

Evaluation of growth promoting activity of *Pleurotus ostreatus* extract on *Trigonella foenum*, *Cicer arietinum*, *Brassica nigra*, *Coriandrum sativum*

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Abstract—Increase in the human population brings in a demand for large scale production of agricultural products to meet the needs. To minimize the loss in the production of plant products, due to pests, use of pesticides has become an unavoidable practice. The harmful impact of chemical pesticides has invariably brought in the necessity of biopesticide usage. As a result, a number of studies propose many herbal and natural plants extracts to replace the chemical pesticides. Mushroom extract has been proven to be an active biopesticide that can be used on the plants to control plant diseases. It has many low molecular and high molecular proteins, which are reported to be effective antimicrobial agents. Several plant pathogens have been identified to be susceptible to mushroom extract. Active compounds like ethyl 2-methylbutyrate, linalool, methional, 3-octanone from the extract are currently explored for preparations of biopesticides. Present study focuses on growth promoting activity of *Pleurotus ostreatus* mushroom extract on selected plants. Experiments were conducted to evaluate growth promotional activity of *Pleurotus ostreatus* extract on *Trigonella foenum*, *Cicer arietinum*, *Brassica nigra*, *Coriandrum sativum*. In potted plant experiments various concentrations of mushroom extract was tested in triplicates. It has been evident from the study that, with increasing concentration of mushroom extract, a selective growth promotion in *Trigonella foenum* was observed whereas a significant inhibition in growth was found with *Brassica nigra*, *Cicer arietinum*, *Coriandrum sativum*. A considerable change in the rhizosphere flora was also observed in the presence of mushroom extract which could have influenced the growth. The statistical analysis by ANOVA revealed a significant value $p < 0.05$, showing a significant impact of mushroom extract on growth in the selected plants.

Keywords— Mushroom extract, *Coriandrum sativum*, *Brassica nigra*, *Cicer arietinum*, *Trigonella foenum*.

I. INTRODUCTION

Mushrooms are a species of fungus which belong to the order of basidiomycetes or ascomycetes. They are ubiquitous and are known to have compounds that can prevent diseases such as hypertension, hypercholesterolemia, atherosclerosis, cancer and infections [1]. Mushrooms have β -D glucans such as Lentinan from *Lentinus edodes* and Schizophyllan from *Schizophyllum commune* that have antimicrobial, immunomodulatory, and anticancer properties. [2]. Volatile compounds such as 3-octanol, 1-octen-3-ol, benzoic acid and an unidentified trace component from oyster mushroom shows antibacterial activity against some bacterial strains. [3][4]

Due to its predominant anti microbial activity mushroom extract has been used as a potential pest control agent in case of plant diseases caused by bacteria and fungi. Antimicrobial activity of *Lentinus edodes* against the pathogenic fungal species was identified because of straight chain alcohol with double and triple bonds present in it [3]. Crude methanol

extract of *A. muscaria* has been reported to show contact toxicity, feeding deterrence, reproduction inhibition and repellency potentials against the pests *S. zeamais*. The insecticidal activity was attributed to the known constituents of *A. muscaria*. [4] [5]. Mushrooms have been known for the high nutritional contents like 35% proteins, all essential amino acids. Mushrooms are a good source of vitamins like niacin, ascorbic acid, riboflavin, thiamine, biotin, and minerals. [6][7]. Addition of spent mushroom substrate to the growth media along with peat showed an increase in pH values, salt contents, macro and micro nutrient concentrations and reduced water holding capacity that increased the seed germination of tomato, courgette and pepper. [8],[9] Increased plant growth and yield was reported with addition of 20-30% of spent mushroom compost in snapbean, cucumber, radish, spinach and tomato seedlings and plants. [10].

The present study aims to investigate the role of mushroom extract in plant growth if any when used as a biopesticide. The study evaluates the effect on growth of herbs *Trigonella*

foenum(Fenugreek), *Cicer arietinum* (chick pea), *Coriandrum sativum*(dhanya), *Brassica nigra* (mustard) in the presence of mushroom extract. Based on the impact of mushroom extract on the growth of plants it can be proposed for use in either plant growth promotion or as an inhibitory agent on plant pathogens.

II. RELATED WORK

Increased plant growth and yield were obtained with addition of 20 to 30% of spent mushroom compost ; plants grown at 50% spent mushroom compost exhibited some stunting.[11][12]The antagonistic activity of 17 species of xylophilic basidiomycotina against 4 fungi ,responsible for foot and root diseases of winter cereals.[13][14]

III. METHODOLOGY

A. Collection of Mushroom sample:

Samples of *Pleurotus ostreatus* mushroom were purchased from “S Mushroom agritech”. Mushrooms were cleaned with millipore distilled water and soil debris was removed. Cleaned mushrooms were sundried cut into bits and were powdered, stored in a air tight container[15][16].

B. Preparation of mushroom extract:

Mushroom samples (400g) were weighed in clean containers into which 4 liters of 100% acetone and methanol were added respectively. The mixture was left covered for 72 hrs by continuous stirring after which mixture was filtered using What mann No.1 filter paper (125mm).The extracts obtained were stored in refrigerator at 4°C.[17]

C. Evaluation of effect of mushroom extract on the germination:

The prepared mushroom extract was taken and different seeds (Fenugreek, Coriander, Chickpea, and Mustard) were mixed with different concentrations of 1%, 2%, 3%, 4%, 5% and were soaked overnight. After 24hrs the seeds were removed and covered in a moist cotton cloth and were observed for germination after 24 hrs.

D. Evaluation of effect of mushroom extract on the growth pattern of different plants:

Different seeds were selected for checking the impact of mushroom extract on germination. *Brassica nigra*, *Trigonella foenum*, *Cicer arietinum*, and *Coriandrum sativum*. Debris of the seeds were removed and they were soaked in different concentrations of mushroom extracts as 1%(1 ml in 100ml of water) ,5%(5 ml in 100 ml of water),10%(10 ml in 100ml of water), appropriate controls were set up .These plants were checked at regular intervals to evaluate the growth by measuring the shoot length, root length, number of lateral roots

and number of leaves. The results were evaluated statistically by ANOVA to determine the significance of treatment on growth.

E. Impact of mushroom extract on the rhizosphere microflora:

The treated garden soil with mushroom extract of different concentrations such as 1%, 5%, 10% were taken and after serial dilution, 0.1 ml of 10^{-5} , 10^{-6} , 10^{-7} dilutions were plated on PDA and Nutrient agar plates to enumerate bacteria and fungi by dilution plate technique.

IV. RESULTS AND DISCUSSION

Evaluation of effect of mushroom extract on germination of seeds

Earlier studies show an increased number and faster germination when the peat soil was mixed with mushroom compost. This could be attributed to the release of mobilized nutrients by the fungi and due to the chemical composition of the mushrooms. Therefore it would be relevant to study the role of mushroom extract on the germination of the selected plants. In the present study, percentage of seed germination after mushroom extract treatment was found as 52.8% in fenugreek , 4.2% in mustard,29.2% in coriander,22.8% in chickpea as depicted in Table [1].

From the Figure 1,the highest percentage of seed germination was found in fenugreek and percentage of inhibition was greater in seed germination was observed in mustard.

2) Evaluation of effect of mushroom extract on the growth of different plants:

The ANOVA test was applied to check any significant difference in growth of Chickpea plant and mustard plant with respect to Water, Control group and different type of Concentrations. Since $p < 0.05$, there is a significant difference in growth with respect .to different concentration level. Also, the experimental studies observed that there is no growth (in cm) of chickpea plant in concentration of 5% and 10%.Hence it would be necessary to standardize the concentration of mushroom extract specific to the plant species and determine the optimum concentration for growth [Table2].

ANOVA test applied to check any significant difference in growth of coriander plant and fenugreek plant with respect to Water, Control, and different concentrations showed a significant difference in growth with respect to different concentration level as the $p < 0.05$;[Figure 2,3,4,5,6]

3) Impact of mushroom extract on rhizoflora:

Mushroom extract is rich in nutrients that can influence the abundance of the microflora when added to the soil. Its antimicrobial activity on certain microorganisms makes it

essential to evaluate the effect of the extract on rhizosphere when added to soil [Table 3]. In the results obtained from the study, soil treated with 1%, 5%, 10% of mushroom extract, showed increase in the rhizobacteria when compared to control which was indicated in the evaluation of number of CFU by dilution plate technique. [figure 7]

V. CONCLUSION AND FUTURE SCOPE

Based on the studies it has been concluded that mushroom extract has both growth promoting and inhibiting properties depending on the concentrations. At lower concentrations it shows a significant promotion in the growth of plants in Fenugreek and simultaneously enhances the germination in seeds. However at higher concentrations there is not much significant impact on the growth.

In the ANOVA analysis of impact of mushroom extract on the growth of plants it has been seen that $p < 0.05$ which shows a significant difference in the growth of plants when compared to the control. It has been evident from the study that as the concentration of mushroom extract increases, rhizosphere microorganisms has been increased when compared to that of control. So based on studies conducted it has been seen that mushroom extract has selective promotion or inhibition on different plants, and a considerable increase in the microbial population of the soil.

Figures and Tables:

Table 1: Percentage of seeds germination after treating with mushroom extract

Plants	% Germination
Fenugreek	52.8
Mustard	4.8
Coriander	29.2
Chickpea	22.8

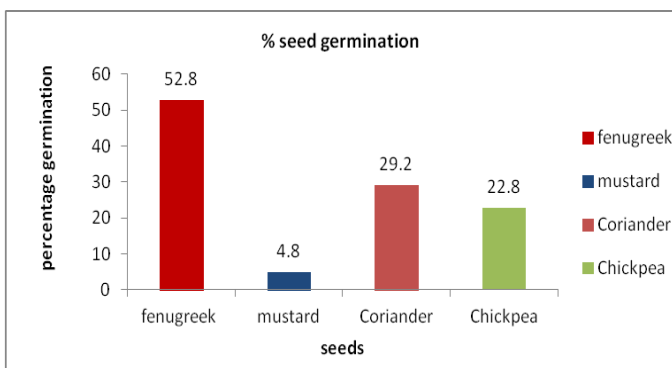


Figure 1: Represents the % of seed germination after mushroom extract treatment

Table 2: Time taken for the seeds to germinate from the day the seeds sown

Name of the seed	Only water	1%	5%	10%	Control
Fenugreek	1 day	2 days	No Growth	2days	2days
Coriander	8days	9days	9days	6days	2days
Mustard	1 day	2days	No Growth	No Growth	2days
Chickpea	4days	5days	No Growth	No Growth	3days

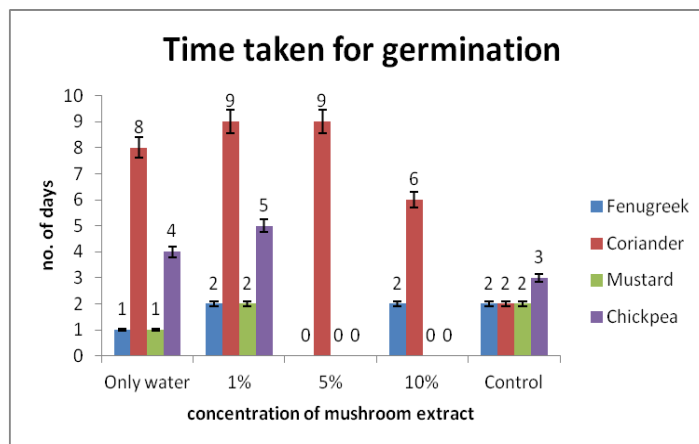


Figure 2: Time taken for seeds to germinate after treating with mushroom extract

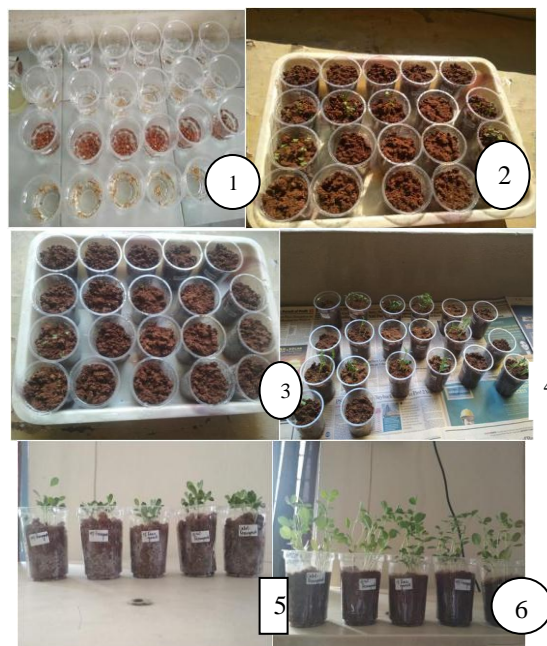


Figure 3: 1) Seeds soaked in different concentrations of mushroom extract, 2) Day 1 from the day fenugreek seeds sown, 3) Day 2 from the day seeds with mushroom extract are sown, 4) Day 5 from the day seeds treated with mushroom

extract are sown,5) Day 5 from the day the seeds treated with mushroom extract are sown,6) day 25 from the day fenugreek seeds treated with mushroom extract are sown.

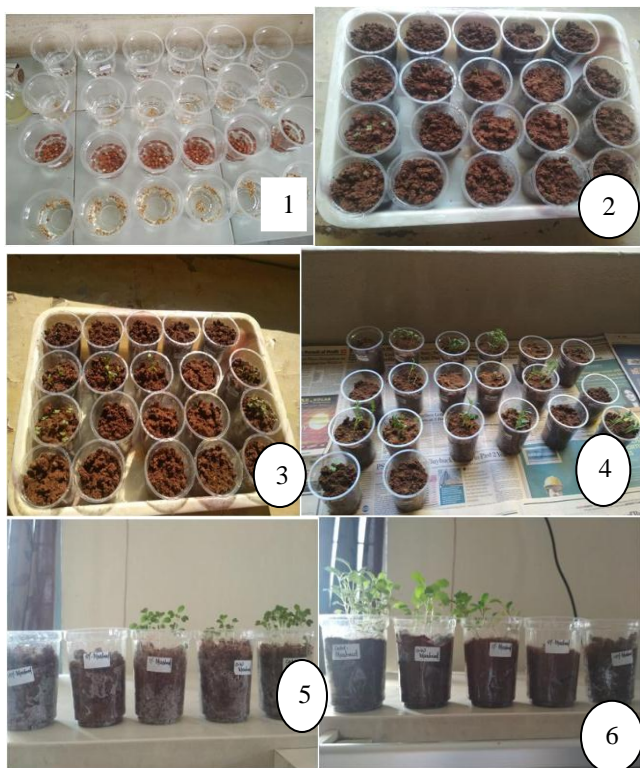


Figure4: 1)seeds soaked in different concentrations of mushroom extract ,2) Day 1 from the day Mustard seeds sown, 3)Day 2 from the day seeds with mushroom extract are sown ,4)Day 5 from the day seeds treated with mushroom extract are sown. 5) Day 5 from the day the seeds treated with mushroom extract are sown,6) day 25 from the day Mustard seeds treated with mushroom extract are sown



Figure5: 1)seeds soaked in different concentrations of mushroom extract ,2) Day 1 from the day Chickpea seeds sown, 3)Day 2 from the day seeds with mushroom extract are sown ,4)Day 5 from the day seeds treated with mushroom extract are sown. 5) Day 5 from the day the seeds treated with mushroom extract are sown,6) day 25 from the day Chickpea seeds treated with mushroom extract are sown.



Figure 6: 1)Seeds soaked in different concentrations of mushroom extract ,2) Day 1 from the day Coriander seeds sown, 3)Day 2 from the day seeds with mushroom extract are sown ,4)Day 5 from the day seeds treated with mushroom extract are sown. 5) Day 5 from the day the seeds treated with mushroom extract are sown,6) day 25 from the day Coriander seeds treated with mushroom extract are sown.

Table 3:No. of CFU/ml in soil treated with different concentrations of mushroom extract.

Mushroom extract (ME)	Mustard	Fenugreek	Chickpea	Coriander
control	24300	25200	21600	24900
1% ME	140820	129480	145660	141510
5% ME	154680	117793	116146	112873
10% ME	138506	25506	127390	126830

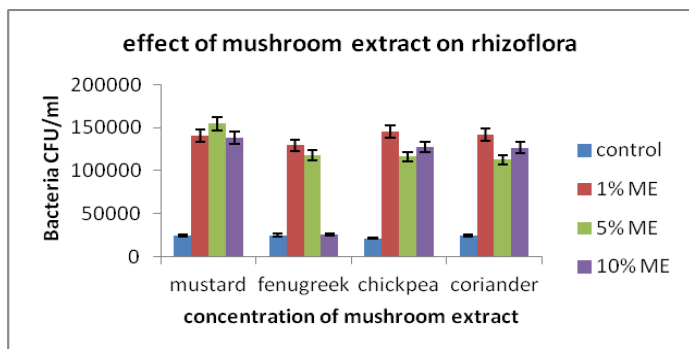


Figure 7: Effect of mushroom extract on the rhizoflora of mushroom treated soil.

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