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# HOST RANGE TEST OF SELECTED ISOLATES OF *Rhizoctonia solani* INFECTING COTTON SEEDLINGS

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## ABSTRACT

An *in vitro* experiment and a pot experiment were conducted to find out the variation in host range of ten selected isolates of *Rhizoctonia solani* infecting cotton seedlings. Fourteen crop species commonly grown in Bangladesh were tested in the experiments. The crop species were rice (*Oryza sativa*), wheat (*Triticum aestivum*), maize (*Zea mays*), jute (*Corchorus capsularis*), mungbean (*Vigna radiata*), grasspea (*Lathyrus sativus*), lentil (*Lens culinaris*), bushbean (*Phaseolus vulgaris*), chilli (*Capsicum annum*), cauliflower (*Brassica oleracea var botrytis*), carrot (*Daucus carota*), bottlegourd (*Lagenaria seceraria*), potato (*Solanum tuberosum*) and sesame (*Sesamum indicum*). Variations were found in their pathogenicity on cotton seedlings and on 14 other crop species causing damping off and seedling mortality. All 14 crop species tested in the study were found susceptible to highly susceptible to the isolates of *R. solani* but their susceptibility was variable. The isolates caused averages of 22.33 to 52.67% seedling mortality. The maximum seedling mortality was found in bushbean, which was followed by chilli, bottlegourd, mungbean, jute, grasspea, cauliflower and sesame showing 52.67, 48.66, 45.06, 41.98, 41.98, 37.66, 37.01 and 34.99% mortality, respectively. The lowest seedling mortality was found in maize preceded by rice.

**Key word:** Cotton, seedling disease, *Rhizoctonia solani*, Host range

## INTRODUCTION

Cotton is an important cash and industrial crop in Bangladesh. Two types of cotton namely upland cotton or American cotton (*Gossypium hirsutum*) and hill cotton or Comilla cotton (*Gossypium arboreum*) are grown in the country. American cotton can be grown in high land areas throughout the country. Occurrence of cotton damping off was first reported by Talukder (1974). Its occurrence was confirmed by Ahmed and Hossain (1985). *R. solani* is the primary pathogen of cotton seedling causing pre- emergence as well as post-emergence damping -off disease complex in Bangladesh. The host range of *R. solani* is extensive. The pathogen is capable of causing seedling damping-off, root rot, collar rot, stem canker, crown rot, bud and fruit rots, and foliage blight on a variety of agriculturally important susceptible crops ( Baker, 1970 and Anderson, 1982) like soybean (*Glycine max* L.; Merr.; Liu and Sinclair, 1991), cotton (*Gossypium hirsutum* L.; Brown and McCarter, 1976), canola (*Brassica campestris* L.; Yitbarek *et al.*, 1987), wheat (*Triticum aestivum* L.; Wiseman *et al.*, 1995), beet (*Beta vulgaris* L.; Carling *et al.*, 1987), potato (*Solanum tuberosum* L. sub sp. *tuberosum*; Escande and Echandi, 1991) and rosemary (*Rosemarinus officinalis* L.; Conway, *et al.*, 1997). *Rhizoctonia solani* also infects a number of turfgrass species (Couch, 1995). The fungus was first identified as the causal agent of a disease known as *Rhizoctonia* blight (brown patch) on creeping bentgrass (*Agrostis palustris* Huds.) in 1913 (Burpee and Martin, 1992; Couch, 1995) and has become regarded as one of the most destructive diseases of both warm- and cool-season .

Yan *et al.* (1984) collected *R. solani* isolates from wheat, rice, maize, cotton and found pathogenic variations. Nelson *et al.* (1996) collected 98 isolates of *R. solani* from roots and stems of soybean and classified into four anastomosis groups. They found that AG-5 was less virulent on soybean than AG-2-2 and AG-4. Sugar beet seedlings were highly susceptible to AG-2-2 and AG-4 but slightly susceptible to AG-5. Dry bean, mustard and flax seedlings were susceptible to AG-2-2 and A G-4. Dry bean and flax were slightly susceptible to AG-5. Yang *et al.* (1996) studied 130 isolates of *R. solani* under AG-9 and found that all the isolates were mildly virulent to canola; two isolates were highly

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virulent to cauliflower and moderately virulent to flax. The isolates were virulent to alfalfa, pea, tomato, wheat, barley, date and bromegrass. It causes disease in a broad range of host plants. Pathogenicity studies reveal that individual *R. solani* isolates can be highly pathogenic to one or several plant species, while they are unable to infect others (Richer and Schneider, 1953; Parmeter, 1970; Anderson, 1982; Ogoshi, 1987 and Adams, 1988). Thus the present study aims to test the host range of selected isolates of *R. solani* infecting cotton seedlings.

## MATERIALS AND METHODS

An *in vitro* experiment and a pot experiment were conducted to find out the variation in host range of ten selected isolates of *R. solani* infecting cotton seedlings at Pathological Laboratory and in front of laboratory in Bangabandhu Sheikh Mujibur Rahman Agricultural University in Gazipur, 2008. Fourteen crop species commonly grown in Bangladesh were tested in the experiments. The crop species were rice (*Oryza sativa*) wheat (*Triticum aestivum*) maize (Zea mays), jute (*Corchorus capsularis*), mungbeabean (*Vigna radiata*) grasspea (*Lathyrus sativus*), lentil (*Lens culinaris*), bushbean (*Phaseolus vulgaris*), chili (*Capsicum annum*), cauliflower (*Brassica oleracea* var *botrytis*), carrot (*Daucus carota*), bottlegourd (*Lagenaria seceraria*), potato (*Solanum tuberosum*) and sesame (*Sesamum indicum*). Fifty isolates of *R. solani* collected from the districts of Gazipur, Dhaka, Rangpur, Pabna, Kushtia, Meharpur, Natore, Banderban and Rangamati were classified into five groups based on multivariate analysis. Ten isolates were selected from 50 taking at least one from each group. The selected isolates were BTH-3, BSA-5, RCO-9, RSA-11, BRU-16, BSA-21, KPR-33, KDO-35, NLA-36 and GKA-29.

***In vitro* experiment to test pathogenicity of ten isolates of *R. solani***

The *in vitro* experiment was conducted following direct inoculation technique using 2% water agar as suggested by Yang *et al.* (1996). Selected ten isolates were grown on PDA in 90 mm petri dish at 27°±2°C separately. After 2 days of incubation, 5 mm discs of the culture containing mycelium of individual isolate was prepared using 5 mm cork borer.

Water agar (WA) was prepared by mixing 20 g agar powder in 1000 ml distilled water. The agar was thoroughly mixed with water and the mixture was cooked until the agar melted. Water agar plate was prepared by pouring 20 ml WA at 48°C in 90 mm petridish. The WA was allowed to cool and solidify. After solidification, each of the plates was inoculated with one mycelial block. The inoculum was placed at the centre of each plate. Seeds of all crop species were surface sterilized with 1% NaOCl solution for 10 minutes and subsequent rinsing in sterilized water for three times. Ten surface sterilized seeds of each crop were placed around the inoculum maintaining uniform distance. All inoculated plates were incubated at room temperature 27°±2°C for 15 days. The plates were arranged on a Laboratory desk following completely randomized design with three replications (plate). The incubated plates were checked every day to record data on seed decay and seedling mortality and continued for 15 days.

**Pot experiment to test pathogenicity of isolate of *R. solani***

A pot experiment was conducted following soil inoculation technique (Tuite, 1969) to find out host range of the selected isolate of *R. solani* BSA-5. Selected 14 crops were included in the experiment.To prepare inoculum of the isolate, wheat grain were soaked in water for 12 hours and 100g of water soaked grains were poured into 500ml Erlenmeyer flask and autoclaved for sterilization. Mycelial disks (5mm in diameter) were cut from the edge of 2-3 days old colonies of the test isolates grown on PDA. Four to five mycelial discs were placed into each of the flasks containing autoclaved wheat grains. The inoculated wheat grains were incubated at 27°±2°C for 2 weeks. For uniform colonization of wheat grains the flasks were shaken by hand at 2-3 days interval. At the end of the incubation period the colonized wheat grains were air dried and stored at 4°C until used (Yang *et al.*, 1996). Soils of the experiment were prepared and sterilized following the procedures mentioned earlier. Four earthen pots were used for each crop. Each earthen pot was filled with 3 kg sterilized soil. 20g inoculum/kg soil of each isolate of *R. solani* was thoroughly mixed with the pot soil and each crop species were sown in

three replicated pots for each treatment. Data on pre-emergence and post-emergence seedling mortality were recorded at 10 and 30 days after sowing.

## RESULTS AND DISCUSSIONS

***In vitro* host range test of ten isolates of *R. solani***

All ten selected isolates of *R. solani* infecting cotton seedlings attacked all 14 crop species tested in the present study causing seedling disease complex. On water agar in petridish they cause decay of ungerminated seeds, pre- and post-emergence mortality of seedlings of different crops (Fig. 1A&B, 2A&B and 3A&B). Seedling mortality varied with the variations of isolates as well as crop species. The highest seedling mortality was caused by BSA-5 (49.9%), which was followed by RCO-9 (49.3%) and RSA-11 (48.4%)

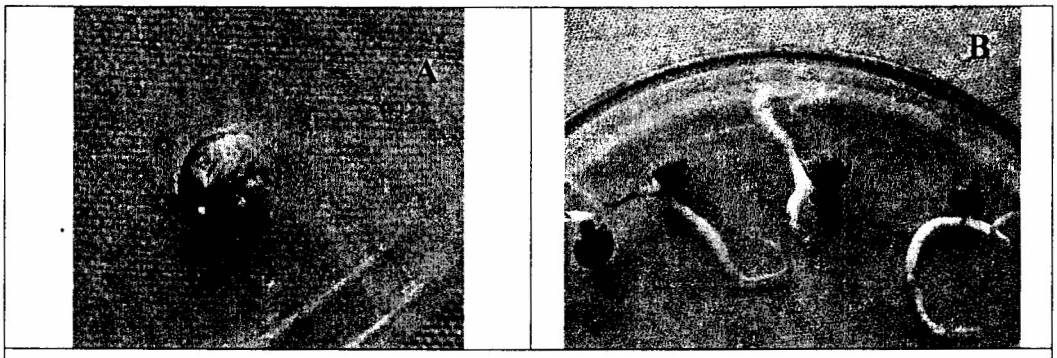


**Fig. 1.** Decay of grasspea seeds(A) and post emergence seedling infection (B) by *R. solani* on water agar plate

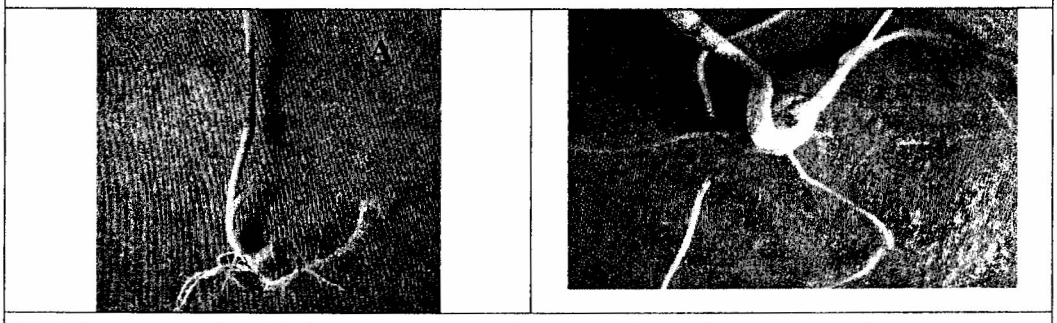


**Fig. 2**. Post emergence shoot infection (A) and root rot (B) of maize caused by *R. solani* on water agar plate

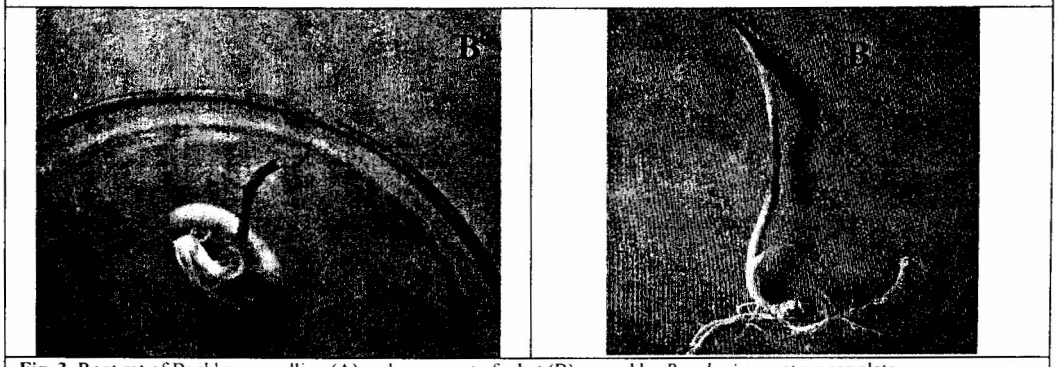


**Fig. 3.** Root rot of Bushbean seedling (A) and crown rot of whet (B) caused by *R. solani* on water agar plate

on water agar plate. The pathogenicity of the three isolates was statistically similar but significantly higher as compared to other isolates. Isolates, BSA-21, KPR-33 and NLA-36 caused 41.5, 39.5 and 36.7% seedling mortality, which were statistically similar but significantly higher as compared to rest of the isolates. The lowest seedling mortality of 21.5% was observed while inoculated with BRU-16, which was statistically similar to KDO-35 and GKA-29 (Fig. 4.).

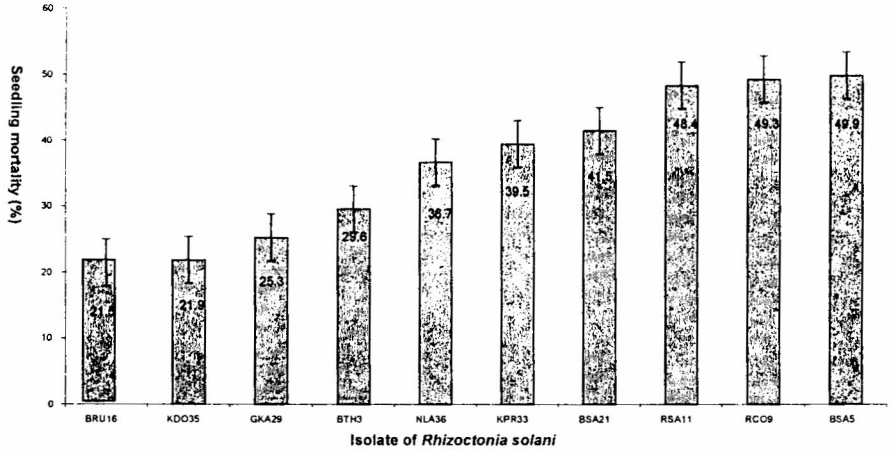


**Fig. 4.** Incidence of seedling mortality in different crop species caused by ten selected isolates of *R. solani* infecting cotton seedlings

All 14 crop species tested in the present study were susceptible to highly susceptible when we categorized any plant species to the isolates of *R. solani* but their susceptibility was variable. The isolates caused averages of 22.33 to 52.67% seedling mortality. The maximum seedling mortality was found in Bushbean, which was followed by chilli, bottlegourd, mungbean, jute, grasspea, cauliflower and sesame showing 52.67, 48.66, 45.06, 41.98, 41.98, 37.66, 37.01 and 34.99% mortality, respectively. The lowest seedling mortality was found in maize which was followed by rice, wheat, potato, lentil and carrot showing 24.33, 22.33, 30.33, 30.34, 32.00 and 32.34% mortality, respectively (Fig. 5).

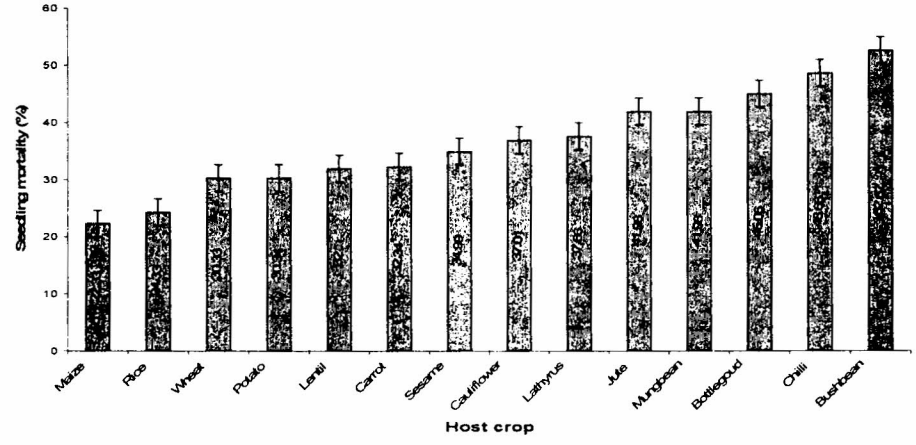


**Fig. 5.** Incidence of seedling mortality in fourteen crop species due to inoculation with isolates of *R. solani* infecting cotton seedlings

**Host range test of a selected isolate (BSA-5) of *R. solani* in a pot experiment**

Soil inoculated with the isolate BSA-5 of *R. solani* caused seedling disease complex in all of the tested crop species causing pre- and post-emergence mortality. Seedlings showed root rot and seedling stem rot symptoms (Fig. 6). Pre-emergence mortality, total seedling mortality (pre-+post emergence) and

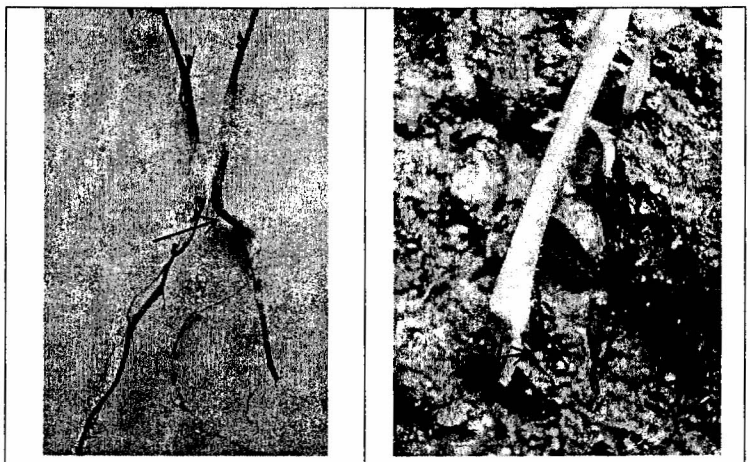


**Fig. 6.** Root and foot rot of grasspea (A), mungbean (B), grasspea grown in soils inoculated with an isolate (BSA-5) of *Rhizoctonia solani* infecting cotton seedlings

plant stand ranged 13.3 - 53.3, 23.3 - 83.3 and 16.7 - 76.7% with means 36.43, 57.84 and 42.14% and standard error 3.171, 4.497 and 4.530%, respectively. The lowest pre-mergence mortality was found in maize (13.3%) followed by rice, bottlegourd, wheat, potato, mungbean, chilli, carrot, bushbean and cauliflower. The highest pre-emergence mortality was observed in grasspea, jute, lentil, and sesame. The lowest total seedling mortality (23.3%) was found in maize followed by bottlegourd, potato, rice, wheat, chilli, bushbean and mungbean. The maximum total mortality (83.3%) was recorded from crop species lentil followed by grasspea, sesame, jute, carrot, cauliflower and bushbean (Table 1).

**Table 1. Host range of an isolate (BSA-5) of *Rhizoctonia solani* on fourteen crop species in a pot experiment**

| Name of crops | Pre-emergence seedling mortality (%) | Total seedling mortality (%) |
|---|---|---|
| Rice | 16.7 | 43.3 |
| Wheat | 30.0 | 50.0 |
| Maize | 13.3 | 23.3 |
| Jute | 50.0 | 73.3 |
| Mugbean | 36.7 | 60.0 |
| Grasspea | 53.3 | 76.7 |
| Lentil | 46.7 | 83.3 |
| Bushbean | 43.3 | 63.3 |
| Chilli | 36.7 | 56.7 |
| Cauliflower | 43.3 | 63.3 |
| Carrot | 40.0 | 63.3 |
| Bottlegourd | 26.7 | 40.0 |
| Potato | 30.0 | 40.0 |
| Sesame | 43.3 | 73.3 |
| Mean±SE | 36.43±3.171 | 57.84±4.497 |

Pre-emergence mortality of jute was statistically similar to that of grasspea and lentil but significantly higher compared to other crop species. Incidence of the disease in lentil, bushbean, cauliflower and sesame was also statistically similar but significantly higher compared to other seven crops. Difference in pre-emergence mortality of two cereal crops, rice and maize was statistically identical (Fig. 7). Trends in total seedling mortality of the crops were almost similar to pre-emergence mortality with few exceptions. Total seedling mortality in lentil was statistically similar to only grasspea but significantly higher compared to other crops. Incidence of the disease in jute, grasspea and sesame was also statistically similar but significantly higher compared to other crop except lentil, which showed the highest incidence(83.3%) of total seedling mortality. Differences in total seedling mortality of mungbean, bushbean, cauliflower and carrot were not statistically significant (Fig. 8).

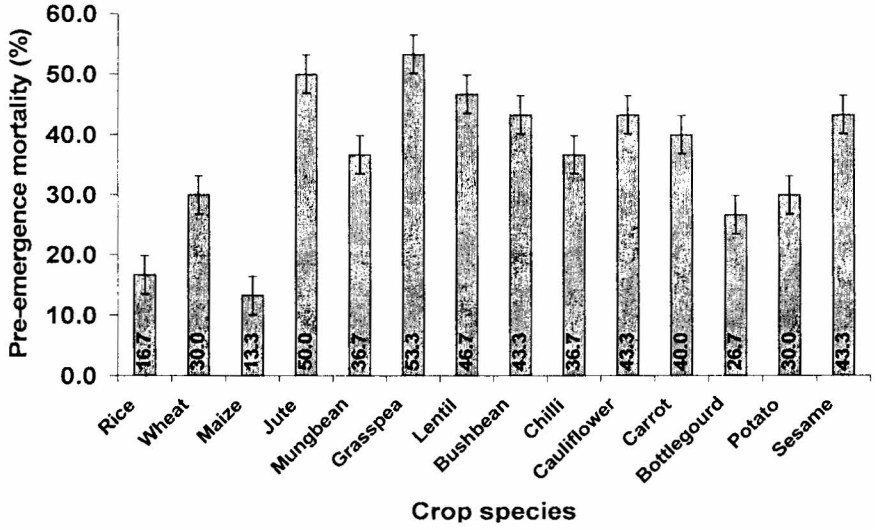


**Fig.7.** Incidence of pre-emergence seedling mortality in fourteen crop species grown in pot soil inoculated with an isolate (BSA-5) of *Rhizoctonia solani* infecting cotton seedlings

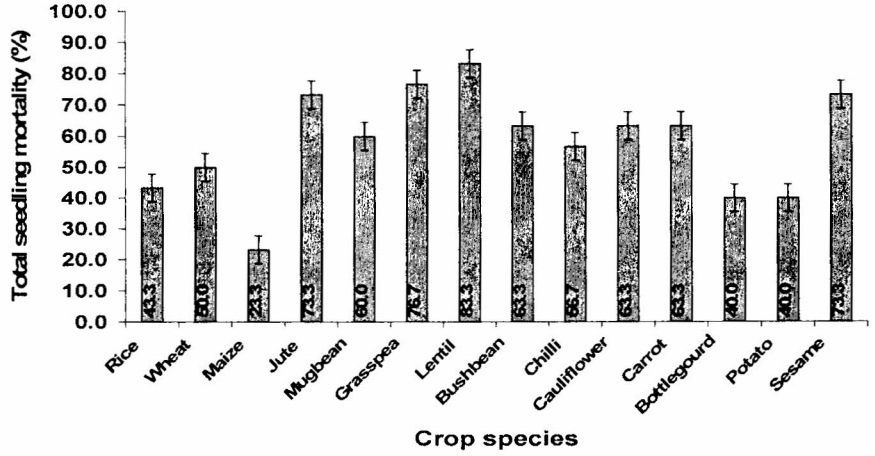


**Fig. 8.** Incidence of total seedling mortality in fourteen crop species grown in pot soil inoculated with an isolate (BSA-5) of *Rhizoctonia solani* infecting cotton seedlings

Many investigators reported that the host range of *R. solani* is wide. The pathogen is capable of causing damping-off of seedling, root rot, collar rot, stem canker, crown rot, bud and fruit rots, and foliage blight on a variety of agriculturally important susceptible crops (Baker, 1970) like soybean (Liu and Sinclair, 1991), cotton (Brown and McCarter, 1976), wheat (Wiseman *et al.*, 1995), beet (Carling *et al.*, 1987), potato (Escande and Echandi, 1991), and rosemary (Conway *et al.*, 1997). Pathogenicity studies revealed that individual *Rhizoctonia solani* isolates can be highly pathogenic to one or several plant species, while they are unable to infect others (Richer and Schneider, 1953, Flentje and Saksena, 1957, Parmeter, 1970, Yan *et al.*, 1984, Ogoshi, 1987, Adams, 1988).

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