EVALUATION OF FULFILL® 50WG (PYMETROZINE) FOR COTTON APHID CONTROL IN 1998 FIELD TRIALS

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Abstract

Fulfill® is a selective new insecticide currently under development by Novartis Crop Protection. It has good activity against a wide range of aphid species, including the cotton aphid, *Aphis gossypii*. Fulfill contains the active ingredient, pymetrozine, which belongs to a new chemical class known as the pyridine azomethines. Pymetrozine exhibits a unique mode of action and is not known to be cross-resistant to any other class of chemistry. Fulfill is compatible for use in cotton IPM and resistance management programs because of its selectivity, low use rate, and unique mode of action. On May 26, 1998 Novartis Crop Protection submitted a petition to EPA requesting registration of Fulfill as a Reduced Risk pesticide on cotton.

Results from 1998 field trials are discussed. In these trials, Fulfill provided good control of the cotton aphid at rates of 2.75 - 4.0 oz/A. Fulfill applied at a rate of 2.75 oz/A also provided good control of the cotton fleahopper in one trial.

Introduction

Fulfill® is a highly selective new insecticide with excellent activity against a wide range of aphid species, including the cotton aphid, *Aphis gossypii*. The active ingredient in Fulfill is pymetrozine, an insecticidal compound which belongs to a new chemical class known as pyridine azomethines. Pymetrozine exhibits a unique mode of action which is characterized as neural inhibition of feeding behavior. It does not have a general toxic or paralyzing effect on aphids, but selectively interferes with normal feeding activities by affecting the neural regulation of fluid intake. Affected aphids stop feeding within a couple of hours after exposure, which consequently results in mortality due to starvation after 2-4 days. It is postulated that pymetrozine affects the activity of the cibarial muscles, the food pump, and the salivary pump (Harrewijn, 1997). No other insecticide is known to cause a selective, irreversible inhibition of feeding without paralyzing the insect.

Fulfill is applied as a foliar spray at low use rates ranging from 2.75-4.0 oz/A in cotton. After application, Fulfill exhibits excellent translaminar movement into plant foliage, and is effectively rainfast as soon as spray droplets have dried. Fulfill also demonstrates significant plant systemic activity. Recent autoradiographic studies (Wyss and Bolsinger, 1997) demonstrate excellent acropetal translocation of Fulfill within the xylem, and more limited basipetal movement within the phloem. Fulfill typically exhibits residual activity for a period of 2-3 weeks.

Fulfill has excellent potential for utility in integrated pest management programs because of its selectivity, low use rate, and unique mode of action. Because Fulfill is highly selective, it has been shown to be safe to many common predators and parasitoids. Results from selectivity tests with pymetrozine under laboratory and greenhouse conditions have shown it to be selective for practically all beneficial groups according to the International Organization for Biological and Integrated Control of Noxious Animals and Plants (IOBC) selectivity rating system (Sechser, 1996). The following beneficial insects, which are commonly found in cotton, have been assigned an IOBC rating of 1, which indicates that the compound is considered harmless (<30% mortality): green lacewings, seven-spotted lady beetles, carabid beetles, *Orius spp.*, *Geocoris spp*., syrphid flies, predatory mites and *Encarsia spp.*

The cotton aphid has a long history worldwide of developing resistance to insecticides; resistance to multiple chemical classes in the cotton aphid has previously been documented (Devonshire, 1989, Georghiou, 1981). Because of pymetrozine's unique mode of action, the estimated risk for developing cross-resistance to other insecticides is considered rather low. Laboratory investigations carried out with 11 *A. gossypii* clones from around the world revealed that responses to pymetrozine bore no apparent relationship to the resistance status of strains of *A. gossypii* to several insecticide classes, including OP's, carbamates, and pyrethroids. In several field trials, pymetrozine showed good activity and no cross-resistance against organophosphate and pyrethroid resistant strains of *A. gossypii* in vegetables (Novartis internal communication).

1998 Field Test Results

Fulfill has been widely tested since 1989 for control of *A. gossypii* in both cotton and vegetables. When *A. gossypii* infests crops other than cotton, it is commonly referred to as the melon aphid. Fulfill has demonstrated excellent activity against the melon aphid, as illustrated by the results presented in Figure 1. In this trial, Fulfill applied once at 2.75 oz/A provided excellent control of a heavy population of the melon aphid in cantaloupes. In general, efficacy against *A. gossypii* has been slightly greater in vegetable crops than in cotton. This is likely due to the fact that vegetable crops tend to be more succulent than cotton, especially older, rank cotton. Succulent plant tissue will

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1016-1019 (1999)
National Cotton Council, Memphis TN

more effectively absorb Fulfill; absorption into the plant is crucial for optimum activity. Additionally, higher water volumes are generally used in applications to vegetables, resulting in better spray coverage.

Nevertheless, Fulfill has also demonstrated good efficacy in many cotton trials across a wide geography, and provides control of the cotton aphid that is comparable with many currently registered insecticides. Results from these field trials have been presented at previous Beltwide Cotton Conference meetings (Koenig et al, 1998; Allemann et al, 1997; Ngo et al, 1995; Minton et al, 1994) and at other professional society meetings. The intention of this manuscript is to present new results generated in the 1998 field season.

Figure 2 presents a summary of test results from a trial conducted by Novartis researchers in Washington County, MS. In this trial, Fulfill was applied once at rates of 2.75 and 4 oz/A and evaluated for aphid control at 4, 7, and 13 days after application. Both rates of Fulfill provided greater than 90% control of the cotton aphid within 7 days after application. The 4.0 oz rate of Fulfill provided greater control than the 2.75 oz rate at the earlier four day rating. Efficacy was slightly greater than the competitive standard Provado applied at 3.75 oz/A and slightly less than Bidrin applied at 8.0 oz/A.

Another summary of test results generated by a Novartis researcher in Ft. Bend, TX is presented in Figure 3. In this trial, Fulfill was applied twice at rates of 2.75 and 4 oz/A and evaluated for aphid control at 7 days after the second application. Both rates of Fulfill were equally effective and provided 91% control of the cotton aphid 7 days after the second application. Efficacy was similar to the competitive standard Provado applied at 3.75 oz/A.

Fulfill was evaluated for control of the cotton fleahopper, *Pseudatomoscelis seriatus*, by a university researcher in Corpus Christi, TX. In this trial, Fulfill was applied twice at the rate of 2.75 oz/A and evaluated for efficacy at three and six days after each application. Figure 4 presents a summary of the efficacy obtained when averaged across all rating dates during the season. Fulfill provided 90% control of the cotton fleahopper, and was more effective than several competitive standards.

Figure 5 presents a summary of test results generated by a Novartis researcher in Vero Beach, FL. In this trial, Fulfill was applied twice at 4 oz/A, and evaluated for efficacy at 5 and 9 days after the first application and 4 days after the second. At the first rating, Fulfill provided over 93% control. Under heavy and increasing aphid pressure, control was 67% at 9 days after the first application. A second application resulted in 93% control by 4 days after application.

Registration Activities

On May 26, 1998, Novartis Crop Protection submitted a petition to EPA requesting registration of Fulfill as a Reduced Risk pesticide on cotton. Fulfill was subsequently granted Reduced Risk status by the EPA. The Reduced Risk Pesticide Initiative establishes an expedited review for applications for pesticide registrations that may reasonably be expected to accomplish one or more of the following: 1) reduce the risks of pesticides to human health, b) reduce the risks of pesticides to non-target organisms, c) reduce the potential for contamination of groundwater, surface water, or other valued environmental resources, and d) broaden the adoption of integrated pest management strategies, or make such strategies more available or more effective. Fulfill meets these criteria based on the following parameters: a) Human Health: Fulfill has a very low acute toxicity. It is anticipated that that Fulfill will not be a "Restricted Use Pesticide", and will carry the least restrictive signal word of "Caution". The low use rate of Fulfill reduces the potential for worker, dietary, and non-occupational exposure. Fulfill is not a mutagen, teratogen, or neurotoxin. Actual plant residues are non-detectable in most cases at proposed pre-harvest intervals, b) Nontarget Organisms: Fulfill has an extremely favorable ecotox profile, and poses minimal risk to birds, bees, fish, and aquatic invertebrates, c) Potential for contamination of valued resources: Fulfill demonstrates only moderate persistence, and also has a high affinity for soil binding. During the time that Fulfill is present in the environment, it is tightly bound and not available for movement into undesired areas, and d) IPM Compatibility: Fulfill is considered to have excellent potential for utility in integrated pest management programs because of its selectivity, low use rate, and unique mode of action.

Summary

Fulfill provided good control of the cotton aphid and the cotton fleahopper in 1998 field trials. Fulfill represents a unique new tool for the management of aphids and fleahoppers in cotton because of the following characteristics: a) new chemistry, b) new mode of action, c) low use rates d) high selectivity e) lack of cross-resistance to other classes of chemistry, and f) Reduced Risk status.

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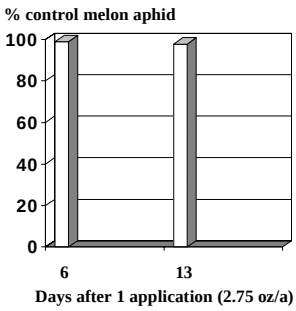

Figure 1. Effectiveness of Fulfill 50WG for control of the melon aphid in cantaloupes.

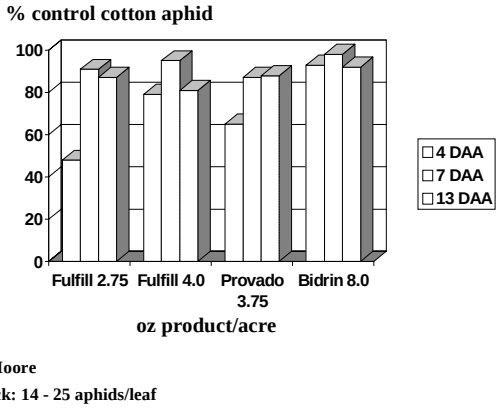

Figure 2. Effectiveness of Fulfill 50WG for control of the cotton aphid (Washington County, MS, 1998).

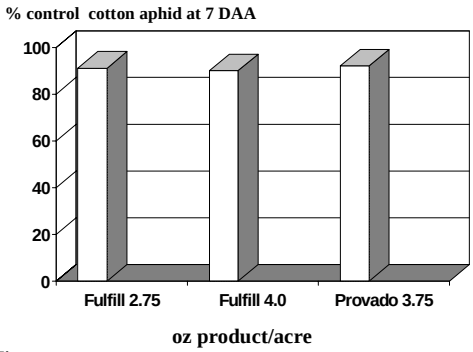

Figure 3. Effectiveness of Fulfill 50 WG for control of the cotton aphid (Ft. Bend, TX, 1998).

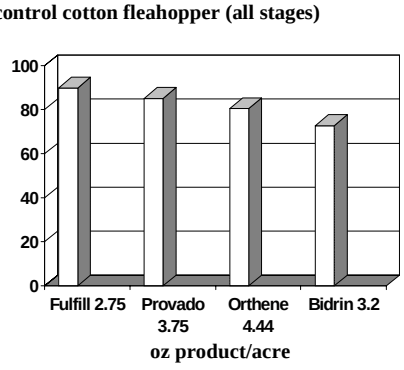

Figure 4. Effectiveness of Fulfill 50WG against the cotton fleahopper (Corpus Christi, TX, 1998)

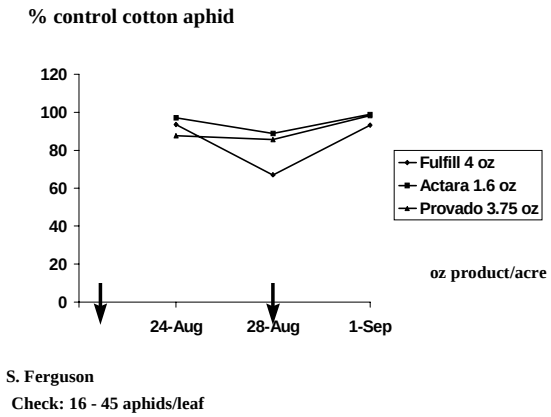

Figure 5. Effectiveness of Fulfill 50 WG for control of the cotton aphid (Vero Beach, FL, 1998).