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Bio Effect (Allelopahic Effect) of Beverages due o Bio Chemicals Present Therein, on Crop Growth with Special Reference to *Coffea Arabica* on *Phaseolus Vulgaris*

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Abstract **– Beverages are inhaled by human beings. Their bio effect (allelopathic effect) on crop growth is studied over here. The effect was due to biochemicals present therein. Aqueous extract of *Coffea arabica* seeds on seedling growth of *Phaseolus vulgaris* is studied. Dilute concentrations of coffee extract were generally taken to test their effect and bioassay done on *Phaseolus vulgaris*. Seedlings of *Phaseolus vulgaris* reacted at different concentrations of Coffee extract in connection to roots, shoots, total seedling length, and root/shoot ratio.**

Keywords **– Allelopathic Effect, Beverages, Bioassay, Biochemicals, Bio-Effect, Crop Growth, *Coffea Arabica,* Coffee Extract, *Phaseolus Vulgaris,* Seedlings.**

I. INTRODUCTION

Bio effect of plant extracts on crop growth is quite important. Afaq and Sinha (1970) have studied the effect of stem extract of *Portulaca grandiflora* on the germination and growth of *Cicer arietinum*[1]. One of the bio effect of plant extract is allelopathy. AL-Mousawi and AL-Naib (1975, 1976) have studied allelopathic effect of *Eucalyptus microtheca*.[2]&[3] Allelopathy is the inhibitory effect of one plant over the other, occurring under the natural conditions, and exerted by chemical means other than nutritional ones (Evenari, 1961).[27] This is fundamentally different from competition, which mediates through depletion of sources. (Del Moral and Cates, 1971)[9] AL-Subai, and Horwath (1981), studied the effect of alternating periods of light and darkness on the tissues of *Phaseolus vulgaris cultivar*.[4]

Beverages are inhaled off and on by the human beings. They form a part of life by way of offering for courtesy. They are inhaled for their stimulating effect. Coffee is one of the common beverages. Aqueous extracts of *Coffea arabica* are utilized here to see their effect on *Phaseolus vulgaris.*

Phaseolus is economically important. Beans are used as a pulse in shelled condition. Bean straw is also used as animal feed. (Morrison, 1956).[19] Humphries (1958) has studied the effect of growth promoting substances on crop production of *Phaseolus*.[14] Sen Gupta (1955) studied the effect of gibberellic acid and kinetin on growth of primary leaf of dwarf bean (*Phaseolus vulgaris*).[23] Skene and Carr (1961) have made a quantitative study of the gibberellin contents of seeds of *Phaseolus vulgaris* at different stages of their development.[24] Growth was also studied in terms of leaf and stem growth in etiolated pea seedlings by Hendricks etal. (1949)[13]

Effect of coffee though stimulating as a beverage, has some harmful effects also. Dermatitis due to workers involved in its preparation is one such example (Chopra et.al 1949).[8] Effect of coffee extract on senesence has also been studied. (Gaur and Gaur 2010a, Gaur and Gaur 2010b).[11] & [12]

With a view to promote crop growth, aqueous coffee extract made from roasted seeds of *Coffea arabica* is utilized over here to study its effect on seedling growth of *Phaseolus vulgaris*. How the bio-chemicals present in roasted coffee beans affect root-shoot length of *Phaseolus vulgaris*? It is the question what is the effect of chlorogenic acid present there in the aqueous coffee extract and at which dilution? Such work has not been done earlier. Hence this work is undertaken.

II. MATERIALS AND METHODS

Materials used were seeds of *Phaseolus vulgaris*. Fresh seeds of *Phaseolus vulgaris* were purchased from the market at Meerut. The investigated species along with their botanical names, common names and the families of the concerned species and their parts used in study are enlisted in Table – 1. Beverage plant used was *Coffea arabica.* Commercial sample of Nescafe Coffee was purchased from the market, which contained powder of roasted seeds of *Coffea arabica*. Aqueous extract of coffee was prepared. Stock solution was prepared by dissolving 1 gm coffee powder in 100 cc of distilled water, which represented concentration, weight /volume – 1:100. Other dilution prepared from it were W/V – 1:200; 1:250; 1:500; 1:1000 respectively. The solutions were stored in air tight bottles in refrigerator.

Seeds of *Phaseolus vulgaris* (Red Rajma) were sterilized with 0.1% Mercuric chloride solution along with petri dishes to be used. They were then washed with distilled water. Four sets of aqueous extracts of different concentrations were taken with three replicates in each case along with water control. Seeds were kept on filter paper spread inside petri plate and smeared with aqueous extract or water till wetting of seeds.

Experiments were performed for 7 days in laboratory conditions. Light conditions used were diffused day light and dark. In dark condition, total darkness was provided. Seedling growth was studied in relation to root length, shoot length, total seedling length and root/shoot ratio. Seedling growth was recorded on 4th, 5th, 6th land 7th day respectively, for various parameters undertaken

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Table 1. Plant Materials

S.No.	Name of Plant investigated/Plant part used for extract			Family
	Botanical Name	Common Name	Plant used for Test	
1.	*Phaseolus vulgaris* (Plant investigated)	Rajma (Red)	Fresh Seeds	Leguminosae (Fabaceae) Sub-family Papilionatae
2.	*Coffea arabica* (Extract used)	Coffee	Seeds (Roasted)	Rubiace

Table 2. Effect of Extracts of Coffee beans in light on the seedling growth in *Phaseolus vulgaris.* (Root length and shoot length)

S.No.	Treatment 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	1.80 ±1.27	1.33 ±0.24	1.16 ±0.24	1.08 ±0.12	2.00 ±0.41
		5	2.13 ±1.19	2.25 ±0.41	1.42 ±0.12	1.83 ±0.24	2.83 ±0.24
		6	3.13 ±1.66	2.75 ±0.41	2.00 ±0.00	2.50 ±0.00	3.50 ±0.00
		7	3.63 ±1.88	3.33 ±0.47	2.66 ±0.24	3.50 ±0.41	4.50 ±0.41
2.	Shoot length ± S.D. (cms)	4	4.50 ±1.80	5.83 ±0.62	4.33 ±0.81	1.66 ±0.24	2.50 ±0.41
		5	5.50 ±1.80	7.50 ±0.41	5.00 ±0.41	2.58 ±0.12	3.50 ±0.41
		6	6.58 ±0.65	8.25 ±0.49	6.25 ±0.49	3.16 ±0.24	4.23 ±0.21
		7	7.13 ±2.19	9.50 ±0.41	7.00 ±0.41	4.16 ±0.24	5.16 ±0.24

Table 3. Effect of Extracts of Coffee beans in light on seedling growth in *Phaseolus vulgaris* (Total length and root/shoot ratio)

S.No.	Treatment Variable	Days after sowing	Control	Coffee beans extracts Concentrations (W/V)			
				1:200	1:250	1:500	1:1000
1.	Total length (cms)	4	6.30	10.05	12.40	13.00	9.53
		5	7.63	10.22	14.06	14.68	10.88
		6	9.51	12.70	15.76	16.38	11.45
		7	10.76	14.50	17.50	18.25	13.68
2.	Root/Shoot Ratio (length)	4	1:2.50	1:2.09	1:2.49	1:1.60	1:3.37
		5	1:2.58	1:1.56	1:2.26	1:1.58	1:3.35
		6	1:2.04	1:1.82	1:2.07	1:1.57	1:1.18
		7	1:1.96	1:1.64	1:1.92	1:1.52	1:1.33

Table 4. Effect of Extracts of Coffee beans in dark on the seedling growth in *Phaseolus vulgaris* (Root Length and Shoot Length)

S.No.	Treatment 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	4.30 ±1.72	4.22 ±1.85	18.05 ±1.58	18.88 ±1.44	7.88 ±3.93
		5	4.68 ±1.19	4.63 ±1.88	18.45 ±1.59	19.38 ±1.24	8.38 ±3.93
		6	4.98 ±1.44	5.80 ±1.97	18.83 ±1.64	19.73 ±1.31	8.88 ±3.93
		7	5.25 ±1.44	5.50 ±2.09	19.50 ±1.66	20.00 ±1.41	9.38 ±2.76
2.	Shoot length ± S.D. (cms)	4	10.20 ±0.47	6.38 ±2.62	15.28 ±2.95	12.00 ±0.16	13.75 ±1.68
		5	10.45 ±0.47	6.63 ±2.57	15.88 ±2.99	12.33 ±0.04	14.18 ±1.67
		6	10.73 ±0.55	7.05 ±2.80	16.30 ±3.05	12.86 ±0.09	14.58 ±1.75
		7	11.13 ±0.65	7.38 ±2.72	16.63 ±3.11	13.17 ±0.24	15.00 ±1.87

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Table 5. Effect of Extracts of Coffee beans in dark on the seedling growth in *Phaseolus vulgaris* (Total Length and Root/shoot ratio).

S.No.	Treatment Variable	Days after sowing	Control	Coffee beans extracts Concentrations (W/V)			
				1:200	1:250	1:500	1:1000
1.	Total length (cms)	4	14.50	10.60	33.33	30.88	21.63
		5	15.13	11.26	34.33	31.71	22.56
		6	15.71	12.13	35.13	32.59	23.46
		7	16.38	12.88	36.13	33.17	24.38
2.	Root/Shoot Ratio (length)	4	1:2.37	1:1.51	1:0.85	1:0.64	1:1.75
		5	1:2.23	1:1.43	1:0.86	1:0.64	1:1.69
		6	1:2.15	1:1.39	1:0.87	1:0.69	1:1.64
		7	1:2.12	1:1.34	1:0.85	1:0.66	1:1.60

Plate – 1

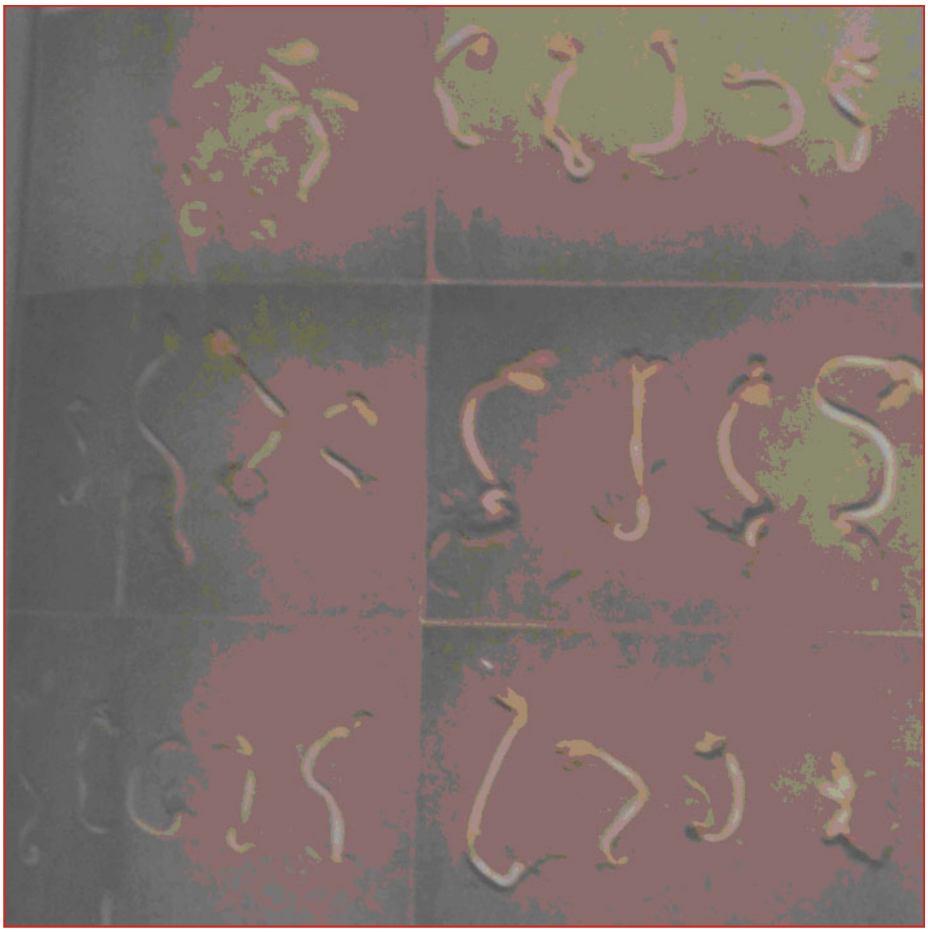

Plate 1 – Seedling Growth

7 days old seedling of *Phaseolus vulgaris* in coffee extract concentrations and control in light and dark.

IN LIGHT

Fig. A Effect of coffee extract in light in control (towards left); in concentration W/V – 1:500 (in centre); in concentration W/V – 1:200 (towards right); in concentration W/V – 1:250 (upwards); in concentration W/V – 1:1000 (down wards).

IN DARK

Fig. B Effect of control in dark; Fig. C Effect of coffee extract in dark at concentration W/V – 1:200; Fig. D Effect of coffee extract in dark at concentration W/V – 1:250; Fig. E Effect of coffee extract in dark at concentration W/V – 1:500; Fig. F Effect of coffee extract in dark at concentration W/V – 1:1000.

III. Discussion

Rice (1974, 1979) has given a broader meaning to allelopathy.[21] & [22] According to him *any direct or indirect effect of one plant over the other, harmful or beneficial is covered under allelopathy.* The effect is through production of chemical compounds that escape into environment Allelochemical are chemical agents that help in chemical interactions between species.

According to Whittaker and Fenny (1970) allelopathic agents are few groups of compounds among secondary

plant substances, such as phenolic acids, flavonoids and other aromatic compounds, steroids, alkaloids and organic cyanides.[26] Allelopathic self inhibition has been reported for *Eucalyptus* and a number of plant species.

Secondary substances are discharged from plants by leaching through leaf surface, exudation from roots. etc. Bottini and Steeco (1982) studied endogenous inhibitor in sunflower (*Helianthus annuus*).[6] They studied drought effect also. Chakrabarti etal (1982) studied allelopathic effect in *Clerodedrum viscosum*.[7] They found inhibition of mustard (*Brassica*) germination and seedling growth.

Seedling growth has been studied in various ways. Engelsma and Meijer (1965) studied the influence of light on the synthesis of phenolic compounds in gherkin seedlings.[10] *Present study deals with influence of natural growth regulators present in coffee beans by way of biochemicals inherent in them.* Kefeli and Kadyrov (1971) made studies on natural growth inhibitors and their chemical and physiological properties.[15] Umemoto (1971) studied, how chlorogenic acid influences flower production in long duckweed *Lemna gibba.*[25]

The present study reveals that bioeffect of coffee extract on seedling growth of *Phaseolus vulgaris* was different in dilute and concentrated coffee extract. The allelopathic effect was found contradictory in roof and shoot. The bioeffect also changed in light and dark conditions. Shoot ratio in comparison to root was also observed and results are compared over her. The effect on total seedling length in coffee extract at different concentrations has also been a point of study over here. Root length was promoted at concentration w/v-1'.1000 both in light and dark. In light, at all other concentrations, the effect on root length was inhibitory, maximum inhibition being at concentration w/v 1: 250 & 1:500.

The observations reveal that coffee extract in dark increased root length at dilute concentration i.e. w/v 1:1000 but decreased it at high concentrations i.e. w/v -1:200. Optimum concentrations for improvement of root length was found at concentration, w/v-1:250 and w/v -1:500. Maximum increase in root length was found at concentration, w/v-1; 500.

Coffee extract in light affected shoot length also. Shoot length decreased generally. The maximum decrease was found at concentration, w/v -1:1000. At concentration, w/v-1:200 there was slight increase in shoot length. Thus at this concentration the effect of coffee extract was promotive, Maximum inhibition was found at concentration, w/v- 1: 500.

In dark, dilute concentrations of coffee extract was highly promotive for shoot length. But at concentration, w/v -1:200, coffee extract inhibited shoot growth in dark. Maximum enhancement in shoot length was found at concentration w/v -1:250.

Effect of coffee extract at concentration w/v -1:200 was found contradictory in light and dark, in relation to shoot growth.

Root/shoot ratio was also studied. Shoot ratio at root ratio 1 was studied in coffee extract in light. The bioeffect was generally inhibitory. Shoot ratio was inhibited. Maximum inhibition was formed at concentration w/v-1:1000. In dark also coffee extract inhibited shoot length at all concentrations. Maximum inhibition was found at concentration, w/v; -1: 500.

Total seedling length was studied in coffee extract in light. The bioeffect was promotive and total seedling length increased in all the cases. The maximum enhancement was found at concentration w/v -1:500. In dark also coffee extract increased total seedling length of *P. vulgaris* except at concentration, w/v-1:200 which had inhibitory effect on total seedling length. Maximum enhancement was found at concentration, w/v - 1: 500. Effect of light on elongation of seedling stem was studied by Blaauw, and Jensen (1954).[5] Such studies were also made by Mohr, 1959,[18] Parker, 1949,[20] etc. Loveys and Wareing (1971a,[16] 1971b)[17] studied stimulating effect of light on leaf expansion in grass seedlings. This involves light stimulation of gibberellin release from some bound form.

IV. CONCLUSION

In present experiment results were different in root and shoot. They showed variability in light and dark also.

(A) ROOT LENGTH:

(i) Coffee extract in *light* increased root length only at concentration w/v-1:1000. Rest of the concentrations shows *inhibitory effect.*

(ii) Coffee extract in *dark* increased root length except at concentration, w/v -1:200. Maximum increase was found at concentration, w/v -1:500

(B) SHOOT LENGTH

(i) Coffee extract in *light* decreased shot length generally except at concentration w/v -1:200. Maximum decrease was found at concentration, w/v-1: 1000.

(i) At concentration, w/v-1:200 the inhibitory effect of coffee extract was counteracted in dark. Coffee extract in dark enhanced shoot length except at concentration, w/v -1:200 Maximum enhancement was found at concentration w/v-1:250

(C) ROOT SHOOT RATES:

(i) In coffee extract in *light* shoot ratio showed *inhibitory effect* at root ratio-1.

(ii) In coffee extract in dark also shoot ratio was found to be *inhibited.*

(D) TOTAL SEEDLING LENGTH:

(i) Told seedling length *increased* in coffee extract in *light.* The optimum concentration being w/v -1:500.

(ii) In coffee extract in *dark*, *total* seedling length *increased* except at concentration. w/v -1:200, which had inhibitory effect. The conclusions drawn are that -

Coffee extract at given concentrations increased root length both in light and dark. Shoot length generally decreased. Shoot ratio was always more than root ratio. However, effect of coffee extract on shoot ratio both in light and dark was inhibitory. Total seedling length increased in coffee extract both in light and dark.

Coffee used as beverage has drawn the attention medicinally and its bioeffect is important for biotic world including plants. Much has to be studied about it, as applicability is certain.

In present experiment results were different in root and shoot. They showed variability in light and dark also.

V. Acknowledgment

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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Author's Profile

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Dr. (Mrs.) Bhavana Gaur was born at Meerut on 15th July, 1950. She passed out M.Sc. in Botany from Meerut College, Meerut (Uttar Pradesh) in 1968,then affiliated to Meerut University, Meerut Meerut University, was later named as Chaudhary Charan Singh University, Meerut. Mrs. Gaur got her Ph.D. Degree from the same University in 1993. Her place of work was school of Plant Morphology, Meerut College, Meerut (Uttar Pradesh). She worked under the Supervision of Dr. Radhey Shiam, who was Head, Department of Botany, Meerut College, Meerut at that time and had been a student of Dr. V. Puri, the reknowned Scientist of his time. In research her field of study was "Plant Physiology", the topic of Ph.D. being-

"Effect of Plant Extracts on Seed Germination, Seedling Growth and Senescence in some species of *Phaseolus*"

She has total teaching experience of 45 years.

In July 1968, she joined N.R.E.C. College, Khurja (District Bulandshahar) as a Lecturer in Botany, where she remained till 30th August 1969. 31st August being Sunday, she joined R.G. (P.G.) College, Meerut on Ist September 1969. She was appointed there as lecturer and was confirmed on Ist September, 1970. She was promoted for the post of reader in 1993, she was associate Professor by 2006. She became Head, Department of Botany in 2007 and remained at the same post till 15th July 2012. During this period she was the senior most teacher in the college and officiated as Principal R.G.(P.G.) College Meerut from time to time. With effect from 15th July 2012 to June 2013, she taught in the college in Superannuation period. She is now retired since July 2013. Still she is busy in doing some scientific work on environmental studies, at her own residence. It is also notable that she was paper setter for competitive exams. i.e. P.C.S. in 2007 from Uttarakhand University. She has several research papers published in journals. A few are given below:

1. B. Gaur and V. Gaur "Impact of *Eucalyptus* leaves as biofertilizer as a remedy to global warming and as an aid to biodiversity conservation" in *Vegetos* Vol. 24 (2) 2011, pp 62-65.
2. B. Gaur and V. Gaur "Biochemical impact of coffee extract on plant development : Special reference to seedling growth in *Phoscolus lunatus*". In *Journal of Plant Development Sciences* Vol. 3, (1&2); 2011, pp 87-93.
3. B.Gaur and V.Gaur "Seedling Growth in *Phoscolus Luratus* with special reference to *Eycolyphus* leaves as biofertilizer and its impact on environmental crisis of climate change and biodiversity". In *Voyager* Vol. 2, 2011, pp. 73-83.

She has about 9 papers accepted in U.K. in various conferences on global warming and climate change in relation to plants. Currently she is busy in writing academic book on Genetics and Plant Physiology. Last year two books, B.Sc.I Botany theory and Practical have been written by her and are to be published soon.

Dr. Gaur is *Life Member* of *Journal of Indian Botanical Society*. She had

been annual member of *Journal of Plant Development Sciences* (J.P.D.S.) 2010, 2011, Voyager 2010-2011 and *Vegetos,* 2011. She has been a reviewer for certain papers of Journals. She has *Organised Conference* on "Global Warming: Global Warming" at R.G. (P.G.) College Meerut. One of her papers was awarded *Compensation Prize*. It is as follows :

B. Gaur and V. Gaur "Climate Change and its effect on journey" paper accepted for oral presentation in 4th climate change Volunteer Team Conference and Expo 11 (CCVG Conference 2011) on 24th - 28th June, 2011 at Mayfair Garden Hotel, London (U.K.)

She was selected as one of the *Best Citizens of India 2012* in the book "Best citizens of India-2012" published by International Publishing House, New Delhi. She was also *selected for "Bharat Jyoti Award" along with "Certificate of Excellence"*. She was listed among *top 100 Scientists of the World-2013* by International Biographic Centre Oxford, U.K.. She was *listee in Marquis who's who in the world 2014* and also in *Marquis who's who in the world 2015* by International Biographic Centre Oxford, England (U.K.).

One of her papers was taken in project by Director Global Warming Institute, Australia. the project was awarded "Eureka prize," the most prestigious prize of Australia.

Dr. Gaur attended many conferences and gave presentation in some of them. Recently Dr. B. Gaur was invited as Honourable Speaker in 11th Global Food Summit on "Food and Beverages" by Programm Manager, David Brown under Supervision of Mark A. Hutchinson Honourable Lt. Governor of Naveda and Carolyn G. Goodman, Honourable Mayor of Las Vegas. The conference is to be held w.e.f. 22nd September to 24 and 26 September 2016 Main theme of the conference is.

"Accentuate innovations and Emergency Novel Research in Food and Beverage Sector".

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Born on September 9, 1976, at Meerut, Dr. Varada Gaur passed out M.Sc. (Zoology) in 1997 from Meerut College, Meerut affiliated to C.C.S. University, Meerut (U.P.) India. She got her Ph.D. Viva done on 9th September 2006 and was awarded Ph.D. degree of C.C.S. University Meerut. Dr. Varada Gaur worked at Meerut College, Meerut for Ph.D. Degree under guidance of Dr. Kapil Kumar, then lecturer at Meerut College, Meerut. Her work on fisheries includes, Hydrobiology and Environment, Macrophytes and Planktons planktonic pigments were also studied by her. The topic of Ph.D. was; "Hydrobiology and Energy Flow in a few ponds of Meerut District with reference to Planktons, Macrophytes, Fishes and Fish Food".

She also passed out exam. for ADCA, (Advanced Diploma in Computer Application).

Her teaching experience is about more than five years. She taught zooloogy in R.G. (P.G.) College, Meerut w.e.f. 1997-1999. She taught B.Sc. and M.Sc. classes. She also taught in M.M. (P.G.) College, Modinagar w.e.f. 2000-2001. Since 1998 to 2006, She worked for Ph.D. Degree. Thereafter she worked at several degree colleges as Lecturer such as SPRC Degree College, Baghpat, SBP Mahila (P.G.) College, Dhampur, Bijnor. She served as Assistant Professor, Biotechnology and Microbiology at Vinayak Vidyapith, Modipuram, Meerut in Session 2014-2015 and onwards. She is shortly to join M.D. college, Bijnor. She has published project on "Global Warming". She has 9 paper accepted at U.K. at various conferences on "Global Warming" and "Climate Change". Her published research papers are as follows:

1. B.Gaur and V. Gaur "Biochemical Impact of Endogenous Harmones Inherent in *Eucalyptus* Leaves on Senescence in *Vigna mungo (L)* Hepper for its use as biofertilizer" in *Journal of Plant Development Sciences* Vol. 2 (1 & 2) 2010, pp 35-39.
2. B.Gaur and V. Gaur, "Senescence in Primary leaves of *Phaseolus Lunatus*, its genetic control as affected by *Eucalyptus* leaf extract and properiety of later as biofertilizer" in *Voyager* Vol. I, 2010, pp 95-104.
3. B. Gaur and V. Gaur, "Biochemical Impact of Coffee Extract on Senescence in Primary leaves of *Vigna radiata* (L) Wilezek", in *Journal of Plant Development Sciences*, Vol 2(3 & 4), 2010 pp 117-121.

She has worked earlier on ponds, hydrobiology, global warming, environmental factors, planktons and macrophytes. One of her papers has been accepted in China and finely graded.

Dr. Gaur was awarded compensation prize for her paper in U.K. as follows:

B.Gaur and V.Gaur "Climate change and its effect on journey", paper accepted for oral presentation in 4th Climate Change Volunteer Team Conference & Expo-11 (CCVG Conference 2011) on 24th to 28th June, 2011 at Mayfair Garden Hotel, London (U.K.).

One of her papers was taken in project by director Global Warming, Institute Australia. The project was awarded "Eureka" prize, the most prestigious prize of Australia.

Dr Gaur is life member of: J. Natcon (International Journal). She had been annual member of Journal of Plant Development Sciences (J.P.D.S.) 2010, 2011, *Voyager* 2010-2011 and *Vegetos* 2011.

Dr. Gaur attended many conferences and gave presentation in some of them.