한국식물병리학회지 3(3) : 217-222(1987)
Korean J. Plant Pathol. 3(3) : 217-222(1987)

Pathogenicity of *Rhizoctonia* Isolates from Southern Horticultural Area in Korea

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南部地方에 發生하는 *Rhizoctonia solani* 의 病原性

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ABSTRACT

Pathogenicity of nine *Rhizoctonia solani* isolates of different anastomosis groups (AG) on seed and hypocotyls of red pepper, cucumber, Chinese cabbage and radish varied considerably from nonvirulent to highly virulent. *Rhizoctonia solani* AG 1 was highly virulent on the above four plant species. AG 2 type 1 was highly virulent on radish and Chinese cabbage, moderately virulent on red pepper, and AG 2 type 2 was avirulent or weakly virulent except red pepper. *R. solani* AG 5 was moderately virulent on hosts tested. In general, virulence of the *R. solani* isolates to a given host varied among anastomosis groups, but not within anastomosis groups. Anastomosis groups lacked host specificity. The pathogenicity was stronger in steam-sterilized soil than in non-sterilized field soil, if the inoculated plants were closely related with orginal host from which the pathogen was isolated. On the other hand, pathogen was more virulent in non-sterilized field soil than in steam-sterilized soil, if the inoculated ones were not closely related. Generally, contrary to other soil-brone plant pathogenic fungi, *Rhizoctonia* isolates tended to be more virulent in non-sterilized field soil than in the same soil which had been steamed. A potential danger of building up propagules of *R. solani* in southern horticultural area are discussed in terms of cropping system.

Key words: Rhizoctonia solani. pathogenicity. anatomosis group vs. host specificity.

要 約

南部地方의 고추, 오이, 대추, 딸기, 水稻 等에 發生한 모잘록病 罹病株에서 分離한 9가지 *Rhizoctonia solani* 菌株의 고추, 오이, 무우, 대추에 대한 病原性을 調査한 結果를 要約하면 다음과 같다. AG1 菌株는 供試한 모든 寄主에 대해 強한 病原性이 있었고, AG 2群 1型 菌株는 무우와 배추에 대해서는 強한 病

This work was supported by research grant from Korea Science & Engineering Foundation in 1986.

原性을, 고추에 대해서는 苗令이 增加함에 따라 發病이 적어 中程度의 病原性이 있었으나, 오이에 대해서는 病原性이 매우 약한 傾向이었다. AG 2群 2型 菌株는 고추를 제외한 나머지 作物에는 病原性이 없거나 약하였고, AG 5 菌株는 共試한 모든 寄主에 대해 中程度의 病原性이 있었다. 各 菌株의 病原性 程度는 菌糸融合群(AG)間에는 差異가 있었으나, 같은 菌糸融合群(AG)內에서는 큰 差異가 없었다. 즉, AG 1은 共試한 모든 寄主에 強한 病原性을 보였으며, AG 2群 1型 菌株는 오이에 대해서만 弱한 程度의 病原性을 다른 寄主에 대해서는 強한 病原性을 나타내었다. 各 寄主의 苗令別 發病率은 殺菌土나 非殺菌土에서 苗令이 많을수록 減少하는 傾向을 보였으나, 오이 뿌리와 水稻줄기에서 分離한 病原性이 強한 菌株에 대해서 各 寄主는 苗令에 따른 發病率의 差異가 없었다. 殺菌土와 非殺菌土에서 病原性을 比較하면 病原菌이 分離된 寄主 및 近緣의 作物에 대해서는 非殺菌土보다 殺菌土에서 더 強한 病原性을 보였으나, 病原菌이 分離된 作物과 遠緣의 作物에 대해서는 殺菌土보다 非殺菌土에서 더 強한 病原性을 보였는데, 全般的으로는 다른 土壤傳染性病과는 달리 殺菌土보다 非殺菌土에서 病原性이 더 強하였다.

INTRODUCTION

Rhizoctonia solani Kuhn is a plant pathogen capable of causing diverse symptoms on many hosts (2). *R. solani* is a typical facultative parasite that can survive saprophytically for long periods, almost exclusively in the form of sterile mycelium (hyphae or sclerotia) associated with organic debris in soil (4).

This species may be divided taxonomically into several biological species or anastomosis groups (AGs). On a worldwide basis, eight anastomosis groups (AG) of *R. solani* have been described (1, 6, 11, 12, 13, 15). With the exception of AG BI (10), the anastomosis groups are genetically isolated and differ somewhat from one another in pathological and cultural characteristics (15, 18). The importance of the anastomosis group (AG) concept in the study of the pathology and ecology of *Rhizoctonia solani* Kuhn is well established (1).

R. solani is a common pathogen of various commercial crops in horticultural area. This fungus is troublesome on red pepper, strawberry, and cucumber, but it is particularly destructive to Chinese cabbage, causing considerable losses wherever these crops are cultivated (7). Isolates of *R. solani* cause bottom rot on Chinese cabbage, and root rot on red pepper. Although *R. solani* is considered as an important pathogen in southern horticultural area, there are few reports on the identification of anastomosis group (8, 9). The relationships of describing anastomosis group and pathogenicity of this fungus in Korea have not been published yet.

The objective of this study was to assess the pathogenicity of *R. solani* isolates with known AG group defined in our previous work (8) obtained from southern horticultural area.

MATERIALS AND METHODS

Pathogenicity tests of 9 isolates of *R. solani* belonging to three anastomosis groups (8) were conducted with four plant species in a plastic film house with temperature fluctuating from 18 C at night to 30 C during the day. All 9 isolates were tested for pathogenicity using hypocotyls of red pepper, cucumber, Chinese cabbage and radish.

Pathogenicity of the isolates to hypocotyls was tested with different stages of seedlings (seed, five, ten, and fifteen-day-old) in steam-sterilized and non-sterilized field soil infested with *R. solani* (Fig. 1). The non-sterilized field soil was sifted through a 5mm mesh sieve and steam-sterilized soil was also sifted and autoclaved for 1 hr at 120 C.

Inoculum for infestation of soil was prepared on moistened barley-sand in 1,000 ml Erlenmyer flasks (1 : 2 : 10 mixture of comminuted naked barley grain, distilled water, and sand sifted through a 2mm mesh sieve, respectively), which were autoclaved for 1 hr at 120 C, inoculated with a 4mm mycelial disk from cultures grown on PDA per 20g of sand, and incubated at 25C for 7 days.

Sections (60 x 150 x 15 cm) in a plastic film

house were filled with sterilized and non-sterilized field soil, respectively, and 1g of inoculum per 400g dry weight of soil was added and mixed thoroughly to a depth of 5cm. Each twenty seedlings of four different stages comprising total eighty of each four crop species were planted in each section. Twenty-one days after planting, seedlings in each section were rated for disease severity on a percentage.

RESULTS AND DISCUSSION

In general, virulence of *R. solani* isolates tested was varied among anastomosis groups, but not within anastomosis groups. Although an isolate of AG 1 from red pepper fruit tested was highly virulent on red pepper, Chinese cabbage and radish but was only weakly virulent on cucumber, two isolates of AG 1 from either cucumber root or rice sheath tested were highly virulent on red pepper, cucumber, Chinese cabbage, and radish (Fig. 1a).

All three isolates of AG 1 from cucumber root, pepper fruit and rice sheath were characteristically consistent with the description of Anderson (1) and Ogoshi (14), in terms of causing seed and hypocotyl rot, aerial blights and web blights of many plant species. Since the cropping system patterns in Chinju area were either Rice-Cucumber-Melon-Watermelon or Rice-Red pepper, the results suggested a potential danger of building up propagules of *R. solani*.

Two isolates of AG 2-1 from red pepper root and Chinese cabbage leaves tested were highly virulent on red pepper, Chinese cabbage and radish but were weakly virulent on cucumber. An isolate of AG 2-2 from rice bordered sheath spot was virulent on red pepper (Fig. 1b). Isolates belonging to AG 2 are known to cause a canker of root crops and many of them cause root disease on crucifers (1). Ogoshi (12) had divided AG 2 into AG 2-1 and AG 2-2: winter crop and/or rush and root type isolates, respectively. Grisham (5) reported that AG 2-1 isolates caused seed rot, damping-off, and root lesions only on radish and AG 2-2 isolates caused crown rot and canker on carrot as well as lesions on radish roots. Our results agreed to the observation of Anderson (1) and Grisham (5), in that crucifers were the host of AG 2 isolates. However, the isolates of AG 2-1, AG 2-2 also caused damping-off of red pepper in this trial.

AG 5 isolate from rice brownish sheath spot was fairly to strongly virulent on plants inoculated (Fig. 1c). There have been few reports on the isolates of AG 5. Bandy et al. (3) reported that AG 5 isolates were pathogenic to the stems of potatoes. We found that AG 5 isolate was pathogenic

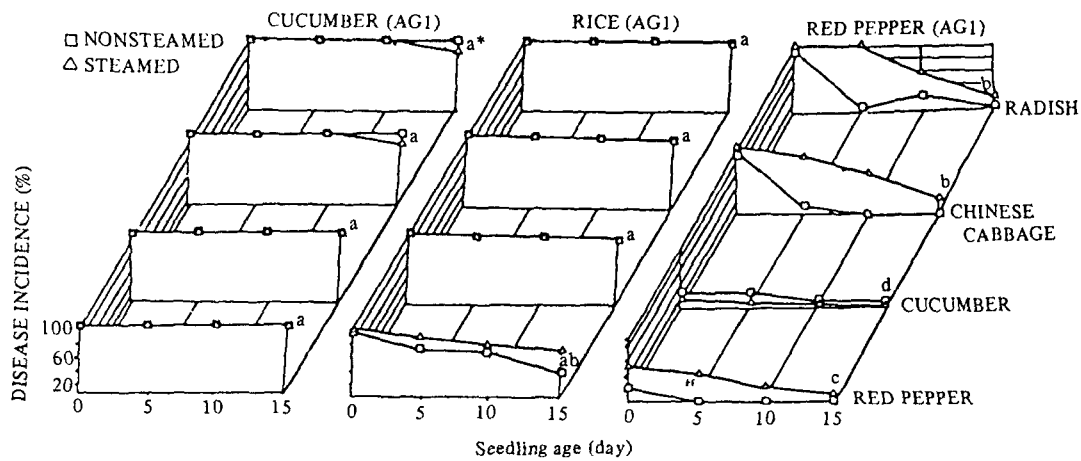

Fig. 1a. Pathogenicity and influence of plant age on damping-off of four hosts tested in steam sterilized and natural field soil infested with Rhizoctonia AG 1 isolates obtained from cucumber, rice and red pepper.
*: Treatment with the same letters are not significantly different (P = 0.05).

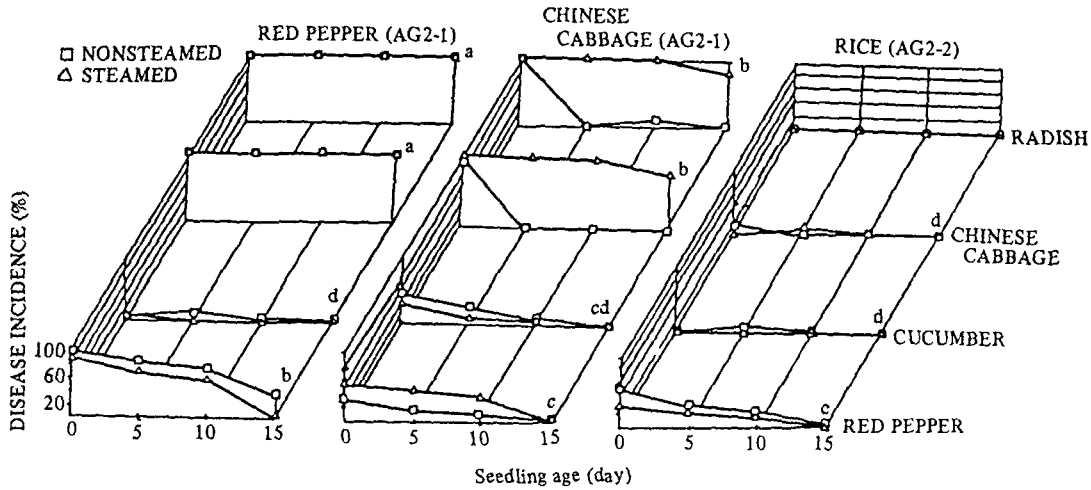

Fig. 1b. Pathogenicity of plant age on damping-off of four hosts tested in steam sterilized and natural field soil infested with Rhizoctonia AG 2 isolates obtained from red pepper, Chinese cabbage and rice. Treatments with the same letters are not significantly different (P = 0.05).

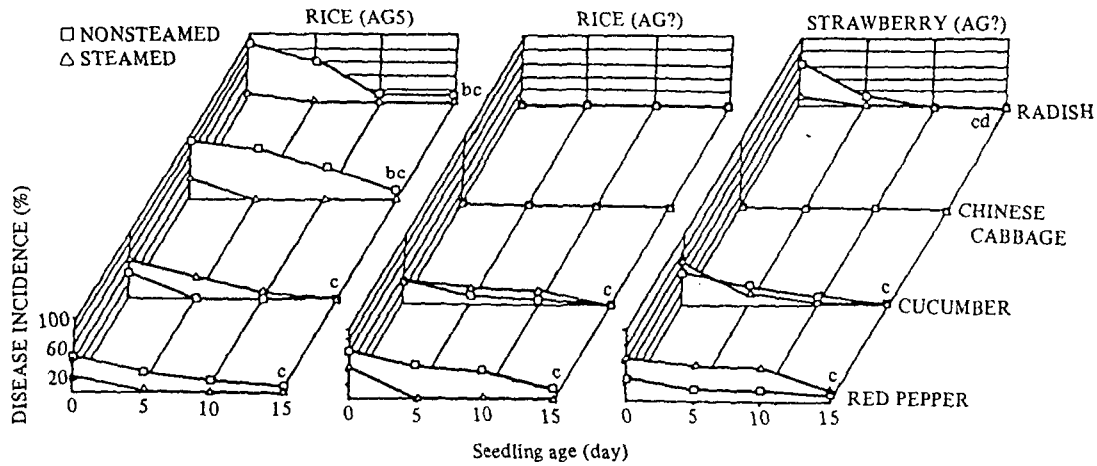

Fig. 1c. Pathogenicity of plant age on damping-off of four hosts tested in steam sterilized and natural field soil infested with Rhizoctonia AG 5 or other isolates obtained from rice and strawberry. Treatments with the same letters are not significantly different (P = 0.05).

to radish, Chinese cabbage and red pepper. Two isolates from rice brown sclerotium disease and strawberry root did not anastomose with any of the tester strains (8) and were avirulent or weakly virulent to plant species tested except red pepper (Fig. 1c).

There were significant differences in the development of damping-off between five-day-old seedlings and fifteen-day-old ones. The younger seedlings were prone to disease infection and the older ones less in both sterilized and non-sterilized field soil (Fig. 1). Disease incidence by highly virulent isolates from cucumber root rot and rice sheath blight, however, were not influenced by plant age of four hosts in both sterilized and non-sterilized field soil (Fig. 1a).

The pathogenicity was stronger in sterilized soil than in non-sterilized field soil, if the inoculated plants were closely related with original host from which the pathogen was isolated (Fig. 1a and 1b). However, such a generalization was in reverse in the case of cucumber. Only two isolated from

cucumber root rot and rice sheath blight were highly virulent on cucumber, but rest of the isolates tested were only weakly virulent. Isolates from red pepper fruit and Chinese cabbage leaf were more virulent in serilized soil than in non-sterilized field soil on plants inoculated. On the other hand, pathgen was more virulent in non-sterilized field soil than in sterilized soil, if the inoculated ones were not closely related with original host from which the pathogen was isolated. Isolates from rice sheath was more virulent in non-sterilized field soil than in sterilized soil on red pepper, cucumber, radish, and Chinese cabbage (Fig. 1b and 1c). Generally, virulence of the most of *R. solani* isolates tested were highly virulent in non-sterilized field soil than in sterilized soil. Richards (17) reported that *R. solani* might be much more virulent on potatoes in natural soil than in the same soil which had been steamed. Our results were in agreement with his report, in a case where the inoculated plants were not closely related with original host from which the pathogen was isolated. The above finding leads us to hypothesize that *R. solani* is parasitically less specialized than other soil-borne plant pathogenic fungi.

None of the seedlings in control plot developed symptoms. *R. solani* was re-isolated from infected seedlings and compared with the original isolate. All re-isolates had characteristics similar to the original inoculum.

Most authors agreed that hyphal anastomosis groups in *R. solani*, which represent genetic isolation, were not host specific although some tendencies were evident (5, 15, 16). Our results on pathogenicity test were in agreement with their reports. Most isolates from different anastomosis groups were capable of causing infection on a variety of plant species. In general, however, isolates within a given anastomosis group were somewhat uniform in their virulence on certain hosts. For example, AG 1 isolates were highly virulent on red pepper, cucumber, Chinese cabbage and radish, but AG 2-1 isolates were weakly virulent on cucumber. Cucumber was susceptible only to the isolates of cucumber damping-off and rice sheath blight and was the most resistant of all to the rest of the isolates tested. In general, AG 1 isolates were more virulent and had wide host range than isolates belonging to other anastomsis groups, which requires further study with more isolates. It was remarkable to observe that any isolates tested in this study from rice turned out to be virulent on red pepper, regardless of their AG identity. Since Rhizoctonia diseases such as buttom rot of Chinese cabbages (7) and others associated with rice sheath other than rice sheath blight were getting severe these days, it was assumed that common patterns of cropping system including rice -pepper cropping might have been conducive in building up potential inoculum.

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