Special Research Report # 106: Disease Management

Biological Control of *Rhizoctonia* Root Rot
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Background
Most flowering plants are propagated via seeds or cuttings that are established in seeding production trays that contain from 72 to over 500 individual plug units per tray. Each unit is filled with an artificial planting media usually consisting of a mixture of peat moss, perlite, and/or vermiculite. Even with the use of this artificial media, extensive production losses can be caused by *Rhizoctonia* root rot. This pathogen appears to gain access to facilities via contaminated seed, infested cuttings, or unsanitary growing practices. The objectives of this research were to: (1) Identify *Bacillus* spp. that naturally colonize roots of bedding plants; (2) identify which of these *Bacillus* spp. might be useful for biological control of *Rhizoctonia* or for plant growth promotion.

Materials and Methods
Isolation. Root samples were collected from 35 genera of annual and perennial bedding plants in well established planting beds. *Bacillus* spp. were selectively isolated using heat treatment and a selective medium. A total of 149 *Bacillus* strains were identified to species using fatty acid analyses.

Evaluation. All 149 *Bacillus* strains were screened with the following procedures. *Bacillus* strains were cultured, quantified, and mixed into a medium consisting of 60% Canadian peat moss, 20% vermiculite and 20% perlite. Impatien plants are the most common bedding plants grown in the US and were selected for this study because of the following: (1) could easily be used in mechanical seeding; (2) the germination of impatien seeds (4 days) and growth of seedlings are rapid; and (3) plants exhibit complete damping-off when infected with *Rhizoctonia* allowing for ease of evaluation.

Seedling damping-off
Impatien seeds ('Super Elfin White') were seeded into 288 cell plug trays. Each tray contained the planting mix...
and one of the 149 Bacillus isolates. Seeds were grown in trays for four weeks and subsequently transplanted into 72 plug seeding trays containing an average of 65 Rhizoctonia sclerotia per plug (sclerotia are survival structures formed by Rhizoctonia). Number of seedlings damping-off in each treatment were compared on a daily basis for two weeks. Two controls were utilized each time Bacillus strains were tested; 1) “Disease control” Rhizoctonia – no Bacillus, 2) “Fungicide Control” Rhizoctonia + Banrot 50WP without Bacillus.

Seven strains from seven Bacillus spp. were selected from the initial screening. Tests were repeated with these strains a minimum of three times. Means of these Bacillus strains were all lower than disease controls (Graph 1).

Three of the seven Bacillus strains were selected to test for a synergist effect by applying combinations of two strains to impatiens transplants. All nine permutations were tested five time. No other changes were made to the described protocol. Combinations of B. cereus, B. lacticolerous, and B. pumilus were synergistic in their suppression of Rhizoctonia (Graph 2).

Graph 2

In order to determine if the Bacillus strains are promoting plant growth in soilless media; the seven previously selected Bacillus strains were incorporated into 100 cell seeding trays as previously described. After four weeks of growth above ground portions of impatiens plants were removed dried and compared with that of a control tray in which no Bacillus strain was added. This was repeated three times and data were compared.

Graph 3

CONCLUSIONS
The fatty acid analysis (MIDI) classified most of the 149 Bacillus strains into 14 spp. The seven most common species associated with the roots were: B. lacticolerous (24%), B. cereus (21%), B. megaterium (13%), B. mycoides (5%), B. pumilus (5%), B. thuringiensis (4%), B. coagulans (4%). Ability to suppress Rhizoctonia by individual strains within these species varied greatly. However, some Bacillus strains were found that slowed progression of root rot and promoted growth of the plant.

IMPACT TO THE INDUSTRY
(1) None of the 149 Bacillus strains are capable of suppressing Rhizoctonia to the same degree as commercial fungicides; however, in the bedding plant industry, these strains have a potential benefit if applications are made at seeding and transplanting. (2) These strains appear to aid in plant growth when an artificial soilless media is used.

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