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(on prominent achievement)

Development of a Novel Insect Control System, Pyriproxyfen Tape Formulation*

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Pyriproxyfen yellow tape formulation is a novel pesticide delivery system utilizing the whitefly's attraction to yellow color and pyriproxyfen's excellent transovarial ovicidal activity against whiteflies. The tape formulation attracts whiteflies by its yellow color causing the whiteflies to come into contact with pyriproxyfen, which initiates the transovarial ovicidal activity against whiteflies. The formulation has an excellent efficacy against whiteflies when the tape is applied horizontally along ridges as a preventive measure. The tape formulation has great advantages in reducing the grower's exposure to the toxicological effects of pesticides as well as reducing the environmental impact because this method offers whitefly control without spraying. This technology is also useful as a tool for integrated pest management (IPM). © Pesticide Science Society of Japan

Keywords: tape formulation, application method, pyriproxyfen, insect growth regulator, integrated pest management (IPM).

INTRODUCTION

Recent demands for safer pesticide products have led the industry to seek safer pesticide formulations and application technology. With this goal in mind, attempts have been made to develop new formulations such as flowables, water dispersible granules, water-soluble packagings and microcapsules with the objective of reducing the grower's exposure to the toxicological effects of pesticides as well as the adverse impact on the environment. However, despite success in developing safer pesticide formulations, development of new application technologies has not been particularly successful to date.

Pyriproxyfen is a juvenoid, an insect growth regulator that shows high efficacy against whiteflies. This compound has an excellent transovarial ovicidal activity against whitefly eggs when it is applied to female adults. Since it is safer for beneficial insects, it is a useful tool for integrated pest management (IPM). Since whiteflies are attracted to yellow, we have developed a novel insect control system utilizing this whitefly behavior and pyriproxyfen's excellent transovarial ovicidal ac-

tivity against whiteflies.

CONCEPT OF PYRIPROXYFEN TAPE FORMULATION

The essential concept of pyriproxyfen tape formulation and application technology is to utilize the whitefly attraction to the yellow tape containing pyriproxyfen. The insect's color preference causes whiteflies to land on the tape formulation and thereafter come into contact with pyriproxyfen, resulting in transovarial ovicidal activity against whitefly eggs. Thus the tape formulation controls the next generation of whiteflies.

WHITEFLY ATTRACTION TO YELLOW TAPE

Previous reports suggested that bright yellow attracted whiteflies more efficiently. Our own study also demonstrated that whiteflies were attracted to a normal yellow and a bright yellow most efficiently.

To investigate the effect of yellow color on efficacy, a biological test using a yellow tape formulation and a white tape formulation was conducted. While the white tape formulation and untreated plot did not inhibit the hatching of whitefly eggs, the yellow tape formulation showed high efficacy. This result indicates that attraction to yellow plays an important role in the biological efficacy of the yellow tape formulation.

* See Part II for the full Japanese article.

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Sustainability of yellow color under sunlight is also an important property of the tape formulation. Using a special coloring agent, the pyriproxyfen tape formulation showed excellent color sustainability. Reflection spectrum of the tape formulation was not changed after 240 hr radiation by a Sunshine Fadometer.

FORMULATION DEVELOPMENT

Formulation study was conducted to optimize the pyriproxyfen content, tape width and its physico-chemical properties. The result of efficacy test using tape formulations with different pyriproxyfen contents showed that tape formulations with 1 g/m² and 2 g/m² of pyriproxyfen have higher efficacy than the tape with 0.5 g/m² of pyriproxyfen.

The result of efficacy test using tape formulations with different widths indicated that tapes with widths of 50 mm and 100 mm showed better control than a tape with a 25 mm width. This result suggests that the area of yellow tape plays an important role in whitefly attraction and affected the biological efficacy against whiteflies.

The formulation study demonstrated that the biological efficacy of the tape formulation is optimized using a yellow tape with 50 mm width containing 1 g/m² of pyriproxyfen.

APPLICATION TECHNOLOGY

Application research of tape formulation was done to determine the best application method and timing. A trial in a tomato greenhouse was conducted using two typical application methods, horizontal and vertical application. Tape formulation showed good whitefly control by both methods. However, from the perspective of labor required for application, the horizontal method seemed more practical. The test was conducted by a preventive measure and the tape formulation was set at the beginning of the cultivation period.

Another test showed that the efficacy of tape formulation as a curative measure after a high whitefly population has already become established was not very effective for control-

ing whiteflies. It is supposed that the biological efficacy of the tape formulation proceeds slowly because it takes time to attract whiteflies to the tapes, place the insects in contact with the formulation, and allow pyriproxyfen, an insect growth regulator, time for its slow action against the next generation of whiteflies. Regarding the setting position, tape formulation should be set over the top of crops so that the tape formulation is not covered by the crops, thus allowing better attraction.

Application research indicated that the tape formulation should be applied horizontally along the ridges as a preventive measure at the beginning of cultivation. Pyriproxyfen tape formulation keeps an excellent whitefly control through the cultivation period by this application method. Additionally, the working time needed for application was significantly reduced using the tape formulation in comparison with a spray application. Tape formulation helps not only to reduce the grower's exposure but also to reduce the time needed for insect control.

SAFETY

Pyriproxyfen tape formulation did not show any adverse effect on *Encarsia Formosa* and *Bombus terrestris*. Tape formulation did not show phytotoxicity on crops even by direct contact.

CONCLUSION

A novel insect control system using a pyriproxyfen yellow tape formulation was successfully developed. The tape formulation and application technology significantly reduced the grower's exposure to adverse affects of pesticides and environmental impacts.

The technology also helps to reduce labor in pesticide application. Furthermore, it is useful as a tool for integrated pest management (IPM) due to its safety for beneficial insects.