

Development and evaluation of a model for management of plant pests in organic cucumber cultivation

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Key words: biological control, chemical pesticide, cucumber, organic cultivation

Abstract

Crop protection strategies in organic horticulture aim to prevent insect pest and plant disease problems through utilization of non-chemical based control means. In order to develop a model for management of plant diseases and insects in organic cucumber cultivation, we compared efficacies between chemical pesticide spraying system and biological control means in semi-forcing and retarding cucumber cultivation during 2005 and 2006. Conventional chemical spray program using various chemical pesticides was applied 5 – 10 days intervals, while two different non-chemical pesticide application programs using two formulated biopesticides Topseed™ and Q-fect™, Suncho™, and Sangsungje™ (biocontrol agents 1) and using egg-yolk and cooking oil(EYCO), Bordeaux mixture, Suncho™, and Sangsungje™ (biocontrol agents 2) were applied 5 – 7 days intervals during entire cucumber cultivation period. Efficacy of both biocontrol agents programs was effective to comparable to conventional chemical pesticide spray program to control plant diseases such as powdery mildew and downy mildew as well as insect pests such as aphids and thrips which are known as major threats in cucumber organic cultivation. In this study, we established and evaluated an effective and economic crop protection strategy using various biological resources can be used to control plant diseases and pests simultaneously in organic cucumber cultivation field.

Introduction

Lack of effective and economic crop protection strategy is one of the key factors limiting expansion of organic agriculture in worldwide. Levels of soil borne pathogens and root disease are generally lower in organic systems than in conventional (Van Bruges, 1995). Airborne pathogens do not generally cause serious problems in organic systems, but there are a few exceptions such as powdery and downy mildews in cucumber major pests are generally aphids and thrips in cucumber system (Zitter *et al.*, 1996). Most effective control of plant diseases and pest control strategies in crop cultivation systems are mainly preventive rather than curative.

In this study, we designed two different biocontrol strategies based on currently available biological products and plant extract product to use crop protection in organic cucumber cultivation system. The designed strategies were used as preventive and the efficacy of the strategies were compared to conventional chemical pesticide program. The results indicated that the developed biocontrol strategy could

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be an effective and economic crop protection system in semi- forcing cucumber cultivation system.

Materials and methods

Designed biocontrol strategy

To design an effective and economic biocontrol strategy in organic cucumber cultivation system, we decided to use two different biocontrol agents. The designed biocontrol agent 1 is a mixture of the formulated biopesticides (Topseed™ and Q-fect™, Greenbiotech Inc., Republic of Korea), the commercial plant extract product Suncho™, and Sangsungje™ (BIG Inc., Republic of Korea). The biocontrol agent 2 consists with egg-yolk and cooking oil (EYCO, Jee *et al.*, 2005), Bordeaux mixture (Dongwon Inc., Republic of Korea), Suncho™, and Sangsungje™. Topseed™ and Q-fect™, and EYCO are known as effective to control powdery mildew, and EYCO and Bordeaux mixture are effective to downy mildew. Suncho™ is an effective bio-pesticide to aphid, and Suncho™, and Sangsungje™ are effective pesticides for thrips. The conventional plot was sprayed with chemical fungicides and bio-pesticides with 5 – 10 days intervals as standard farming practices. The designed biocontrol agents were sprayed with 5 – 7 days intervals by foliar application

Field trials

A two-year study (2005-2006) was carried out in a semi-forcing cucumber cultivation greenhouse located at Gurye in Jeonnam province, which is located in the South region of Korea. All experiments were conducted with three replications in a randomized block design. Each plot was 300 m² containing 3 plants/m². The cucumber was cultivated using standard farming practices without any applications of fungicide or insecticide unless indicated in the experimental details. For assessments of disease incidence of powdery mildew and downy mildew, 30 plants were chosen randomly from each plot and rated disease severity by naked eye at weekly. For assessments of pest incidence of aphids and thrips, 15 plants were chosen randomly from each plot and counted total numbers of insects from 5 leaves/plant.

Results

Effect of application of the designed biocontrol agents on control of powdery and downy mildew disease.

The severity of both diseases in the conventional spray system and the designed biocontrol spray systems was higher in 2005 than in 2006 in both cultivation systems. The efficacy of the designed biocontrol agents was compared with that of a fungicide treatment in both cucumber cultivation systems (Figure 1). Application of the formulated product resulted in effectively reduction in the incidence of both diseases similar to that of fungicide application in 2006, but slightly lower than that noted with fungicide treatment in 2005 (Figure 1).

Effect of application of the designed biocontrol agents on control of aphids and thrips.

The severity of both pests in the conventional spray system and the designed biocontrol spray systems was higher in 2005 than in 2006 in both cultivation systems. The efficacy of the designed biocontrol agents was compared with that of an insecticide treatment in both cucumber cultivation systems (Figure 2). Application of

the formulated product resulted in effectively reduction in the occurrence of both pests similar to that of chemical insecticide application in 2006, but slightly lower than that noted with fungicide treatment in 2005 (Figure 2).

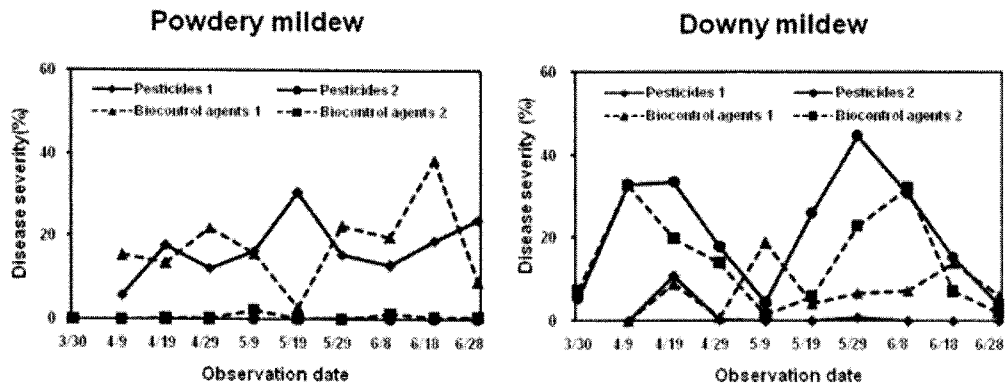


Figure 1: Effect of regular foliar application of the designed biocontrol agents on disease incidence of cucumber powdery and downy mildew in 2005 (treatment 1) and 2006(treatment 2).

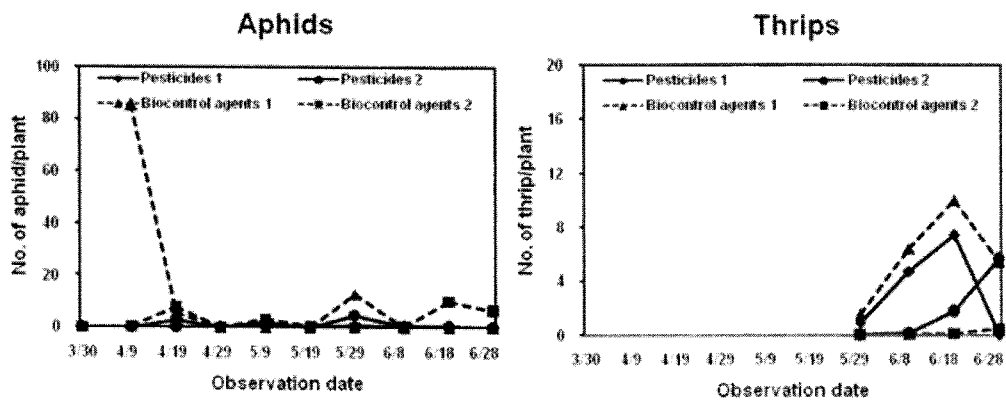


Figure 2: Effect of regular foliar application of the designed biocontrol agents on pest incidence of aphids and thrips in 2005 (treatment 1) and 2006 (treatment 2).

Discussion

In order to control plant diseases and pests in cucumber cultivation greenhouse, a 5 - 10-day interval application method for fungicide and insecticide spraying has been suggested. Powdery and downy mildew disease in organic cucumber have been reported as major diseases, and aphids and thrips are major pests. Chemical fungicides and insecticides are not allowed in organic crop cultivation, although some natural and plant extract-based fungicides and insecticides are applied regularly to control foliar diseases and pests. Biological control of plant diseases and pests is permissible in organic systems, but few products are available because of limitation of effectiveness and economic of the products. This study illustrates the possibility of developing environmentally-friendly control using mixtures of the commercialized products, plant extracts, EYCO, and Bordeaux mixture can be used simultaneous

control of powdery mildew, downy mildew, aphids, and thrips. The designed biocontrol agents can be made at low cost by the farmers themselves. Therefore, these control system will be useful for many cucumber growers, organic farmers in particular.

Conclusions

In cucumber fields, powdery mildew, downy mildew, aphids, and thrips have become serious problems in Korea, and control of these relies mainly on intensive application of chemical pesticides. In an effort to develop an effective environmentally-friendly control system, we utilized preventive control approaches by regular foliar applications of the designed biocontrol agents to control plant diseases and pests simultaneously. The control efficacy of the developed biontrol agents were comparable with that of conventional chemical pesticide in two year's field trials, and these system will be useful for many cucumber growers, organic farmers in particular.

Acknowledgments

This study was carried out with the support of "Cooperative Research Program for Agricultural Science & Technology Development (Project No. PJ004811)", RDA, Republic of Korea).

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