Ecology and Control Strategy of White Rot of *Allium* Crops

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To establish control strategy of garlic white rot which occurs severely in the main cultivation areas of *Allium* crops in Korea, spread methods of white rot pathogen, influences of environmental factors (temperature, soil humidity), cultural factors (seeding time, burial depth of seeds, cropping system, lime application), and pathological factors (survival rate and fine structure of sclerotia) on disease occurrence or development, elucidation of inoculum density in the cultivated lands, disease resistance of garlic and onion varieties were studied. Also effective control system of garlic white rot was established through treating fungicides at sowing time and growing stages.

White rot pathogens of *Allium* crop, sclerotia, were spread through sclerotia on plant residues of non-harvested infested garlic bulbs in field soils, garlic seeds harvested from infested field, and contact between diseased plants and neighbor plants. There are differences among garlic varieties in seed transmission rates. When nine garlic varieties harvested from infested plots were sown in the healthy field, highly susceptible varieties, 'Wando', 'Daeseo', 'Namdo' and 'Kodang' showed high disease incidences, whereas other five varieties were not infected at all.

Influences of environmental, cultural and pathological factors on the disease occurrence and development of garlic white rot were evaluated. Garlic white rot developed high at near 20?of ambient temperature and near 15% of soil humidity. The disease incidence was reduced remarkably less than 13% of soil humidity or more than 17% of soil humidity. Also the control possibility of garlic white rot causing severe yield losses of *Allium* species and varieties using cultural practices such as optimal sowing date and burial depth, and lime application, was investigated. Inoculum density of white rot pathogen decreased remarkably with increase of soil depth and most of sclerotia were distributed within 5cm of soil depth. Disease severity of white rot was higher on lightly planted garlics than on deeply planted ones. White rot occurred higher

on early-sown garlics, before middle October, than on late-sown ones, after late October. Meanwhile, increasing application rate of lime ranged from 100 to 300gram under vinyl house condition reduced disease severity of white rot. Rotational cropping system using, barley and garlic, reduced the disease incidence. Analysis of correlation between disease incidence and soil physico-chemical properties showed that garlic white rot occurred very low in the garlic field contained with high organic matter contents. Survival rate of white rot pathogens was higher in the topsoil than in the subsoil. Comparing survival rate between the two species of *Sclerotium* causing white rot of *Allium* crops, survival rate of *Sclerotium cepivorum* forming comparatively smaller sclerotia was higher that of *Sclerotium* sp. forming comparatively larger sclerotia. Electron-micrograph of fine structures of sclerotial surfaces and rind layers showed that there were more wrinkles on the sclerotial surfaces of *Sclerotium* sp. than on that of *S. cepivorum* and mycelial matrix of rind layer of *Sclerotium* sp. was more loose than that of *S. cepivorum*.

We developed a new method for isolation of sclerotia from infested field soils that can be used for ecological study of *Sclerotium* spp. and establishment of control strategy. Soil samples collected from heavily infested fields were evenly mixed and placed on a automatic sieve shaker connected with tap water. After 10 min of shaking, residues on 0.5mm and 0.25mm sieves were separately collected and suspended with 70% sugar solution, which method floats sclerotia in aqueous layer. Then, floated fraction was carefully separated and mixed with a same volume of 1% sodium hypo-chlorite solution to differentiate with organic materials. This method provides a direct count of sclerotia under a dissecting microscopy. Recovery ratios of two white rot pathogens, *S. cepivorum* and *Sclerotium* sp., was 82.3 and 72.0%, respectively. Inoculum density in garlic cultivated soil showed big differences according to stage of sclerotial decomposition. In the sowing season sclerotial density of white rot pathogen in garlic cultivated soils ranged from one to three per 30 gram soil, whereas that in the soils heavily-infested with white rot pathogen reached 13 scleroia per 30 gram soil.

In field trial all of nine garlic varieties were highly susceptible to *Sclerotium cepivorum* and cold-type garlics were less susceptible than warm-type garlics. Meanwhile garlic cultivars used showed differences among resistant responses to *Sclerotium* sp., forming large sclerotia. Three warm-type garlics, 'Kodang', 'Wando' and 'Koheung', showed highly susceptible response, but three cold-type garlics, 'Seosan', Danyang' and 'Yechon' showed moderate resistant response, and two warm-type garlics, 'Namdo' and 'Daeseo', and a cold-type garlic, 'Euisung' showed resistant response. In case of onion, only two onion varieties, 'Samnamjosang' and Yangchunhwang' showed light disease resistance response against *Sclerotium cepivorum*. However None of onion varieties showed disease resistance response against both of two species of *Sclerotium*, but one

onion line, L22-5, showed high disease resistance response and seven onion lines including L19-1 showed moderate disease resistance response.

To establish control system of garlic white rot, five fungicides showing high suppressive activity on mycelial growth and sclerotial germination were selected. The selected fungicides were treated with several combinations at sowing time and in the early time of disease occurrence in the field of four main garlic cultivation areas. Most of combined treatments with the fungicides showed good control performance. Especially when seed garlics were seed-coated with benoram WP, sown in the field disinfected by drenching with metconazole SC, and garlic seedlings were sprayed with metconazole SC from the early time of disease occurrence twice at ten day-intervals, garlic white rot were controlled most effectively in all of experimental plots of four main cultivation areas. In order to develop control model of garlic white rot, control effects of cultural practices (eradication of diseased plant debris, deep seeding), chemical application (fungicides, compost and lime application) on disease development of white rot were evaluated in field contaminated severely with white rot pathogen. As a result, systemic application of fungicides for controlling garlic white rot, lime application and eradication of diseased plant debris suppressed disease incidence of garlic white rot.

In addition correlation between disease incidence of garlic white rot and yield losses was analyzed using Microsoft Excel 2000 program. There was a positive correlation between disease incidence of garlic white rot and yield losses. Two regression equations of yield on disease incidence and determination coefficients was obtained from two garlic varieties ('Namdo' and 'Daeseo') as follows; y(yield)=-9.834x(percentage of infected plants)+895.99 (R2=0.9231) from 'Namdo' and y= -6.1546x +746.32(R2=0.8006) from 'Daeseo'. Also garlic white rot reduced remarkably plant growth of garlic (plant height and stem diameter).