Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*

Wu Weijia, Sun Taoze, Zeng Longjun and Mu Hongna*

*College of Horticulture and Gardening, Yangtze University, Jingzhou, Hubei, China*

*Corresponding Author*: Mu Hongna, College of Horticulture and Gardening, Yangtze University, Jingzhou, Hubei, China.

**Received**: August 23, 2019; **Published**: September 30, 2019

**DOI**: 10.31080/ecag.2019.05.00209

**Abstract**

In this paper, the effects of inoculation of *P. indica* on the growth of *Oenothera biennis* had been carried out in greenhouse. During the whole experimental process no application any chemical fertilizer except for water supply. The results showed that the inoculation of *P. indica* can promote the growth of *O. biennis*. The soluble sugar content, chlorophyll, soluble protein content, total glomalin content and easy-to-extract glomalin content were higher than control. The biomass (fresh and dry weight, plant height, leaves number) of inoculated group was much higher compared with the control. The soluble sugar was the significantly different between inoculated group and control. Our finding illustrated that *P. indica* can prompt the growth and increase some soluble compound content for *O. biennis*.

**Keywords**: *Piriformospora indica*; *Oenothera biennis*; inoculation effect; GRSP

**Introduction**

*Piriformospora indica*, a genus of the genus Basidiomycetes of the genus Basidiomycetes, was discovered in 1998 by Indian scientist Verma in the Thar Desert of northwest India [1,2]. It is an endophytic fungus different from mycorrhizal fungi. It is easy to culture and can colonize a variety of plant roots, promote the absorption of nutrients in the soil by plants and has a significant growth-promoting effect on host plants [1,3,4]. In addition, there were positive effect on plants resistance to abiotic stresses (such as high salt, drought and heavy metals) and biotic stress (plants to various diseases), increase crop yield finally [6-10]. In view of its obvious promoting effect, the is getting more and more attention from researchers [4].

*Oenothera biennis* L., belong to Onagraceae family, commonly known as evening primrose, is distributed natively in North America. There are numerous therapeutic value, such as anti-inflammatory, hypotensive, astringent and sedative, which has been applied in ordinary therapeutic action in North American [12]. The gallic acid, extracted and purified from the seeds of *O. biennis*, possess anti-tumor potential [13]. It was reported that new Oenotheralanosterol A and B constituents isolated from *O. biennis* root [14]. There are diverse phytochemicals in *O. biennis* organs, those active ingredients play vital role in keeping human health. In addition, the ornamental value, beautiful and fragrant flower, is the second important trait.

Seeing that the excellent character of *O. biennis* and the profitable fungi strain, new question emerge, is there any good effect of *P. indica* on *O. biennis* phytochemicals? Then a pre- experiment had been carried out to explore the above question.

**Materials and Methods**

**Material**

*O. biennis* seeds were utilized as plant material. Seeds was sterilized in 75% ethanol and washed with sterile water. Then sowed in sterilized soil (121°C, 30 minutes, sterilized twice) and set in greenhouse in Spring season in 2019. When two true leaves unfolded, the
Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*

seedlings were planted in plastic pot filled with sterilized soil (from deep soil of forest farm, with less fertility), cultivated in greenhouse still. One week later, *P. indica* hypha was added (0.4g fresh hypha per kilogram soil) except control pots. During the whole experimental procession, offered water at regular intervals, without additional mineral elements.

**Methods**

The harvested plant were take the height, fresh weight, dry weight. Fresh leaves were detected chlorophyll content, by dimethyl sulfoxide extraction method [15]. The soluble protein content was determined by Coomassie Brilliant Blue G-250 staining method [16]. The soluble sugar content was determined by fluorone colorimetric method [17,18]. The content of total glomalin-related soil protein (T-GRSP) and easily extracted glomalin-related soil protein (EE-GRSP) was determined by WRIGHT [19,20].

**Data statistics and analysis**

Data statistical analysis was performed using SPSS software.

**Results**

**Inoculation effect of *P. indica* on the growth of *O. biennis***

After 80 days of inoculation with *P. indica*, the effect on the growth of *O. biennis* was listed in table 1. As for fresh weight and dry weight, those inoculated plant were 26.7% and 58.59% higher than control respectively. Leaves number had increased by 18.96%. Plant height increased by 1.05 cm compared to control, which is equivalent to an increase of 15.92%.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh weight (g)</th>
<th>Leaves number</th>
<th>Dry weight (g)</th>
<th>Plant high (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>9.53</td>
<td>15.83</td>
<td>1.28</td>
<td>12.12</td>
</tr>
<tr>
<td><em>P. indica</em></td>
<td>12.07</td>
<td>18.83</td>
<td>2.03</td>
<td>14.05</td>
</tr>
</tbody>
</table>

*Table 1: The effect of *P. indica* on growth of *O. biennis* after inoculated 80days.*

**Inoculation effect of *P. indica* on the quality of *O. biennis***

The effect of *P. indica* on *O. biennis* quality was illuminated as following. The soluble protein content in leaves was 28.60% in *P. indica* inoculated plant higher than control (Figure 1). The chlorophyll and soluble sugar content increased 13.98% and 78.71% respectively compared with the control (Figure 2). Compared with control, total glomalin content and easy extraction of glomalin content significantly increased 41.16% and 24.26% respectively (Figure 3).

![Figure 1: The effect of *P. indica* on soluble protein content of *O. biennis*.](image)

Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*

Discussion

*P. indica* can interact with plant roots to form symbiosis, which promotes the absorption of nutrients by plant roots and promotes plant growth [21,22]. In our experiment, plant height, fresh and dry weight were promoted, which presented there must exist positive interaction between *O. biennis* root and *P. indica*.

*O. biennis* chlorophyll content was higher in inoculated plant. It was reported that chlorophyll is mainly synthesized by nitrogen and phosphorus P elements in soil [23] while *P. indica* accelerates the synthesis of chlorophyll by accelerating the absorption of minerals such as nitrogen and phosphorus [24]. The chlorophyll content of *O. biennis* inoculated by *P. indica* was higher than control. High chlorophyll can improve photosynthetic capacity. More leaves, higher soluble sugar and soluble protein were ascribed to high chlorophyll to some extent.

---

**Citation:** Mu Hongna, *et al.* “Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*”. *EC Agriculture* 5.10 (2019): 628-633.
The soluble sugar content was the most outstanding matter in this experiment, which increased reaching 78.81%. The soluble sugar is one of the important constituent of plant quality, which reflect the resistance of plant to stress [25]. *O. biennis* was cultivated in greenhouses (located on the top of our Laboratory Building) and the temperature is extremely high. *O. biennis* can grow well, which must be closely related to high soluble sugar and other soluble contents in plant.

Glomalin-related soil protein (GRSP), produced by soil fungi, plays crucial roles in the global carbon cycle and improves soil quality. GRSP and soil organic carbon (SOC) contribute to the formation and stability of soil aggregates [26]. “Soil” aggregates improve the physicochemical characters of soil, then plants that rooted in the soil are beneficiaries. In this paper, the treatment group inoculated with *P. indica*, both biomass and inner physiological index (soluble sugar and protein, chlorophyll) were higher than control, which contribute to higher contents of GRSP.

The use of GRSP has been suggested as a biological indicator of soil quality, because it undergoes limited decomposition and has low sensitivity to environmental fluctuations [27]. However, GRSP contents were affected by urbanization [28], high manure amendments [29], the deep of soil layers, plant diversity and climate condition [30]. In this paper, the soil condition was similar when experiment began. The difference between control and treatment groups was ascribed to the inoculation of *P. indica*.

**Conclusion**

This experiment found out inoculation of *P. indica* can accelerate the growth *O. biennis*, which illustrated by more plant biomass (fresh weight, dry weight, plant height) and inner soluble compound in treatment group. Meanwhile, soluble sugar was significantly promoted by inoculation of *P. indica* (p < 0.05). In addition, the GRSP content of inoculated group was higher than control group. So, conclusion that there was positive interaction between *P. indica* and *O. biennis* can be draw. It will be amazing in application *P. indica* in *O. biennis* cultivation, as soon as prospects is concerned.

**Conflicts of Interest**

The authors declare there is no conflicts of interest.

**Bibliography**


**Citation:** Mu Hongna., *et al.* “Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*”. *EC Agriculture* 5.10 (2019): 628-633.
Inoculation Effect of *Piriformospora indica* on *Oenothera biennis*


