초 청 강 연

1. *Pythium* Species Associated with Turfgrass Leaf Blight at Golf Courses in Korea : Their Identification and Disease Occurrence.

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Pythium species are widely distributed in water and soil and most of them are soil-inhabiting organisms throughout the world. They are pathogenic to various agronomically important crops. *Pythium* species cause seed rot, seedling damping-off, and root rot of most plants and soft rot of fleshy plants and leaf blight of ground cover plants in contact with soil.

Turfgrass leaf blight caused by *Pythium* species was a serious problem in golf courses in Korea. It occurs almost every year, particularly in years with hot and wet summer. Eleven species of *Pythium* and heterothallic *Pythium* spp. were identified from 125 isolates collected from leaf blight symptoms on creeping bentgrass (*Agrostis palustris* Huds.), Kentucky bluegrass (*Poa pratensis* L.), and zoysiagrasses [*Zoysia japonica* Steud., and Z. *matrella* (L.) Merr.] at thirty-five golf courses in Korea during 1990～1996. The identified species included P. *aphanidermatum*, P. *arrhenomanes*, P. *catenulatum*, P. *graminicola*, P. *myriotylum*, P. *oligandrum*, P. *periplocum*, P. *rostratum*, P. *torulosum*, P. *ultimum* var. *ultimum*, and P. *vanterpoolii*. Of the species, P. *arrhenomanes*, P. *catenulatum*, P. *graminicola*, P. *oligandrum*, P. *periplocum*, P. *rostratum*, P. *torulosum* and P. *vanterpoolii* were reported for the first time in Korea. Mycological characteristics of sporangia, oogonia, antheridia, and oospores observed on the sucrose-asparagine bentgrass leaf culture medium were described for each species. P. *myriotylum*, P. *rostratum*, P. *torulosum* and P. *vanterpoolii* showed characteristic colony patterns on the potato-carrot agar medium, which can be used and criteria for species identification of *Pythium*.

Of the eleven species, P. *aphanidermatum* and P. *myriotylum* favored relatively high temperatures with the optimum temperature of 35℃, and P. *torulosum* and P. *vanterpoolii* grew well at relatively low temperatures with the optimum temperature of 25℃. P. *aphanidermatum*, P. *arrhenomanes*, P. *catenulatum*, P. *graminicola*, P. *myriotylum*, P. *periplocum*, P. *rostratum*, P. *torulosum*, and P. *ultimum*, P. *vanterpoolii* were pathogenic to creeping bentgrass and Kentuchy bluegrass. *P. aphanidermatum*, *P. catenulatum*, and *P. graminicola* were often isolated on July through August under humid or rainy and relatively high temperature conditions, whereas *P. torulosum* and *P. vanterpoolii* were frequently isolated on March through May when humid or rainy and relatively low temperature conditions occurred. *P. arrhenomanes* and heterothallic *Pythium* sp. (Ht-F) were able to infect Zoysiagrass and caused stem and crown rot of grasses at poorly drained areas under humid or rainy conditions. *P. oligandrum* and heterothallic *Pythium* sp. (Ht-L) were avirulent on all test turfgrasses.

2. Etiology and Biological Control of Seedling Disease in Water-Seeded Rice

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Microbial contamination-free seeds were required to study etiology of rice seedling disease. For this purpose, rice seeds were soaked for 2 hrs in freshly prepared 2.6% sodium hypochlorite with pH 7.3 in 0.3 M potassium phosphate. This treatment was not only very effective to disinfest contaminants on seeds but also seems to promote seedling growth. On the basis of this observation, study regarding the direct effect of sodium hypochlorite on rice seedling growth was conducted. Several fungicides such as Vitavax 200FF and copper were used to control rice seedling disease in Louisiana. In addition, farmers had practiced presoaking rice seeds one day before planting. However, Vitavax 200FF and copper, and cultural practice of presoaking seeds because of problems associated with waste water were prohibited from being used for rice seedling disease control by Environmental Protection Agency. Because of these reasons, it was urgent to develop biological control of rice seedling disease. However, for accomplishing these objectives, detailed etiological information on this disease, i.e. when and for how long were seedlings susceptible and exactly which portions of the seed and seedling were susceptible.

Bacteria were eliminated from rice seeds following immersion in household bleach solutions adjusted to pH 7.0, while fungi were eliminated at pH 5.0 and below. The direct effect of sodium hypochlorite (2.6% NaOCl, pH 7.3) on rice seedling growth, used as a surface sterilant, was tested. Seedling growth following seed treatments with $HgCl_2$ followed by NaOCl and NaOCl followed by sterile water was significantly greater than when seeds were treated with sterile water followed by sterile water, $HgCl_2$ followed by sterile water, and $HgCl_2$ followed by KH_2PO_4. These results indicate that sodium hypochlorite directly stimulated rice seedling growth apart from an indirect effect related to elimination of microbial contaminants.

Etiological studies elucidated the process of rice seed and seedling infection by *Pythium* species. Infection rates of embryos were significantly higher than that of endosperms. The development of roots from dry-planted seeds was significantly reduced by *P. arrhenomanes* and *P. myriotylum* compared to that of roots from noninoculated controls after 5 days. Susceptibility to *P. arrhenomanes*, *P. myriotylum* and *P. dissotocum* was significantly reduced at 2 to 4 days after planting, and rice seedlings were completely resistant at 8 days after planting. There was a steep decline in emergence following 2 days exposure to inoculum of *P. arrhenomanes* and *P. myriotylum*. In contrast, *P. dissotocum* was much less virulent, requiring longer exposure times to cause irreversible seedling damage. These results indicate that rice seedlings become resistant to infection after a very short period of time even though they may still be submerged. This short period of susceptibility suggests that this disease should be amenable to biological control because the introduced agent need not predominate for more than a few days at specific sites of infection.

Of 148 carbon sources tested, several, such as L-arabinose, D-galactose, D-melezitose, D-melibiose, and lactulose, support growth of the *Bacillus* spp. used for biological control but not the pathogenic *Pythium* species. Results indicated that, with one exception, inclusion of carbon sources preferentially utilized by the biological control agents in seed coating formulations resulted in a significant level of disease control in greenhouse and field. However, carbon sources such as glucose and sucrose which supported growth of the biological control agents and *Pythium* species did not control rice seedling disease.

A spontaneous rifampicin-resistant mutant of *B. megaterium* was used to monitor seed and seedling populations of this strain. Populations of this marked strain declined to undetectable levels within 2 days of planting seed that had been coated with an L-arabinose formulation. However, populations of total culturable bacteria increased during this same time period as compared to nonamended seed treatments. These results were unexpected and suggest that biological control of seedling disease with an introduced bacterium resulted from an altered seed and seedling microbial community rather than from a direct effect of the introduced strain. Further research should address this intriguing hypothesis by examining microbial community dynamics. It may be possible to characterize disease suppressive microbial communities and provide them with a selective advantage with specific amendments to be coating formulations.

3. 수면부상성 제형으로 개발한 Carpropamid의 벼 도열병 방제효과 및 논에서의 주성분 이동

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벼 도열병 방제의 생력화를 위하여 약제 처리방법이 개선된 수면 부상성 입제를 제제하여 도열병에 대한 방제효과, 사용방법 및 논에서의 주성분 분포를 시험하기 위하여 Nihon Bayer Agrochem K. K사와 Bayer AG시가 개발한 살균제인 carpropamid로 수면부상성 입제(UG)를 제제하여 시험하였다. UG제형의 특성은 용해성 필름에 포장된 입상의 약제를 논뚝에서 투척하여 도열병을 방제하는 손쉬운 방제수단으로 약효를 발현하는 원리는 최초 논에 투척된 후 용해성 필름이 물에 녹아 파괴되고 그 속에 있는 입상의 입제가 물에 부상하기 시작하여 논물에서 사방으로 약 10m 정도 자체 에너지로 이동하여 입상의 농약이 물에 의해 붕괴되고 논바닥으로 가라앉은 후 벼의 뿌리 및 잎집으로 주성분이 침투 이행하여 약효를 나타낸다.

Carpropamid UG 제형의 제조처방은 4.18% carpropamid 원제, 1% white carbone, 2% xanthan gum, 3.5% sodium dinlkyl sulfosuccinate 계통의 계면활성제를 첨가하여 압축성형 입체기로 1mm의 굵기의 입제망을 이용하여 제제한 후 건조한 용해성 필름으로 수중 용출도는 UG제형은 약제처리 1시간 후 0.247ppm, GR은 3.34ppm 용출되어 두 제형간 용출량의 차이는 매우 심하였다.

Carpropamid UG 제형의 논물에서의 이동성 및 주성분 분포는 처리 지점과 멀수록 농도가 조금 낮게 나타났고, 중간 지점에서 오히려 높은 경향이었다. UG 제형은 약제처리 2시간 후 논문에 약 68%, 토양에 32% 정도 분포하였으며 처리후 시간이 경과하면 할수록 주성분은 토양에 많이 분포되는 것으로 나타난 반면, GR(일반 입제)의 경우 2시간 후에는 전체 주성분의 98.6%가 토양에 분포하며 수중에는 1.4%로 매우 낮은 농도로 분포되었다.

온실에서 시험결과 처리약량이 ha당 주성분량의 200g, 400g에서 83.3%, 90%의 방제효과를 나타내 대조약제인 probenazole 1,800g 처리보다 높게 나타났다. UG 제형을 1개 지점에 처리하여 확산 이동후 벼도열병에 대한 방제효과는 처리 14일 이후에 각 지점별로 방제효과가 전체적으로 균일하게 나타났으나, 처리 지점에서 거리가 먼 7m 지점에서는 방제효과가 조금 낮은 경향이었다.

수용성 필름에 포장하여 시험구 중앙에 투척하여 포장에서 시험한 결과 400g d.i./ha에서 90% 이상의 방제효과를 보였으며, 약제 투척지점과 그 이외 지점간의 방제효과 차도 거의 없었다. Carpropamid UG는 이앙 20일 이후인 6월 중순에 투척 처리하는 것이 가장 효과적이었다. Carpropamid UG 100g 한 봉지를 투척 처리하여 시험한 결과 처리지점에서부터 3m까지는 94%, 3-6m 시험구에서는 95.8%, 6-10m에서는 89,2% 방제효과를 나타내 거리별 방제효과는 큰 차이가 없었다. ha당 사용 주성분의 량은 동일하게 하고 투척개수 및 포장 규격을 달리하여 시험을 실시하였다. 10a당 50g 봉지 20개를 투척한 시험구와 100g 봉지 10개 투척구간 방제효과 차는 거의 없는 것으로 나타났다.