production, root colonization, and total microbial activity were investigated. The dual culture assay was accomplished to elucidate existence of antibiotics. In this assay, any antagonistic bacteria did not inhibit growth of six important fungal plant pathogens, suggesting that these antagonists do not produce antibiotics. root surface or rhizosphere soil colonizations were examined with spontaneous rifampicin-resistant mutants equal to antagonistic ability of wild types. KJ2C12 colonized consistently rhizosphere soil while yellowish colonies of KJ1R5 and KJ9C8 well colonized root surfaces and rhizosphere soil. Total microbial activity in pots treated with the antagonistic bacteria was measured using fluorescein diacetate hydrolysis. total microbial activity of three antagonistic bacteria treatments was significantly higher than that of buffer-treated control until 4days after treatment. However, total microbial activity of treatment of three antagonistic bacteria decreased after 7 days. These results indicate that the antagonistic bacteria, KJ1R5 and KJ9C8 colonized and protected roots well against Phytophthora blight of pepper through competition of infection courts, especially competitions.

2-16. Evaluation of control methods for the best practicing conditions for the control of bacterial blossom blight of kiwifruit

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Control of bacterial blossom blight of kiwifruit (*Actinidia deliciosa*) has been mainly depended on chemical control. Recently cultural practices such as trunk girdling of kiwifruit trees and rainproof installation over kiwifruit trees also were conducted as the alternative control practices. Each of the control methods was evaluated for the best practicing conditions for the control of bacterial blossom blight of kiwifruit. Among the various combinations of spray times and spray periods, optimum spray program of antibiotics was turned out to be 3 times with intervals of 10 days from early May during the flowering season of kiwifruits. Optimum periods of trunk girdling of kiwifruit trees were from late March to late April. Trunk girdling with 20-30 ㎜ wide showed best control efficacies on bacterial blossom blight, irrespective of the heights of girdling on trunks of kiwifruit trees. Optimum period of rainproof installation over kiwifruit trees was from March till late April, irrespective of installation methods.

2-17. Cloning and mutational analysis of pyrroquinoline quinone(PQQ) genes from a phosphate - solubilizing biocontrol bacterium *Enterobacter intermedium.*

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E. intermedium 60-2G possessing a strong ability to solubilize insoluble phosphate, has

plant growth-promoting activity, induced systemic resistance activity against scab pathogen in cucumber, and antifungal activity against various phytopathogenic fungi. The phosphate solubilizing activity of 60-2G may be mainly accomplished by production of gluconic acid through a direct extracellular oxidation of glucose by glucose dehydrogenase that required a PQQ cofactor for its activation. A *pqq* gene cluster conferred phosphate-solubilizing activity in *E. coli* DH5α was cloned and sequenced. The 6,783 bp *pqq* sequence had six open reading frames (from A to F) and showed 50 - 95 % homology to *pqq* genes from other bacteria. The *E. coli* strain expressing the *pqq* genes solubilized phosphate from hydroxyapatite after a pH drop to 4.0, which paralleled in time the secretion of gluconic acid. To study the role of PQQ in biocontrol traits of *E. intermedium*, PQQ mutants of 60-2G were constructed by marker exchangee mutagenesis. The PQQ mutants of *E. intermedium* were lost activities of solubilizing phosphate, growth inhibition of phytopathogenic fungi, and plant growth promotion. These findings suggest that PQQ plays an important role, possibly activation of certain enzymes, in several beneficial bacterial traits of *E. intermedium* by as yet an unknown mechanism.

2-18. Enhancing Resistance of Red Pepper to Phytophthora Blight Diseases by Seed Treatment with Plant Growth Promoting Rhizobacteria

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Plant growth promoting rhizobacteria (PGPR) have been shown to suppress phytopthora blight. This suppression has been related to both microbial antagonism and induced resistance. The PGPR isolates were screened by dual culture plate method and most of the isolates were showed varying levels of antagonism. Among the PGPR isolates pyoverdin, pyochelin and salicylic acid producing strains showed the maximum inhibition of mycelial growth of *Phytophthora capsici* and increased plant growth promotion in red pepper. PGPR isolates further analysed for its ability to induce production of defence related enzymes and chemicals. The activities such as Phenyle alanin ammonia lyase (PAL), Peroxidase (PO), Polyphenol oxidase (PPO) and accumulation of phenolics were observed in PGPR pretreated red pepper plants challenged with *Phytophthora capsici*. The present study shows that an addition of direct antagonism and plant growth promotion, induction of defense related enzymes involved to enhance resistance against invasion of *P. capsici* in red pepper.

2-19. Isolation and characterization of an antifungal substance from Burkholderia cepacia, an endophytic bacteria obtained from roots of cucumber.

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In order to develop a new microbial fungicide for the control of vegetable diseases using