



## Impacts of waste biomass of *Salvinia cucullata* L. on growth, physiological and biochemical parameters of *Vigna unguiculata* L.

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### Abstract

*Salvinia cucullata* L. is an aquatic plant which is actively growing biomass and also easily available. In this study *Salvinia cucullata* biomass has been utilised to show the impact on *Vigna unguiculata* L. This experiment was conducted to find out the effect of biomass on germination, growth and biochemical parameters. The seeds of groundnut were germinated in six different concentrations of added biomass having 0-100 mg/l of biomass. It was observed that seedling vigour index, metal tolerance indices were increased and the percentage of phytotoxicity were decreased. The pot culture experiment revealed that, the growth parameters were found to be increased with increase in concentration of biomass and seedlings showed better result in terms of growth in at 10<sup>th</sup>, 20<sup>th</sup> and 30<sup>th</sup> days thereby indicating that it had stimulating effect on the seedling growth. Similarly the total chlorophyll content, total soluble protein content were increased but free proline content was decreased with increase in concentration of biomass at 10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup> and 100<sup>th</sup> days after treatment. So, it could be concluded that *Salvinia* biomass had an inducing effect on plant growth and it can be further utilised as biofertilizer.

**Keywords:** *salvinia cucullata*, *vigna unguiculata* l., germination, growth parameters, biochemical parameters

### Introduction

Biomass waste is a type of waste that originates from all living sources. There are different sources of biomass, such as agriculture, food processing plants, paper manufacturing units, municipal waste, and so on. Basically we may divide biomass source either from plant origin or animal origin.

*Salvinia cucullata* L. has been widely introduced as an ornamental plant & has been used as a mulch for crops in dry areas near water bodies where it grows. It is used to remove excess nutrients, other pollutants from water. It is used as paper-making, handicraft etc. It is also used for biofuel, sewage treatment. It helps to purify waste or contaminated waters & removes organic material from eutrophicated water. It is used to inhibit growth of Human cancer cells without destroying nearby healthy ones.

### Material and Methods

Seeds of *Vigna unguiculata* L. were obtained from Orissa University of Agriculture and Technology (O.U.A.T), Bhubaneswar. The present study was undertaken with *Salvinia cucullata* biomass at 20, 40, 60, 80, and 100 mg of biomass along with control (untreated). Seeds of *Vigna unguiculata* L. were surface sterilized with 0.1% of mercuric chloride and washed thoroughly with tap water and then with distilled water. Uniform sized seeds were placed in petridishes of 10 cm with different concentrations of biomass and one with control at a constant temperature of 26°C. The seeds were submerged in 10 ml of test solutions

and distilled water twice a day. Each treatment was replicated five times. The number of seeds germinated in each treatment was counted on 5 days after sowing (DAS) and the total germination percentage was calculated. Tolerance index<sup>1</sup> and vigour index of seedlings were calculated<sup>2</sup>. The root and shoot length of seedlings in various treatments were measured on 10<sup>th</sup> days after showing (DAS). The plant samples were kept in an oven at 60° C for 24 hours and the dry weights were taken by using electronic balance.

In pot culture experiment seeds were shown in pretreated soil (soil treated with 20,40,60,80 and 100 mg of biomass/kg of soil with one control i.e. biomass less soil) and different growth parameters and biochemical parameters like total chlorophyll content<sup>3</sup>, total soluble protein content<sup>4</sup> and free proline content<sup>5</sup> were observed in plants at 10, 20, and 30 and 100 days after treatment (DAT).

All the experiments were done in triplicates and the data were statistically analyzed and standard errors of mean (SEM) was calculated.

### Results and Discussion

#### Germination studies

There was concentration dependant decrease in number of seed germinated for waste biomass treatment in *Vigna unguiculata* L. The effect of waste biomass on germination, seedling vigour index and metal tolerance index are presented in table.

**Table 1:** Effect of waste biomass of *Salvinia cucullata* L. on seedling vigour index, metal tolerance index and percentage of phytotoxicity on 5 days after treatment of the *Vigna unguiculata* L.

Treatments	Germination Percentage	Radicle length (in cm)	Seedling Vigour Index	Metal Tolerance Index	Percentage of Phytotoxicity
Control	60±3.1622	0.20±0.0066	19.8	3.610	96.389
20 ppm	99±2.0000	0.23±0.0334	22.77	4.151	95.848
40 ppm	99±2.0000	0.74±0.1437	73.26	13.357	86.642

60 ppm	99±1.6733	0.89±0.1368	88.11	16.064	83.935
80 ppm	99±1.4142	3.02±0.1506	298.98	54.512	45.487
100 ppm	99±0.8944	5.54±0.1299	548.46	100	0

Values of 5 replicates ± SEM

**Table 2:** Effect of waste biomass of *Salvinia cucullata* L. on root length, shoot length and percentage of moisture content on 10 days after treatment on *Vigna unguiculata* L.

Treatments	Root Length (in cm)	Shoot Length (in cm)	Shoot Fresh Weight (in gram)	Shoot Dry Weight (in gram)	Moisture Content (in %)	Root Fresh Weight (in gram)	Root Dry Weight (in gram)	Moisture Content (In %)
Control	5.1 ± 0.07	5.6 ± 0.04	3.115 ± 0.07	0.684 ± 0.01	78.037	0.926 ± 0.01	0.302 ± 0.005	67.386
20 ppm	9.6 ± 0.86	8.4 ± 0.05	3.927 ± 0.02	0.806 ± 0.02	79.432	1.862 ± 0.01	0.548 ± 0.003	70.569
40 ppm	13.2 ± 0.67	10.8 ± 0.08	6.154 ± 0.01	0.935 ± 0.01	84.806	2.575 ± 0.02	0.672 ± 0.004	73.902
60 ppm	17.1 ± 0.87	13.4 ± 0.56	7.414 ± 0.032	1.039 ± 0.01	85.985	3.820 ± 0.02	0.802 ± 0.002	79.005
80 ppm	18.6 ± 0.57	13.9 ± 0.09	7.585 ± 0.04	0.996 ± 0.09	86.868	3.825 ± 0.04	0.768 ± 0.004	79.921
100 ppm	18.2 ± 0.54	13.5 ± 0.61	7.805 ± 0.02	1.074 ± 0.01	86.231	3.916 ± 0.07	0.786 ± 0.006	79.928

Values of 5 replicates ± SEM

**Table 3:** Effect of waste biomass of *Salvinia cucullata* L. on Root length, Shoot Length and Percentage of Moisture content of 20 days of *Vigna unguiculata* L. plants.

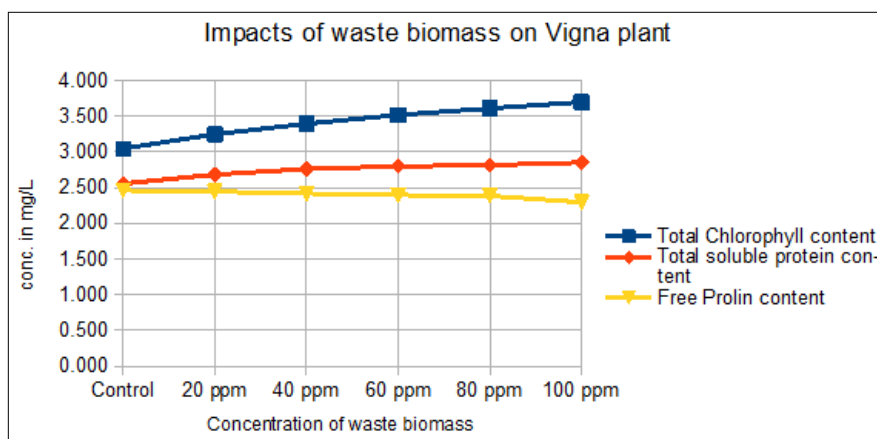
Treatments	Root Length (in cm)	Shoot Length (in cm)	Shoot Fresh Weight (in gram)	Shoot Dry Weight (in gram)	% of Moisture Content	Root Fresh Weight (in gram)	Root Dry Weight (in gram)	% of Moisture Content
Control	9.24 ± 0.076	8.61 ± 0.04	2.254 ± 0.007	0.499 ± 0.004	77.861	0.062 ± 0.009	0.020 ± 0.005	67.741
20 ppm	12.08 ± 0.867	10.34 ± 0.05	2.589 ± 0.009	0.524 ± 0.020	79.760	0.135 ± 0.011	0.029 ± 0.003	78.518
40 ppm	15.46 ± 0.675	11.12 ± 0.08	2.964 ± 0.012	0.568 ± 0.013	80.836	0.146 ± 0.021	0.030 ± 0.004	79.452
60 ppm	19.69 ± 0.874	15.43 ± 0.56	3.141 ± 0.032	0.586 ± 0.006	81.343	0.163 ± 0.021	0.033 ± 0.002	79.754
80 ppm	21.32 ± 0.549	16.12 ± 0.61	3.183 ± 0.021	0.593 ± 0.013	81.369	0.166 ± 0.072	0.033 ± 0.006	80.120
100 ppm	21.85 ± 0.576	16.52 ± 0.09	3.157 ± 0.043	0.579 ± 0.009	81.659	0.164 ± 0.043	0.032 ± 0.004	80.487

Values of 5 replicates ± SEM

**Table 4:** Effect of *Salvinia cucullata* L. on Root length, Shoot Length and Percentage of Moisture content of 30 days of *Vigna unguiculata* L. plants.

Treatments	Root Length (in cm)	Shoot Length (in cm)	Shoot Fresh Weight (in gram)	Shoot Dry Weight (in gram)	% of Moisture Content	Root Fresh Weight (in gram)	Root Dry Weight (in gram)	% of Moisture Content
Control	14.58 ± 0.26	14.58 ± 0.45	2.742 ± 0.006	0.674 ± 0.003	75.419	0.608 ± 0.004	0.204 ± 0.004	66.440
20 ppm	18.98 ± 0.83	13.66 ± 0.43	3.167 ± 0.009	0.716 ± 0.006	77.391	1.365 ± 0.006	0.338 ± 0.006	75.238
40 ppm	20.34 ± 0.76	15.08 ± 0.59	4.334 ± 0.053	0.934 ± 0.009	78.449	1.573 ± 0.007	0.385 ± 0.005	75.524
60 ppm	22.46 ± 0.98	17.26 ± 1.04	6.872 ± 0.089	1.239 ± 0.008	81.970	2.351 ± 0.006	0.470 ± 0.008	80.00
80 ppm	25.92 ± 0.85	18.68 ± 0.65	7.385 ± 0.076	1.266 ± 0.007	82.857	2.529 ± 0.004	0.486 ± 0.009	80.782
100 ppm	25.46 ± 0.94	18.16 ± 0.85	8.119 ± 0.088	1.450 ± 0.008	82.140	3.266 ± 0.008	0.625 ± 0.007	80.863

Values of 5 replicates ± SEM



**Fig 1:** Impact of waste biomass of *Salvinia cucullata* L. on different parameters of *Vigna unguiculata* L.

**Effect of biomass on growth parameters**

The comparative changes in the growth parameters were observed in *Vigna unguiculata* L. plants of 10, 20, 30 days old (developing stage) grown in pot culture treated with different concentrations of biomass (0-100 mg/kg of soil).

Some of the salient features of the present investigation are described as follows.

**Effects of biomass on growth parameters:** The root and shoot length also increased remarkably with increase in

concentrations. The root and shoot length of the seedlings treated with 100ppm was the highest as compared to all other treatments.

**Effect of biomass on Biochemical parameters of *Vigna unguiculata* L.:** The comparative changes in total chlorophyll content, and biochemical alterations (soluble protein content and free proline content) were observed in *Vigna unguiculata* L. plants of 10, 20, 30 days old (developing stage) grown in pot culture treated with different concentrations of biomass.

Total chlorophyll contents were increased with increase in concentration after 10, 20, 30 days of treatment on the plants. At 10 days after treatment it was observed that the total chlorophyll content were increased from control to 100ppm respectively. Similarly at 20 days after treatment it was observed that the total chlorophyll content were increased from control to 100ppm respectively and also at 30 days after treatment it was observed that the total chlorophyll content were increased from control to 100ppm respectively. Similarly in samples of 100 days after treatment, it was observed that the total chlorophyll content was increased from control to 100ppm respectively.

There was a gradual increase in protein content with rise in different levels of concentrations of waste biomass. Here protein content was produced in maximum amount when plants are subjected at treatment of 100ppm. and least amount when plants are subjected at treatment of control. Free proline contents were decreased with increase in concentration of waste biomass at 10, 20, 30 and 100 days after treatment on the plants. It was observed that the free proline content were decreased from control to 100 ppm respectively.

### Discussion

Effect biomass treatments in plant growth inhibition has been reported by many authors. Uptake of different organic substances by plants shows increasing growth and metabolism of plants. The present study provides the effect of waste biomass in growth and biochemical parameters of *Vigna unguiculata* L. seedlings with a potentiality of its tolerance after exposure to different concentrations of biomass. Seed germination was not much more affected by the presence biomass waste. Since, germination is the most crucial stage of plant development, the seed germination can be frequently used as an indicator of early response of the plants in the unfavourable environment<sup>[6]</sup>. In this study, results obtained from the germination studies indicated that *Vigna unguiculata* L. showed higher seedling growth and dry weight at 100 mg/kg of added biomass in the soil. The values of growth parameters indicated that waste biomass had a significant stimulating, beneficiary and nutritional effect at 100 mg/kg concentration. From the result of this investigation, it can be concluded that addition of waste biomass has a stimulating effect on the germination process and seedling growth of *Vigna unguiculata* L. Similar results were also found with the addition of waste egg shell. Waste egg shells can fulfil the mineral requirement for the growth of *Vigna mungo* L. plants as it enhanced the nutrient level in soil<sup>7</sup>. It was also observed that the soil which were treated with *Salvinia* waste contained more nutrient than the normal garden soil. So, *Salvinia molesta* D. S. Mitch. Waste can be recommended as the organic fertilizer which can fulfill the nutrient level of soil and enhance the soil fertility<sup>8</sup>. Similar

results also found in addition of *Azolla* as biofertilizer in growth of plants<sup>[9]</sup>.

### Conclusion

The values of growth and biochemical parameters indicated that addition of waste biomass of *Salvinia cucullata* L. had a significant stimulating, beneficiary and nutritional effect for *Vigna unguiculata* L. and all the parameters like germination of seed, growth and bio-chemical parameters are found to be increased with increasing concentration of added waste biomass. From the result of this investigation, it can be concluded that waste biomass of *Salvinia cucullata* L. can be used as biofertiliser for growing plants.

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