separated into two broad categories which we call the 'constructive' processes and the 'limiting' processes'.

Of the constructive processes, three seem noteworthy: *growth*, *morphogenetic movements* and *differentiation*. *Growth* is used generally in sense of an increase in living matter. It involves of energy and storing some energy by synthesis of new protoplasm. Further growth involves *morphogenetic movement* i.e. the migration of protoplasm which gives rise to changes in form. This leads to *differentiation*. This is increase in detectable differences in chemical composition of parts of an organism. These detectable differences in composition may bring a change in morphological pattern. (Bonner, 1965).

The limiting process pointed out by Bonner (1965) cover external and internal limiting factors. Limiting processes fashion the intricate pattern of living organism by guiding the constructive processes.

To know the answers to above questions we are at the mercy of experiments for only they will find a solution to the problem. This experimentation is attempt in this direction.

Studies on growth with special reference to effects of plant extracts have been an investigating point since long. (Yardeni and

Evenari, 1952). Recently also the work has been undertaken. (Sharma *et al.*, 2009).

Table 2. Effect of Extracts of Coffee beans in light on the seedling growth in *Phaseolus lunatus*

S.No.	Variable	Days after sowing	Control	Coffee beans extracts			
				Concentrations (W/V)			
				1:200	1:250	1:500	1:1000
1.	Root length ± S.D. (cms)	4	1.16 ±0.24	6.50 ±1.08	3.39 ±1.72	3.16 ±0.62	2.17 ±0.62
		5	1.67 ±0.24	7.40 ±0.99	4.80 ±1.99	3.36 ±0.62	2.83 ±0.88
		6	2.33 ±0.23	8.00 ±0.50	5.43 ±1.40	4.23 ±0.55	3.33 ±0.85
		7	3.50 ±0.50	8.80 ±0.59	5.83 ±2.01	4.66 ±0.62	4.00 ±0.82
2.	Shoot length ± S.D. (cms)	4	3.00 ±0.41	10.50 ±1.78	6.66 ±0.24	7.80 ±2.55	8.16 ±0.22
		5	3.50 ±0.41	12.06 ±2.22	8.16 ±0.85	8.73 ±1.52	8.66 ±0.22
		6	4.83 ±0.62	13.47 ±2.46	9.50 ±0.71	10.33 ±2.95	9.07 ±0.09
		7	5.90 ±0.65	14.43 ±2.43	11.83 ±1.55	12.03 ±2.88	10.00 ±0.41
3.	Total length (cms)	4	4.16	17.00	10.59	10.96	10.33
			5.17	19.46	12.96	12.39	11.49

		5					
		6	7.16	21.47	14.93	14.56	12.40
		7	9.40	23.23	17.66	16.69	14.00
4.	Root/Shoot Ratio (length)	4	1:2.58	1:1.62	1:1.69	1:2.47	1:3.76
		5	1:2.09	1:1.42	1:1.39	1:2.47	1:3.06
		6	1:2.07	1:1.51	1:1.62	1:2.22	1:2.27
		7	1:1.69	1:1.64	1:2.03	1:2.58	1:2.5

Table 3. Effect of Extracts of Coffee beans in dark on the seedling growth in *Phaseolus lunatus*

S.No.	Variable	Days after sowing	Control	Coffee beans extracts			
				Concentrations (W/V)			
				1:200	1:250	1:500	1:1000
1.	Root length ± S.D. (cms)	4	2.00 ±0.61	6.63 ±1.11	2.33 ±0.61	2.00 ±0.61	1.23 ±0.21
		5	4.00 ±0.61	8.75 ±1.23	3.33 ±0.85	3.00 ±0.61	2.00 ±0.61
		6	5.00 ±0.61	9.63 ±1.11	4.16 ±0.62	3.33 ±0.62	2.25 ±1.04
		7	5.88 ±0.43	9.88 ±2.14	4.63 ±1.09	5.63 ±1.41	3.38 ±1.03
2.	Shoot length	4	17.66	21.00	9.83	10.75	8.50

	± S.D. (cms)		±1.56	±0.82	±0.62	±2.17	±1.47
		5	18.83 ±2.46	22.66 ±2.62	11.16 ±0.85	13.00 ±2.50	10.25 ±1.47
		6	19.66 ±2.49	25.00 ±4.08	12.00 ±0.82	13.00 ±2.58	10.25 ±1.70
		7	21.00 ±2.58	23.30 ±4.72	12.88 ±0.74	13.83 ±2.19	10.63 ±1.67
3.	Total length (cms)	4	19.66	27.63	12.16	12.75	9.73
		5	22.83	31.41	14.49	14.75	11.50
		6	24.66	34.63	16.16	16.33	12.50
		7	26.88	33.21	17.51	19.51	14.01
4.	Root/Shoot Ratio (length)	4	1:8.83	1:3.17	1:4.22	1:5.38	1:6.91
		5	1:4.71	1:2.59	1:3.35	1:3.92	1:4.75
		6	1:3.93	1:2.59	1:2.88	1:3.90	1:4.55
		7	1:3.57	1:2.36	1:2.78	1:2.47	1:3.15

Table 4. Effect of Extracts of Coffee beans in dark on Leaf expansion in *Phaseolus lunatus*

S.No.	Variable	Days after sowing	Control	Coffee beans extracts			
				Concentrations (W/V)			
				1:200	1:250	1:500	1:1000
1.	Leaf length (mms)	7	14.33	18.00	13.33	17.00	14.66
2.	Leaf Breadth (mms)	7	9.33	11.33	8.66	10.00	9.00

Growth promoting activity of caffeic acid found in coffee extract was studied by Thimann etal (1962). Effect of chlorogenic acid an ingredient of coffee was studied in *Lemna gibban* by by Umemoto (1971).

Conclusions drawn as a result of experimentations in present endeavour on seedling growth in *Phaseolus lunatus* as affected by coffee extract are as follows:

(A) Effect on root lengthl: In light, coffee extract caused increase in root length at all concentrations. Maximum increase was founds at concentration W/V – 1:200. Thereafter gradual decrease was found with decreasing concentration.

In dark, root length was promoted at higher concentration W/V – 1:200 as compared to control and rest of the Concentrations.

(B) Effect on shoot length: In light, coffee extract increased shoot length as compared to control. The increase was more in comparison to root length. Maximum increase was found at concentration, W/V – 1:200. At lower concentration, shoot length decreased in haphazard manner.

In dark, shoot length increases in coffee extract as compared to control. Increase is more than that of root length. Maximum increase is found in concentration, W/V – 1:200. At lower concentration, decrease in shoot length is observed as compared to concentration W/V – 1:200. But even in lower concentration, shoot length is always more than that in control.

(C) Effect on total seedling length: In light, in coffee extract, tremendous increase was observed in total seedling length. Maximum increase was observed at concentration W/V – 1:200. Gradual decline in total seedling length was observed at lower concentration.

In dark, tremendous increase in total seedling length is observed as much as 4 times as compared to control. Maximum increase is found at concentrations W/V – 1:200. At lower concentrations, there is gradual decrease.

(D) Effect on root / shoot ratio: In light, at root ratio 1, shoot ratio was promoted only at dilute concentration W/V – 1:1000. At higher concentra- tions, decrease in shoot ratio was observed in coffee extract.

In dark, at root ratio 1, shoot ratio is promoted as compared to control only at single concentration, W/V – 1:1000 of coffee extract. Moving to higher concentration, there is gradual decline in shoot ratio.

(F) Effect on leaf expansion: Leaf expansion was studied in coffee extract in dark only. Leaf length and leaf breadth were studied. Increase in leaf length was observed at concent- rations, W/V – 1:200 and 1:500 respectively. Irregular decrease was found at other concentrations. Leaf breath showed increase at concentration, W/V

1:200 and irregular decrease at rest of the concentrations.

Above findings tally with earlier studies made on effect of plant extracts on seedling growth. In this connection the work taken over by Evenari (1961) on "Chemical influences of other plants (Allelopathy)" is note worthy. Endogen- ous levels of growth regulators and their relationship to rooting of Dahlia cuttings is shown by work of Biran and Halevy (1973). Effect of plant extracts has also been studied recently by Kavita, *et al.* (2009).

ACKNOWLEDGEMENT

It is my faithful endeavour at this moment to thank Dr. R. Shiam, Ex-Head, Department of Botany, Meerut College, Meerut. I feel a deep sense of gratitude for the guidance provided by him.

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