International Journal for Multidisciplinary Research (IJFMR)
ISSN: 2582 – 2160, Volume - 1, Issue - 2

Effect of Dishwashing Detergent Baron Growth of Crop Plants

[1]PathakTrapti, [2]BhardwajNagendra, [3]Sharma Jaimala

[1]Assistant Professor, [2]Retired Professor, [3]Professor
Acropolis Technical Campus, Indore, India

***Abstract*- A detergent is a chemical compound or mixture of compounds used as a cleaning agent. Powder and liquid detergent can be used for cleaning, washing clothes or dishes. To study the effect of various concentrations of Vim Bar (VB) on two plant species namely *Vignaradiata* (mung) and *Cicerarietinum* (Gram) were selected for the present study. Six different concentrations of VB *viz.* 0.025%, 0.05%, 0.1%, 0.2%, 0.4% were prepared and pot experiment was conducted. Then various morphological and biochemical parameters were studied.To study the effect of dishwash detergent (VB) on growth and reproduction, pot experiment was also conducted on Mung and Gram plants. These leguminous plants are consumed in daily diet in various capacities. The Mung is sown in the month of April as rabi crop. The Gram is sown in the month of November as Kharif crop. For the study sandy loam soil and cow dung manure were mixed in the ratio of 1:4 and filled in the twelve inch pots. Total 54 pots were taken then in each pot five seeds were sown. Six different concentrations of VB *viz.* 0.025%, 0.05%, 0.1%, 0.2%, 0.4% was prepared and for comparison control set using tap water was also studied. For analysis standard research methods were used. The collected data were subjected to student's't' test for statistical analysis. The results of pot experiment showed that at 0.025% and 0.05% of VB stimulated plant growth in both the variety of Gram and Mung. Maximum retardation in seed production was observed at 0.4% in both detergents.VB adversely affected the plants growth. Lower concentration of detergents stimulates the plant growth, but at higher concentration the growth was adversely affected. Low concentration of detergent may be beneficial for plant growth, whereas higher concentration inhibit the plant growth.**

***Keywords*:Detergents, Dish wash bar, Crop Plants, Growth.**

INTRODUCTION:

Detergents are effective cleaning products. The detergents are mainly use to break down the surface tension that exists between grease and water. Cleaning products are part of our everyday life, it may present a significant risk to humanhealth.Dishwashing cleaning agents are corrosive and toxic depending upon their composition, concentration and physical form. All the dishwashing detergents are highly alkaline in nature. They are available as liquids, gels and cakes.They are referred to as "surface active agents" or "surfactants". Detergent surfactants were developed during World War I and World War IIdue to shortage of animal and vegetable fats and oils. Today, detergent surfactants are made from a variety of chemicals derived from petroleum and/or oleo chemicals (derived from fats and oils).

Surfactantsperformimportant functions in cleaning, apart from this trace amounts of these agents are highly toxic and will promote rapid hydrolysis and degradation of organic tissues. The active ingredient, quaternary ammonium hydroxide can be absorbed through the skin and diffuse into the body.

However, during the past few years, there has been serious public concern about the ecological and health problems arising from the use of such synthetic detergents on a large scale. The planned use of cleaning product ingredients is acceptable if the predicted exposure concentration is lower than the concentration that would harm animals, plants or microorganisms.

Current chemical technology for the production of household and commercial cleaning detergents is not sustainable. Use and disposal of such a large amount of chemicals is found to have adverse impact on environment. This means that the sources of most raw materials for current products are not renewable and that the environment and health effect of current products are often detrimental and cumulative. Society has no viable choice but to begin to shift from the old ways to cleaning things to newer, more sustainable and more biologically compatible ways of cleaning.

Chemicals in cleaning supplies can be harmful to our health, other than toxic for the environment.They contain large amounts of phosphates. If this enters the water in concentrated quantities, it causes algae and phytoplankton to grow that in turn kills life in the water body.

REVIEW OF LITERATURE:

Various concentrations of dishwashing detergents produce species specific effects because of different proportion of chemical constituents present in it. It may produceeither acute or chronic toxicity.

Plants are photosynthetic bodies which produce their own food by absorption of nutrients and water from soil. When plants

absorb the detergent contaminated water the ill effects may include inhibition of seed germination (Ernst et al., 1971) [1], chlorosis (Klein et al., 1963) [2], reduction of root growth (Dutta et al., 1985) [3], dwarfing (Singh and Singh, 2000)[4], retardation of seedling growth (Kale et al., 1968)[5], effects like retardation of growth, inhibition of pollen germination and pollen tube growth, decrease in root length and decrease in overall growth activity. Surfactants may influence translocation of heavy metals from soil into plants (Shandala et al., 1991) [6].

Regression analysis showed that the detrimental effects on plant yield were due to soluble salt damage caused by the sodium in the detergents. As detergent rate, frequency of application or both increased, plant dry weight accumulation and fruit yield decreased. Applying detergent also increased time of fruit maturity. Significant inhibition of shoot growth and inhibition of radical growth was seen in case of sunflower. Growth, chlorophyll content, transpiration rate and leaf relative water content of sunflower plant was also adversely effected (Gadallah, 1996)[7].

MATERIAL AND METHOD

To study the effect of dishwash detergents (VB) on growth and reproduction, pot experiment was also conducted on Mung and Gram plants. These leguminous plants are consumed in daily diet in various capacities. The Mung is sown in the month of April as Rabi crop. The Gram is sown in the month of November as Kharif crop.

For the study sandy loam soil and cow dung manure were mixed in the ratio of 1:4 and filled in the twelve inch pots. Total 54 pots were taken then in each pot five seeds were sown.

Six different concentrations of VB viz. 0.025%, 0.05%, 0.1%, 0.2%, 0.4% was prepared and for comparison control set using tap water was also studied. The experiments were designed as *follows -:*

Table 1: Experimental Design

S. No.		**No. of Pots used**						**Days of harvesting**
		1	**2**	**3**	**4**	**5**	**6**	
Concentration	**Treatment**	**Control**	**0.025%**	**0.05%**	**0.1%**	**0.2%**	**0.4%**	
1.Gram (*Cicerarietinum*) RSG-888	VB	9	9	9	9	9	9	45^{th}, 90^{th}, 135^{th}
2.Mung (*Vignaradiata*) RMG-492	VB	9	9	9	9	9	9	23^{rd}, 46^{th}, 69^{th}

Each pot contained 5 plants

Various concentrations of VB were prepared in tap water and plants were irrigated daily. After germination the grown up plants of Gram (RSG-888) harvested after 45^{th}, 90^{th} and 135^{th} day and Mung (RMG-492) was harvested after 23^{rd}, 46^{th} and 69^{th} days. At each harvest three pots were terminated out of nine at the time of harvesting.

The plants were removed from the pots without damaging their parts and washed thoroughly with water to make it free from adhering soil. Then various morphological and biochemical parameters were studied. For analysis standard research methods were used. The collected data were subjected to student's't' test for statistical analysis. The height of the plant was measured with the help of meter scale. Height of root and shoot of these plants was calculated from the soil surface to the tip of last root and to the tip of fully expanded leaf.To study the effect on growth, length of root and stem was measured. Number of branches, number of leaves and leaflets, number of nodules on the root, number of flowers and pods per plant were also counted. Number of seeds and leaf area were recorded.

RESULTS

The results of pot experiment showed that at 0.025% and 0.05% of VB stimulated plant growth in both Gram and Mung. Root length, shoot length, dry weight, leaves, number of flower and total seed production increased at lower concentrations and decreased at higher concentrations after treatment of VB. Maximum retardation in seed production was observed at 0.4% concentration of detergents. Weight of seeds decreased drastically at 0.4% by 82.75% after (135^{th} days) of sowing in Gram plant.The results revealed that low concentration of detergent may be beneficial for plant growth, whereas higher concentration inhibit the plant growth.

Table 2:Effect of various concentrations of VB on the growth of Cicerarietinum (Gram) plant on 45thday of sowing.

Parameters	Treatments					
	Control (0.00%)	**0.025 (%)**	**0.05 (%)**	**0.1 (%)**	**0.2 (%)**	**0.4 (%)**
Root length (cm)	25.44±0.44	44.15±0.48	21.52±1.35	36.57±0.35	31.88±0.66	24.54±0.04
Root dry weight (g)	0.21±0.02	0.22±0.03	0.14±0.01	0.15±0.01	0.13±0.02	0.14±0.02
Stem length (cm)	28.58±0.51	25.77±0.99	33.96±0.23	25.25±0.17	27.37±0.27	22.0±0.25
Stem dry weight (g)	0.39±1.55	0.33±17.43	0.19±3.25	0.34±0.40	0.27±2.33	0.23±2.05
Number of nodules	7.53±0.36	10.4±0.49	14.06±0.27	15.0±0.84	19.47±0.51	2.47±0.52
Number of leaves	25.2±0.12	28.93±0.63	17.67±3.0	30.2±0.49	26.8±0.50	21.2±0.6
Number of leaflets	260.26±3.86	267.0±41.02	256.73±7.56	294.06±3.77	265.66±0.64	191.6±6.41
Leaf area (cm^2)	1.26±0.13	1.24±0.05	1.32±0.13	1.28±0.14	1.10±0.25	0.96±0.16
Number of branches	2.66±0.01	3.20±0.04	3.0±0.1	3.133±0.03	2.87±0.07	1.53±0.14

International Journal for Multidisciplinary Research (IJFMR)
ISSN: 2582 – 2160, Volume - 1, Issue - 2

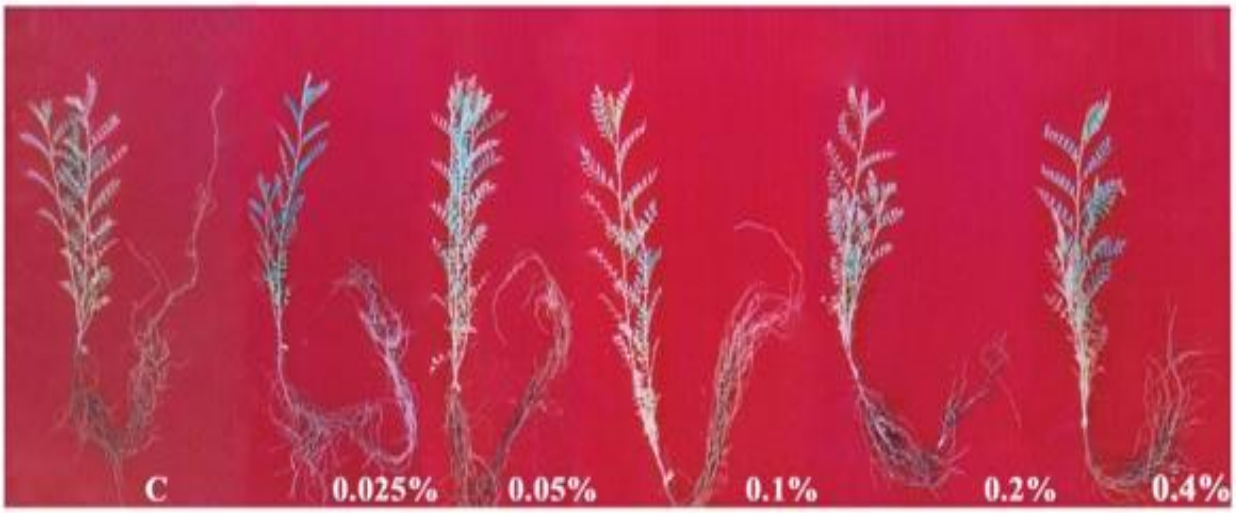
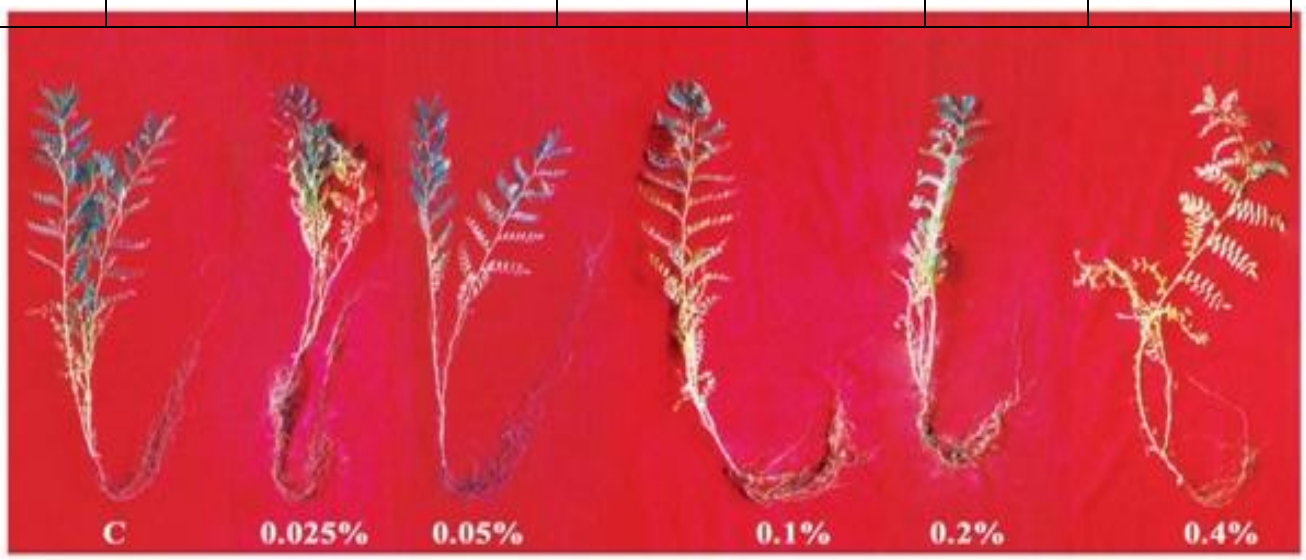


Fig 1: Root Length Shoot Length after 45th days at different concentration of VB

Table 3:Effect of various concentrations of VB on the growth of Cicerarietinum (Gram) plant on 90th day of sowing.

Parameters	Treatments					
	Control (0.00%)	**0.025 (%)**	**0.05 (%)**	**0.1 (%)**	**0.2 (%)**	**0.4 (%)**
Root length (cm)	27.20±1.43	29.71±1.53	28.18±1.18	31.42±1.41	74.68±1.19	21.74±1.33
Root dry weight (g)	0.17±0.02	0.45±0.02	0.33±0.17	0.383±5.044	0.411±0.032	0.273±7.881
Stem length (cm)	41.38±0.229	35.06±0.526	44.153±0.061	35.66±0.4156	38.33±0.358	34.36±0.643
Stem dry weight (g)	1.104±0.013	1.295±2.886	1.255±0.041	0.960±0.057	1.163±0.058	0.725±0.054



Number of nodules	39.0±0.165	47.46±0.714	43.73±0.588	51.533±0.823	58.33±0.839	13.66±0.785
Number of leaves	43.13±1.009	42.26±1.029	51.13±1.387	41.33±0.407	35.4±0.523	22.733±0.614
Number of leaflets	568.26±15.425	561.66±9.310	666.26±12.411	538.4±8.511	462.4±9.574	295.733±11.138
Leaf area (cm^2)	1.45±0.31	1.67±0.07	1.53±0.09	1.45±0.22	1.44±0.22	1.12±0.12
Number of branches	2.2±0.140	3.2±0.170	3.06±0.129	2.93±0.l014	2.73±0.477	1.73±0.081
Number of pods	2.0±0.134	2.26±0.201	1.2±0.303	2.33±0.463	1.66±0.259	1.13±0.157
Number of flowers	6.2±0.27	7.26±0.32	10.06±0.69	8.66±0.38	6.73±0.42	4.9±0.34

Fig 2 : Root Length Shoot Length after 90th days at different concentration of VB

Table 4:Effect of various concentrations of VB on the growth of Cicerarietinum (Gram) plant on 135th day of sowing.

Parameters	**Treatments**					
	Control	**0.025 (%)**	**0.05 (%)**	**0.1 (%)**	**0.2 (%)**	**0.4 (%)**
Root length (cm)	29.06±0.13	23.26±0.40	27.35±0.28	31.44±0.51	31.86±0.58	11.43±0.26
Root dry weight (g)	0.32±0.03	0.48±0.01	0.35±0.03	0.38±0.03	0.42±0.01	0.12±1.08
Stem length (cm)	37.33±0.12	35.30±0.45	39.74±0.18	42.66±0.75	39.46±0.43	31.10±0.18
Stem dry weight (g)	1.03±0.02	1.29±0.04	1.26±0.01	1.23±0.04	1.16±0.02	0.50±3.17
Number of nodules	62.73±1.23	57.9±0.93	64.93±0.48	50.06±0.83	52.13±0.19	16.66±0.17
Number of leaves	74.33±0.203	65.86±0.43	70.73±0.658	53.0±0.14	45.26±0.12	30.06±0.39
Number of leaflets	888.86±8.13	586.6±9.89	853.26±11.27	701.73±5.95	856.21±3.09	281.1±6.44
Leaf area (cm^2)	1.98±0.46	1.34±0.23	2.59±0.24	1.81±0.16	1.53±0.11	1.23±0.05
Number of branches	2.46±0.10	2.46±0.11	2.86±0.01	1.6±0.06	1.73±0.06	1.13±0.14
Number of seeds	5.2±0.02	3.66±0.37	6.13±0.29	3.53±0.14	3.53±0.15	0.89±0.08
Weight of seeds	0.87±9.16	0.40±0.02	1.01±0.03	0.44±0.02	0.52±9.17	0.15±3.51

International Journal for Multidisciplinary Research (IJFMR)
ISSN: 2582 – 2160, Volume - 1, Issue - 2

Fig 3: Root Length Shoot Length after 120th days at different concentration of VB

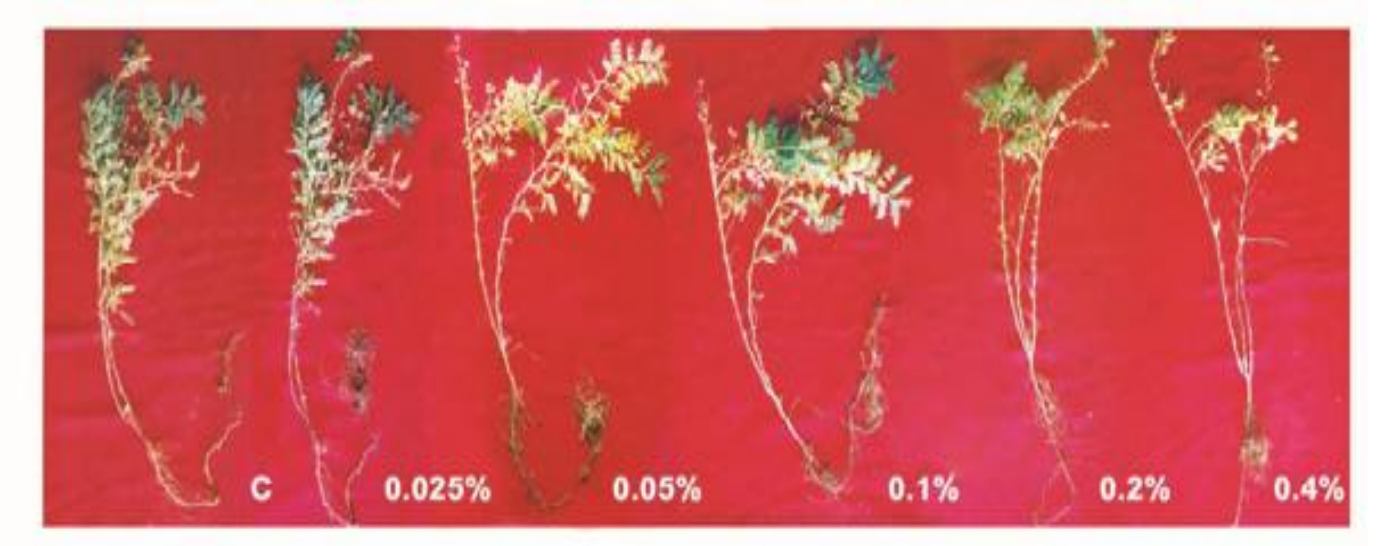


Table 5: Effect of various concentrations of VB on the growth of Vignaradiata(Mung) plant on 23rd day of sowing.

Parameters	Treatments					
	Control	**0.025 (%)**	**0.05 (%)**	**0.1 (%)**	**0.2 (%)**	**0.4 (%)**
Root length (cm)	25 ± 0.23	22.26 ± 0.48	17.0 ± 0.75	19.53 ± 0.17	22.73 ± 0.81	14.99 ± 0.52
Root dry weight (g)	0.30 ± 0.003	0.25 ± 0.002	0.20 ± 0.003	0.21 ± 0.003	0.30 ± 0.006	0.20 ± 0.001
Stem length (cm)	21.0 ± 0.91	16.46 ± 0.17	12.8 ± 0.23	14.13 ± 0.40	22.93 ±1.48	9.8 ± 0.57
Stem dry weight (g)	2.0 ± 0.001	1.9 ± 0.006	1.5 ± 0.007	2.1 ± 0.007	2.5 ± 0.007	2.1 ± 0.007
Number of nodules	1.2 ± 0.23	0.53 ± 0.24	0.33 ± 0.06	0.2 ± 0.11	0.6 ± 0.11	0.33 ± 0.17
Number of leaves	14.26 ± 0.54	13.33 ± 0.17	10.8 ± 0.30	12.66 ± 0.06	12.13 ± 0.43	9.13 ± 0.17
Leaf area (cm^2)	12.94 ± 0.55	7.05 ± 0.14	3.11 ± 0.06	5.19 ± 0.25	13.42 ± 0.39	5.56 ± 0.22

Fig 4: Root Length Shoot Length after 23th days at different concentration of VB

Table 6 :Effect of various concentrations of VB on the growth of Vignaradiata(Mung) plant on 46th day of sowing.

Parameters	Treatments					
	Control	0.025 (%)	0.05 (%)	0.1 (%)	0.2 (%)	0.4 (%)
Root length (cm)	54.4 ± 1.70	50.86 ± 0.37	48.73 ± 0.33	38.46 ± 0.46	38.13 ± 2.18	18.13 ± 0.54
Root dry weight (g)	0.79 ± 0.03	0.69 ± 0.06	0.58 ± 0.01	0.59 ± 0.02	0.6 ±0.02	0.38 ± 0.01
Shoot length (cm)	41.33 ± 12.58	42.26 ± 0.29	53.73 ± 0.59	50.8 ±0.11	50.4 ± 0.6	29.86 ± 0.46
Shoot dry weight (g)	3.30 ± 0.02	3.35 ± 0.08	2.79 ± 0.26	2.7 ± 0.01	2.53 ± 0.01	1.07 ± 0.01
Number of nodules	8.0 ± 0.30	14.3 ± 0.20	13.4 ± 0.72	10.6 ± 1.59	5.53 ± 0.26	3.26 ± 0.17
Number of leaves	17.8 ± 0.52	14.4 ± 0.34	12.0 ± 0.69	13.2 ± 0.34	11.8 ± 0.4	52.6 ± 0.2
Leaf area (cm^2)	19.68 ± 0.75	17.39 ± 0.83	28.66 ± 0.80	14.34 ± 0.73	11.59 ± 0.16	7.22 ± 0.88
Number of flowers	5.26 ± 0.29	3.26 ± 0.24	3.33 ± 0.17	4.8 ± 0.11	2.26 ± 0.06	0.86 ± 0.24
Number of pods	3.86 ± 0.37	4.2 ± 0.46	4.13 ± 0.06	5.06 ±0.17	3.33 ± 0.06	3.73 ± 0.24
Number of branches	5.93 ± 0.17	4.8 ± 0.11	4.0 ± 0.23	4.4 ± 0.11	3.36 ± 0.13	4.33 ± 0.06

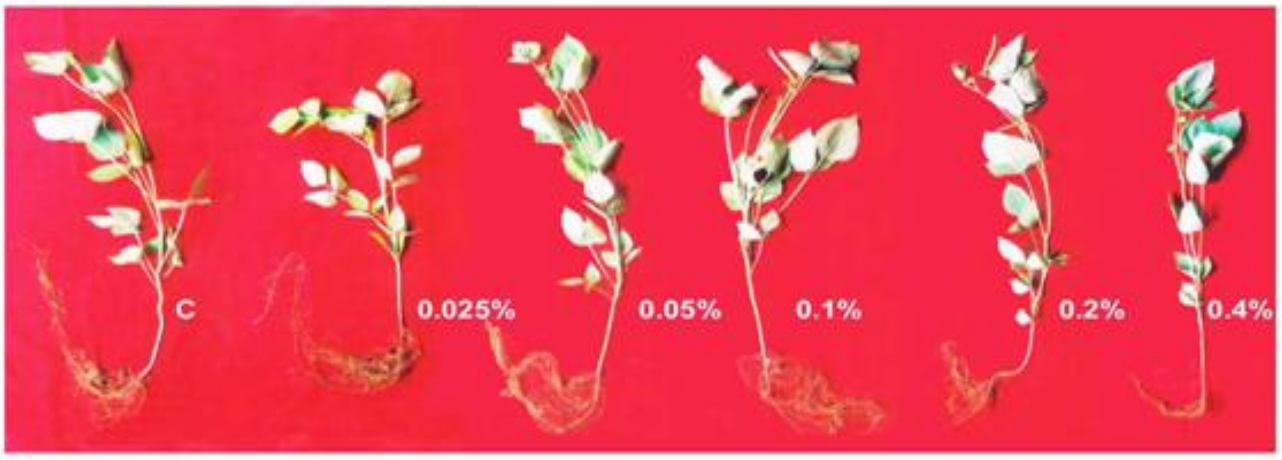


Fig 5:

Root Length Shoot Length after 46th days at different concentration of VB

Table 7 :Effect of various concentrations of VB on the growth of Vignaradiata(Mung) plant on 69th day of sowing.

Parameters	***Treatments***					
	Control	***0.025 (%)***	***0.05 (%)***	***0.1 (%)***	***0.2 (%)***	***0.4 (%)***
Root length (cm)	37.17 ± 0.33	37.8 ± 0.45	30.26 ±0.42	30.60 ± 0.81	37.23 ± 0.59	17.44 ± 1.76
Root dry weight (g)	1.98 ± 0.01	2.06 ±0.03	1.30 ± 0.08	1.04 ± 0.04	2.13 ± 0.09	0.64 ± 0.02
Stem length (cm)	54.02 ± 2.55	58.4 ± 0.68	45.2 ± 0.4	38.86 ± 0.24	63.13 ± 0.58	26.73 ± 0.17
Stem dry weight (g)	4.98 ± 0.04	5.06 ± 0.02	3.81 ± 0.05	3.01 ± 0.02	5.07 ± 0.01	1.88 ±0.05
Weight of seeds	1.95 ± 0.77	2.09 ± 0.81	1.23 ± 0.03	0.92 ± 0.07	2.32 ± 0.03	0.46 ± 0.03
Number of seeds	41.93 ± 0.17	52.66 ±3.01	34.26 ± 0.73	29.26 ± 1.87	31.2 ± 1.05	15.33 ± 0.24
Number of nodules	26.4 ± 0.75	13.93 ± 2.28	16.0 ± 0.23	9.26 ± 0.24	15.46 ± 0.24	6.0 ± 0.57
Number of leaves	21.2 ± 1.31	20.8 ±0.72	26.8 ± 0.15	18.2 ± 0.87	29.0 ± 0.52	12 ± 0.2
Leaf area (cm^2)	18.40 ± 0.85	16.25 ± 0.10	13.52 ± 0.13	8.95 ± 0.07	17.99 ± 0.93	7.46 ± 0.23
Number of flowers	7.06 ± 0.17	9.06 ± 0.13	8.66 ± 0.24	7.4 ± 0.34	10.73 ± 0.24	5.19 ± 1.19
Number of pods	10.73 ± 0.24	10.2 ± 0.2	8.06 ± 0.06	7.13 ± 0.17	10.33 ± 0.06	4.26 ± 0.29
Number of branches	7.06 ± 0.43	6.93 ± 0.24	8.93 ± 0.06	6.06 ± 0.29	9.66 ±0.17	4 ± 0.3

Fig 6: Root Length Shoot Length after 69th days at different concentration of VB

DISCUSSION

To study the effect of VB and BB, a laboratory experiment was conducted on both the crop plants i.e. Gram (Cicerarientum) and Mung (Vignaaurea). The result showed that the root length of Gram increased at 0.025% and decreased at 0.4% throughout the growth period. Decrease in root length of Mung plant at all the concentrations of VB was observed. Maximum decline was observed at 0.4%.

Litz et al. (1987) [8]andMuramato et al. (1989) [9]observed decrease in root length due to higher concentrations of detergent. The decrease in the root length was due to the presence of Sodium dodecyl sulphate, which is an important ingredient of detergents. The uptake of LAS in a plant is very high and however it is slowly metabolized, resulting in converting protein molecules into peptides by breaking their chemical bonding.

According to and Mayers (1998) [10]and Horowitz and Givelberg (2006)[11] poor growth in the root may be due to stops absorption of both water and nutrientsin absence of waxy cuticle as their function is water absorption. Detergent dissolves lipid that surrounds the root cells. It certainly kills outer cells, the root hair cells are also killed by detergents therefore without supply of nutrients, and the plant dies. It also concluded that exposure of surfactant solutions, ions and amino acids to the roots, presumably due to a loss of membrane integrity. After 2-3 days, the plant wilted and, at higher concentrations of surfactants may kill the plant.

Gastsly (2007)[12] reported that an increase in detergent concentration will damage cell membranes, thus decreasing their permeability, and therefore allowing more of the pigment to be released. If the concentration of detergent is doubled the cells will be (at least partly) damaged, which will lead to double the amount of beta cyanine being let out of the cells.

Stem length of Gram increased only at 0.05% of VB and decreased at remaining concentrations. It showed maximum reduction in the stem length at 0.4% concentration at III harvest.

The effect VB on stem length of Mung showed variation to a large extent, but decline was observed at higher concentration (0.4%).

Similar results were observed by Michael (2000)[13] and Katie (2004)[14] who found reduction in stem length due to increase in concentration of detergents. Devligher et al. (1995)[15] concluded that possible reason for increased the growth of plant at lower concentration is higher uptake of nutrients (K, Ca and Na).

Poongodi and Sasikala,(2013)[16] studied the efficacy of synthetic detergent on seed germination, seedling growth and certain biochemical parameters of Green gram (Vignaradiata L.) for a period of seven days. The green gram seeds were raised in petriplates irrigated with different concentrations of detergents (0.01, 0.02, 0.03, 0.04 & 0.05%). There was gradual decline in the selected parameters with increase in detergent concentrations. The lower concentration of detergent (0.01%) enhanced the growth and development of green gram better than control. Higher concentration of the detergent (0.02% & above) inhibited the growth and biochemical parameters of green gram seedlings.

REFERENCES

[1] Ernst R., Arditti J. and Healey P.L., 1971. Biological effects of surfactants II : influence of the ultrastructure of orchid seedlings. New Phytol. 70 : 457.

[2] Klein S.A., Jenkins D. and McGauheyP.H., 1963. The effect of ABS (Alkyl benzene sulphonate) on soil and plants. J. Water Pollut Control Fed.,35 : 636.

[3] Dutta M., Sen O. and Bhattacharya S., 1985. Effect of the detergent sodium lauryl sulfate on the somatic nuclei of Vignaradiata. Environment and Ecology., 3 : 551-553.

[4] Singh P. and Singh J., 2000. Studies on the toxicity and biodegradation of detergents. Proc. Acad. Environ. Biol., 9 : 125-130.

[5] Kale C.K., Sharma L.N. and KrishanM.G., 1968. Effect of alkyl benzene sulphonate on the growth of Abelmoschusesculentus and Raphanussativus. Indian J. Agric. Sci., 38-504.

[6] ShandalaM.G.,VoloshchenkoO.I., Mudryi I.V., 1991. Hygienic significant of surface-active substances in the conditions of soil contamination with chemical substances. Gig. Sanit., Jan.; (1) : 4-6.

[7] Gadallah M., A.A., 1996. Phytotoxic effects of industrial and sewage waste waters on growth, chlorophyll content, transporation rate and relative water content of potted sunflower plants. Water, air and soil pollution : 89(1-2) : 33-47.

[8] Litz N., DoeringH.W., Thiele M., BlumeH.P., 1987. Behaviour of linear alkylbenzenesulfonate in different soils : a comparison between field and laboratory studies. Ecotoxicol. Environ. Saf., 14(2) : 103-116.

[9] Muramoto S., Oki Y. Nishizaki H. and Aoyama I., 1989. Variation in some elements contents of water hyacinth due to cadmium or nickel treatment with or without surface active agents. J. Environ. Sci. Health., A-24 : 925-934.

[10] Mayers C., 1998. What effect does detergent have on plants. Cambridge University Area of Science. Botany ID:

910736262Bt.
[11] Horowitz Menashe and GivelbergAssia, 2006. Toxic effects of surfactants applied to plant roots. Pest Management Science, 10(6): 547-557.
[12] GastslyN.G., 2007. Effect of detergent concentration of membrane permeability of beet root cells.
[13] Michael M., 2000. The effect of detergents on Brassica rapa., (Research Report).
[14] Katie K., 2004. The effect of detergents on pea growth. (Research Report).
[15] Devliegher Ward, SyamsulArif M.A., Verstraete Willy, 1995. Survival and Plant Growth Promotion of Detergent-Adapted Pseudomonas fluorescensANP15 and Pseudomonasaeruginosa7NSK2. Applied and Environmental Microbiology, 61(11) : 3865-3871.
[16] Poongodi N. and Sasikala T., 2013. Effect of Detergent on Selected Morphological andBiochemical Parameters of Green Gram (Vignaradiata L.) .International GlobalResearch *Analysis, Volume: 2, Issue: 7, ISSN No. 2277- 8160.*