INHIBITORY EFFECT OF MEDIATIONAL BOTANICAL EXTRACTS AGAINST ROOT ROT OF MUSKMELON CAUSED BY PHYTOPHTHORA DRECHSLEI (TUCKER)

M. Z. Anjum, M. U. Ghazanfar and S. Hayat
Department of Plant Pathology, University College of Agriculture, University of Sargodha, Pakistan

ABSTRACT

Phytophthora drechsleri (Tucker) causing root rot of muskmelon is a threatening pathogen in Pakistan. Non-chemical control based on the use of plant extracts are considered the best alternatives of noxious chemical pesticides as they are considered to be eco-friendly with no or minimal residual effects. The results of all tested botanicals suppressed the mycelial growth of pathogen. Extract of garlic (Allium sativum) showed maximum (86.5%) mycelial growth inhibition of root rot pathogen, followed by parthenium (Parthenium hysterophorus) (82.8%) and datura (Datura stramonium) (82%) at 30% concentration, while minimum inhibition was shown by Aak (Calatropis procera) (42.8%). These results suggested that plant extracts can be used as an alternative to chemicals for the management of root rot of muskmelon.

Keywords: antifungal, muskmelon, plant extracts, Phytophthora drechsleri

INTRODUCTION

Muskmelon (Cucumis melo L.) is an important fruit in world’s fresh fruit market (Mabalaha et al., 2007). Many diseases cause severe losses to this crop but root rot caused by Phytophthora drechsleri (Tucker) is economically important disease of muskmelon in Pakistan (Majid et al., 1994). Management of fruit crop diseases through chemicals gave rapid control but their regular usage creates resistance in pathogen, hazardous to human health and environmental problems. World is moving to organic farming, so there is a need of alternatives which are non-toxic, environmental friendly and having long term effectiveness against pathogens. Plant extracts have great potential as an alternative to noxious chemicals. Antibacterial and antifungal potential of plant extracts gained the attention of researchers throughout the world. During last two decades, many scientists worked on biocidal potential of botanicals (Tegegne et al., 2008). Use of plant extracts is environmentally safe approach as compared to chemicals (Kumar et al., 2008; Masih et al., 2014). Plant extracts such as Xanthium strumarium (Kim et al., 2002), Cinnamomum zelanicum (Abdolmaleki et al., 2008) and Carumcarvi, Pinus halepensis, Zataria multiflora (Abdolmaleki et al., 2010) have been reported to suppress the mycelial growth of P. drechsleri. Cabbage, garlic and alfalfa extracts have showed antifungal activity against P. capsici (Demirci and Dolar, 2006). The objective of present study was to evaluate the plant extracts against root rot of muskmelon for its sustainable management.

MATERIALS AND METHODS

Collection, Isolation and identification of pathogen

Diseased samples were collected from muskmelon growing area of district Jhang 30°35’N and 71°39’E, Punjab, Pakistan. The samples were kept in zip bags and brought to laboratory for further processing. Isolation was performed from root samples on PARP medium (corn meal agar 17 g L⁻¹, 0.4 ml Pimaricin L⁻¹, 0.25 g Ampicilline L⁻¹, 0.01 g Rifampcin L⁻¹, 5 mL Pentachloronitrobenzene (PCNB) L⁻¹, 1 mL Dimethylsulphoxide (DMSO) L⁻¹) by using tissue segment method (Rangaswamy, 1958). The pathogen was identified based on cultural and morphological characteristics described in literature (Bush et al., 2006; Jadesha, 2014). The pathogen was identified based on cultural and morphological characteristics described in literature (Bush et al., 2006; Jadesha, 2014). Culture was maintained on PDA (potato starch 4 g L⁻¹, agar 20 g L⁻¹ and dextrose 20 g L⁻¹) and stored at 4°C for further use.
Preparation of plant extracts
Fresh leaves of eight different plants, healthy fruits of chilli and cloves of garlic were collected locally from the area of University College of Agriculture, University of Sargodha (Table 1). The plant parts were washed with tap water in order to remove surface dust/pollutants. Leaves of all tested plants were blended in water with 1:1 (w/v) to obtain its crude extract. Chilli fruits and garlic cloves purchased from local market were blended in water with 1:1 (w/v) and crude extracts were passed through double layer of muslin cloth and filtered with Whatman filter paper No.1 in 250 ml Pyrex flasks. The extracts were centrifuged at 10000 rpm for 5 minutes and supernatant was sterilized at 40°C for 10 min to avoid the risk of contamination and stored at 4ºC for further use (Jaganathun and Narasimhan, 1988; Ramaiah and Garampalli, 2015).

Table 1. List of plant species used for evaluating their antifungal activity against mycelial growth of P. drechsleri

<table>
<thead>
<tr>
<th>Common/Local name</th>
<th>Botanical name</th>
<th>Family</th>
<th>Plant part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aak</td>
<td>Calatropis proceras</td>
<td>Asclepiadaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Beri</td>
<td>Ziziphus mauritiana</td>
<td>Rhamnaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Chilli</td>
<td>Capsicum annuum</td>
<td>Solanaceae</td>
<td>Fruit</td>
</tr>
<tr>
<td>Datura</td>
<td>Datura stramonium</td>
<td>Solanaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Garlic</td>
<td>Allium sativum</td>
<td>Liliaceae</td>
<td>Cloves</td>
</tr>
<tr>
<td>Kaner</td>
<td>Nerium oleander</td>
<td>Apocynaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Niazbo</td>
<td>Ocimum basilicum</td>
<td>Lamiaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Parthenium</td>
<td>Parthenium hysterophorus</td>
<td>Asteraceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Sisal</td>
<td>Agave sisalana</td>
<td>Asparagaceae</td>
<td>Leaves</td>
</tr>
<tr>
<td>Thyme</td>
<td>Thymus vulgaris</td>
<td>Lamiaceae</td>
<td>Leaves</td>
</tr>
</tbody>
</table>

Statistical analysis
The statistical analysis was carried out using R.3.0.3- Statistical package. Two factor factorial analyses were used for the interpretation of the results. Each set of experiment was repeated three times independently. The inhibition over control percentage (%) was determined by using the formula and the treatment means were separated by using LSD (Gomez and Gomez, 1984). Inhibition over control percentage (%)= C-T/C×100 where C= mycelial growth of pathogen in control, and T= mycelial growth of pathogen in dual culture.

RESULTS
Pathogen inhibition by plant extracts
Aqueous extracts of ten different plant species were tested at different concentrations (10, 20 and 30%) against P. drechsleri under laboratory conditions. Extracts (F9, 180 = 1534.16, P< 0.001), concentrations (F9, 180 = 3053.46, P< 0.001) and days (F9, 180 = 947.19, P< 0.001) effect was highly significant. Interactions of extract and concentrations (F18, 180 = 17.05, P< 0.001), interaction of extracts and days (F9, 180 = 59.14, P< 0.001), interaction of concentrations and days (F9, 180 = 69.70, P< 0.001) and interaction among extracts, concentrations and days (F9, 180 = 5.92, P< 0.001) were also significant. According to our findings, extracts of all tested plant spp. inhibited the mycelial growth of P. drechsleri. Maximum inhibition showed by A. sativum (86.5%), P. hysterophorus (82.8%) and D. stramonium extracts (82.0%), followed by A. sisalana (77.5%), T. vulgaris (74.7%), C. annuum (69%) and O. basilicum (51.5%). While less than 50% mycelial inhibition showed by N. oleander (47.7%), Z. mauritiana (43.5%) and C. procera (42.8%), respectively. Results also showed that concentrations at 10% of P. hysterophorus and A. sativum extracts have great potential to inhibit the pathogen (Table 2).

DISCUSSION
Antifungal ability of different plant species has been tested on different soil borne fungi and viruses (Kuc and Shain, 1977; Beckman et al., 1981; Bahraminejad et al., 2012; Shafique, 2012; Bahraminejad et al., 2013). The present results provided insights that plant extracts (Table 1) significantly inhibited the mycelial growth of pathogen.
The aqueous extracts of *P. hysterophorus*, *A. sativum*, *T. vulgaris* and *D. stramonium* showed mycelial growth inhibition of *P. drechsleri*, which directly correlates to results of different authors (Tariq and Magee, 1990; Kshemkalyani et al., 1990; Singh et al., 1992; Reimers et al., 1993; Naganawa et al., 1996; Avato et al., 2000; Kyung and Lee, 2000). The anti fungal effects of *P. hysterophorus*, *A. sativum*, *D. stramonium* and *T. vulgaris* leaf extracts of these species and found that these plants have a great potential to control the soil borne fungal pathogens. Ajowe is *A. sativum* derived compound that have ability to restrict the growth of many fungi. In present study, extract of *A. sativum* showed maximum inhibition of *P. drechsleri* mycelial growth, which may be due to ajowe. Results of Abeke et al. (2006) also matched with our findings, they concluded that 3% garlic extract inhibited the growth of Phytophthora isolates. Aqueous extract of Parthenium have great potential to inhibit the growth of fungal pathogens, it showed maximum mycelium inhibition zone at 1% concentration against *F. solani* (Bajwa et al., 2003; Shafique and Shafique, 2012). Antifungal activity of datura and thyme against soil borne pathogens has been reported by Zaker (2014), Sahu et al. (2015). Sarpong (2016) reported the antifungal impact of neem extract against Phytophthora species, which also correlates to the results of present study. *Z. mauritiana* contains many bioactive compounds like cardiac glycosides, tannins, polyphenols and saponins, and its leaf extract totally inhibits the spore formation of *F. solani* at 20% concentration (Abu-Taleb et al., 2011). The current investigation showed that extract of *Z. mauritiana* could not inhibit the mycelial growth of *P. drechsleri* significantly even at 30% concentration which might be due to less effectiveness of bioactive compounds produced by *Z. mauritiana* against tested pathogen.

Datura leaf extract inhibited the mycelial growth and spore germination of *Alternariaalternate* (Bagri et al., 2011) and *Phytophthora infestans* (Abayhne and Chauhan, 2016). Overall, the present study provided insights into the utilization of plant extracts to manage the plant pathogenic *P. drechsleri* and potential replacement of hazardous chemical fungicides.

**CONCLUSION**

The present study demonstrated that crude extracts prepared from different plants provide significant suppression of fungal pathogen and showed the potential to combat the soil borne pathogens. The utilization of plant extracts to control fungal diseases is opening new insights to replace the health hazardous synthetic chemicals. The results suggested the use of these environmental friendly methods to develop a healthy society and resolve the food security issues.

**REFERENCES**


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