Synthesis of Silver Nanoparticles by Chemical and Biological Method and Study of Seed Germination

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ABSTRACT

Invasive weeds dominate native plants by affecting allelopathic potential of plants. Nanotechnology has wide range of applications in various fields. Silver nanoparticles (AgNP) were synthesized by chemical as well as biological reduction method using aqueous plant extract (Altenanthera, ALT and Euphorbia, EUG). The allelopathic potential of synthesized silver nanoparticles was screened for seed germination bioassay that indicates the seed germination assay, root and shoot length root-shoot ratio for moongbean for different concentrations.

Keyword: AgNP, Altenanthera, Euphorbia, Seed germination

1. INTRODUCTION

Nanotechnology has a large scope of applications in various fields such as biotechnology, agriculture, chemical medicine etc, because of their unique physicochemical properties. The nanoparticles exert effect on plant growth and development. Different chemical and physical processes are widely used for their synthesis.[1-3] However, these methods are usually expensive and are affecting the environment, so cost effective environmentally safe methods are required for synthesis of nanoparticles. Many biological systems are used for green synthesis of nanoparticles. The plant biomolecules reduce metal salt during Np synthesis.[4-5]

In the present work silver nanoparticles (AgNP) were synthesized by chemical and biological reduction methods. The synthesized AgNP were screened for their impact on seed germination assay on moongbean.[6]

2. EXPERIMENTAL

Chemical synthesis

Silver nitrate solution was prepared in conductivity water, which was then used for reduction of silver ions. Sodium citrate solution was added drop by drop to silver nitrate solution with constant stirring. This solution was then heated for 1 hr. A clear solution turns golden yellow indicating formation of silver nanoparticles.

Biological synthesis

Dried plant powder was added to 20 ml conductivity water, boiled for 5 minutes. Silver nitrate solution was prepared and to this plant extract was added drop wise with constant stirring. Reddish brown color was observed indicating the formation of nanoparticles.

Seed Germination Assay

Healthy moongbean seeds were used for seed germination assay. Chemically and biologically synthesized AgNP’s were examined on moongbean. From the stock solution
of synthesized AgNP’s solutions with various concentrations were prepared and used for assay with water as control. The seeds of moongbeans were thoroughly washed with conductivity water. Sterilized petri-plates lined with germination papers were used. Root, shoot length and percent seed germination was measured on 2\textsuperscript{nd} and 3\textsuperscript{rd} day.

3. RESULTS AND DISCUSSION

Silver nanoparticles (AgNP) were chemically and biologically synthesized. Synthesized AgNP’s were characterized by XRD, TEM and FESEM. UV-Vis spectroscopy revealed the presence of silver nanoparticles.

The seed germination was examined on 3\textsuperscript{rd} day. Root and shoot length was measured. It was estimated that 50\% seeds were germinated by the control while low concentration i.e. 2 ppm of all three solutions of chemically synthesized and biosynthesized AgNPs on moongbean seeds resulted high percentage of seed germination than that of the control. All the results had been estimated on 3\textsuperscript{rd} day. Results of the same are presented in figure 1 and 2 and Table 1. Results showed that AgNPs at lower concentration acts as growth promoter, while at higher concentration they are toxic to plants.

Table 1: Effect of biological and chemical synthesized AgNP on moongbean seed germination assay.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Alternanthera</th>
<th>Euphorbia</th>
<th>chemical Synthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2ppm</td>
<td>4ppm</td>
<td>8ppm</td>
<td>2ppm</td>
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<tr>
<td>Root Length</td>
<td>4.6</td>
<td>6.9</td>
<td>5.7</td>
<td>4.6</td>
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<tr>
<td>Shoot Length</td>
<td>9.1</td>
<td>10.4</td>
<td>8.4</td>
<td>6.4</td>
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<tr>
<td>% germination</td>
<td>50</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
</tbody>
</table>

Figure 1: Effect of biological and chemical synthesized AgNP on moongbean seed germination assay.
1. Figure 2: Seed germination with 1. chemical synthesized 2. Alternanthera 3. Euphorbia synthesized AgNP’s.

4. CONCLUSIONS

A simple, fast and efficient method was adopted for synthesizing silver nanoparticles in an eco-friendly manner. Chemically synthesized AgNPs were produced using sodium citrate by chemical reduction of Ag(I) ions to Ag(0). Bio-reduction of Ag(I) to Ag(0) was done using plant extract of individual plants Alternanthera tenella and Euphorbia geniculata. Low concentration of bio-synthesized and chemically synthesized AgNPs promoted seed germination than that of the control while high concentration of AgNPs inhibit seed germination and might be toxic to seeds.

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REFERENCES